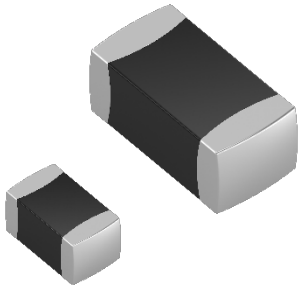
NTC thermistors for temperature measurement

SMD NTC thermistors for automotive applications

Series/Type:	**Soft termination series**
Ordering code:	**B57*V6/C6**
Date:	2024-03-14
Version:	2

Applications

Temperature measurement and compensation in various automotive circuits such as

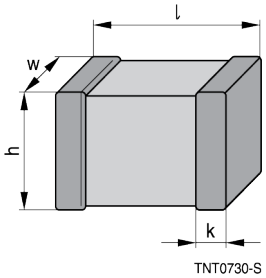


- charging and temperature control of battery packs and battery management systems (BMS)
- electronic control units (ECUs), e.g. motor management, HVAC, electronic power steering (EPS), gearbox controls, ABS systems
- temperature sensor for air-conditioning
- LED lighting
- DC/DC converter, inverters, on-board chargers (OBC)
- thermal protection of semiconductors (GaN/SiC) in power modules.

Features

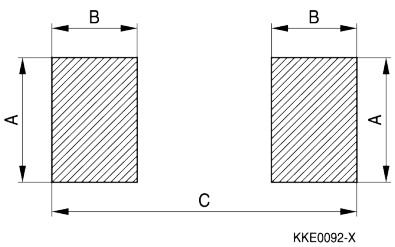
- Qualification based on AEC-Q200
- Multilayer SMD NTC thermistor with flexible soft termination and nickel barrier plating layer (NiSn)
- Soft termination provides improved resistance to mechanical stress compared to standard termination.
- Accurate temperature measurement from -40 °C to 150 °C
- Excellent long-term aging stability in high-temperature and high-humidity environment
- Tight R and B tolerances
- Short response time
- 100% Pb free, RoHS
- UL approval pending (file number E69802)

Dimensional drawing



Case size EIA/mm	l mm	w mm	h mm	k mm
0603/1608	1.6 ±0.2	0.8 ±0.15	0.9 max.	0.4 ±0.2
1206/3216	3.2 ±0.2	1.6 ±0.2	1.3 max.	0.6 ±0.4

Recommended solder pad layout



Case size EIA/mm	A mm	B mm	C mm
0603/1608	1.0	1.0	3.0
1206/3216	1.8	1.2	4.5

General technical data, case size 0603 (1608)

Operating temperature		T_{op}	-40 ... 150	°C
Maximum power	(at 25 °C, on PCB)	P_{25}[1)]	180	mW
Rated temperature		T_R	25	°C
Dissipation factor	(on PCB)	δ_{th}[1)]	approx. 3	mW/K
Thermal cooling time constant	(on PCB)	τ_c[1)]	approx. 4	s
Heat capacity		C_{th}[1)]	approx. 12	mJ/K
Weight of component			approx. 6	mg

[1)] depends on mounting situation

Electrical specifications and ordering codes, case size 0603 (1608)

R_{25} kΩ	$\Delta R_R/R_R$ %	$B_{25/50}$ K	$B_{25/85}$ K	$B_{25/100}$ K	Ordering code
10 k	±1	3380	3435	3455 ±1%	B57332V6103F360[2)]
10 k	±1, ±2, ±3, ±5	3568	3610	3624 ±1%	B57343V6103+360
10 k	±3	3590	3635	3650 ±3%	B57342V6103H060
47 k	±1	4050	4108	4131 ±1.5%	B57359V6473F260[2)]

+ = Resistance tolerance: F = ±1%, G = ±2%, H = ±3%, J = ±5%

[2)] extended temperature range -45°C to 150 °C

General technical data, case size 1206 (3216)

Operating temperature		T_{op}	-40 ... 150	°C
Maximum power	(at 25 °C, on PCB)	P_{25}[1)]	50	mW
Rated temperature		T_R	25	°C
Dissipation factor	(on PCB)	δ_{th}[1)]	approx. 5	mW/K
Thermal cooling time constant	(on PCB)	τ_c[1)]	approx. 10	s
Heat capacity		C_{th}[1)]	approx. 50	mJ/K
Weight of component			approx. 24	mg

[1)] depends on mounting situation

Electrical specifications and ordering codes, case size 1206 (3216)

R_{25} kΩ	$\Delta R_R/R_R$ %	$B_{25/50}$ K	$B_{25/85}$ K	$B_{25/100}$ K	Ordering code
5 k	±3	3375	3420	3455 ±2%	B57621C6502H062
5 k	±5	3375	3420	3455 ±2%	B57621C6502J062

Reliability data

Tests of SMD NTC thermistors are based on AEC-Q200.

The parts are mounted on standardized PCBs.

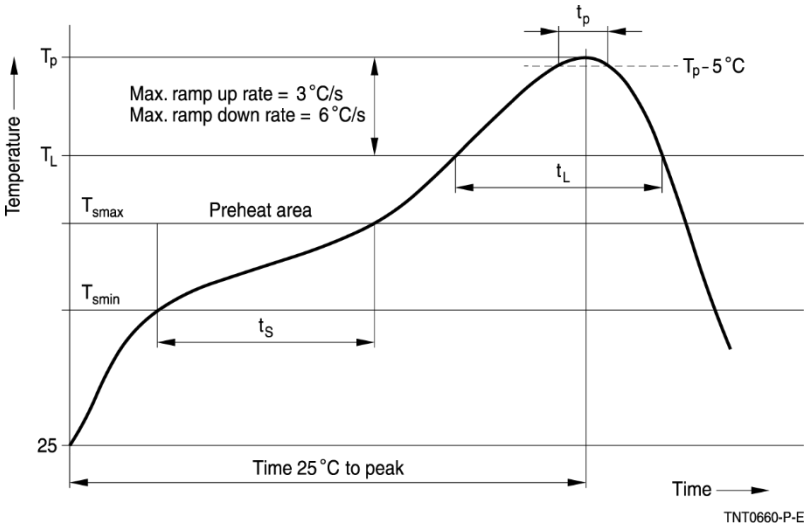
Test	Standard	Test conditions	$\Delta R_{25} / R_{25}$ (typical)	Remarks
Pre and post stress electrical test		Resistance at: 25 °C and 100 °C	-	
High temperature exposure (storage)	MIL-STD-202, method 108	Test temperature: 150 °C Duration: 1000 h Unpowered **Exceptions:** B57342V6* and B57621C6*	< 1% < 5%	
Temperature cycling	JESD22, method JA-104	Lower test temperature: Top min Upper test temperature: Top max Number of cycles: 1000 Transfer time: < 10 s Dwell time: 15 min Air – Air	< 5%	Temperature cycling is performed acc. MIL-STD-202, method 107. No warranty will be assumed for the reliability of solder joint.
Biased humidity	MIL-STD-202, method 103	Test temperature: 85 °C Rel. humidity of air: 85% Duration: 1000 h Test voltage: V_{NTC} = 0.3 V DC	< 5%	
Operational life	MIL-STD-202, method 108	Test temperature: 150 °C P_{max} = 0.35 mW Duration: 1000 h	< 5%	
External visual	MIL-STD-883E, method 2009	Visual inspection		
Physical dimensions	JESD22, method JB-100	Measured with callipers		Within the specified values
Resistance to solvents	MIL-STD-202, method 215	Not applicable for SMD NTC thermistors (component has no marking, color coding, or coating)		
Mechanical shock	MIL-STD-202, method 213	Peak value: 1500 *g* Half sine Condition F	< 5%	

Test	Standard	Test conditions	$\Delta R_{25} / R_{25}$ (typical)	Remarks
Vibration	MIL-STD-202, method 204	Acceleration: 5 *g* Sweep time: 20 min. Frequency range:10 … 2000 Hz 3 x 12 cycles **Exception:** B57621C6*	< 1% < 5%	
Resistance to soldering heat	MIL-STD-202, method 210	Dip: 260 °C; 10 s 1 heat cycle **Exceptions:** B57342V6* and B57621C6*	< 1% < 3%	
ESD	AEC-Q200-002, method -002	Discharge capacitance: 150 pF Discharge resistance: 2 kΩ Charging voltage: 6 kV Contact discharge 2 pulses in each polarity	< 5%	
Solderability	J-STD-002	a) Dip: 235 °C; 5 s: aging 4 h @ 155 °C b) Dip: 215 °C; 5 s: steam aging 8 h @ 92 °C c) Dip: 260 °C; 7 s: steam aging 8 h @ 92 °C		95% of termination wetted
Electrical characterization		R (25 °C), R (100 °C), B (25/100)		Within the specified values
Flammability	UL-94; V-0 or V-1	Not applicable for SMD NTC thermistors (component is not coated or encapsulated with plastic materials)		
Board flex	AEC-Q200-005, method -005	Max. bending 5 mm Duration @ max. bending: 60 s **Exception:** B57621C6*	< 2% < 5%	
Terminal strength	AEC-Q200-006, method -006	B573*V6* Max. F: 10 N B57621*V6* Max. F: 17.7 N	< 2% < 5%	
Resistance drift after soldering		Reflow soldering profile	< 1%	

Recommended soldering profiles

Reflow soldering

Temperature ranges for reflow soldering acc. to IEC 60068-2-58 recommendations



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_s	60 … 120 s	60 … 120 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	40 … 150 s	40 … 150 s
Peak package body temperature	T_p[3)]	215 °C … 260 °C	235 °C … 260 °C
Time (t_p) above (T_p -5 °C)	t_p	10 ... 40 s	10 … 40 s
Average ramp-down rate	T_p to T_{smax}	6 °C/ s max.	6 °C/ s max.
Time 25 °C to peak temperature		max. 8 minutes	max. 8 minutes

[3)] Depending on package thickness

Note:

- All temperatures refer to the topside of the package, measured on the package body surface.
- Number of reflow cycles: 3
- Iron soldering should be avoided, hot air methods are recommended for repair purposes.

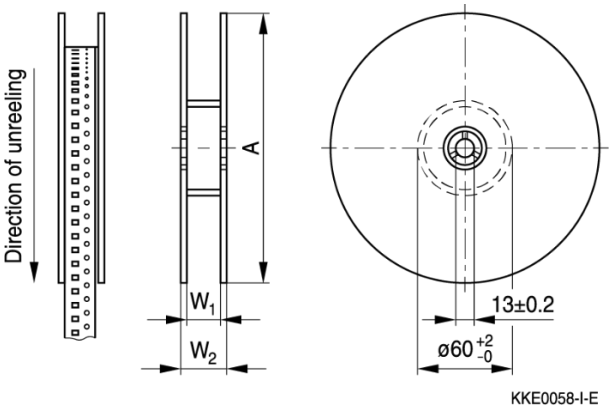
Recommended solder

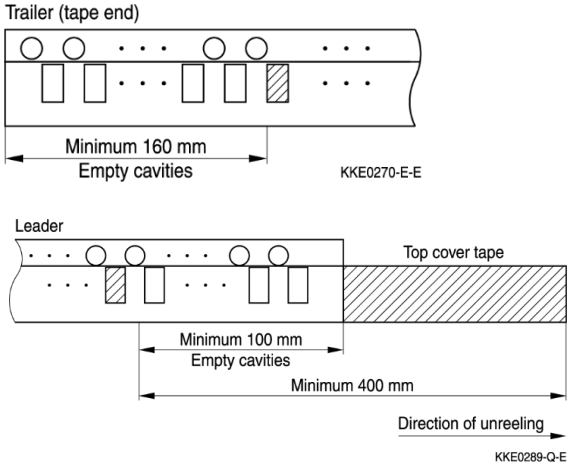
Flux-less Pb-free Sn (95.1 … 96.0), Ag (3.0 … 4.0), Cu (0.5 … 0.9) solder is recommended.

Taping and packing

Tape and reel packing according to IEC 60286-3

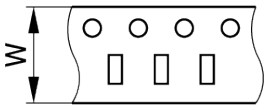
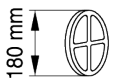
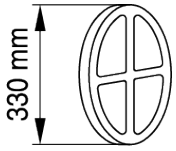
Reel dimensions and tolerances





		8-mm tape	
Definition	Symbol	180-mm reel	330-mm reel
Reel diameter	A	180 +0/-3	330 +0/-2.0
Reel width (inside)	W1	8.4 +1.5/-0	8.4 +1.5/-0
Reel width (outside)	W2	14.4 max.	14.4 max.

Packing units for discrete chips

					
Case size inch/mm	Chip thickness class	Cardboard tape W	Blister tape W	∅ 180-mm reel pcs.	∅ 330-mm reel pcs.
0603/1608	0.8 mm	8 mm	–	4000	16000
1206/3216	0.8 mm	-	8 mm	4000	16000
	1.2 mm	-	8 mm	4000	12000

Packing codes

The last two digits of the complete ordering code state the packing mode.

60 ≙ cardboard tape, 180-mm reel

62 ≙ blister tape, 180-mm reel

70 ≙ cardboard tape, 330-mm reel

72 ≙ blister tape, 330-mm reel

Cautions and warnings

Storage

- Store thermistors only in original packaging. Do not open the package before storage.
- Storage conditions in original packaging: storage temperature –25 °C to +45 °C, relative humidity ≤ 75% annual mean, 95% on max. 30 days in a year, dew precipitation and wetness are inadmissible.
- 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.
- Avoid contamination of thermistor surface during storage, handling, and processing. Touching the metallization of unsoldered thermistors may change their soldering properties.
- Avoid storage of thermistor in harmful environments like corrosive gases (SO_x, Cl etc.)
- After opening the factory seals, such as polyvinyl-sealed packages, use the SMDs as soon as possible.
- Solder thermistors after shipment from TDK Electronics within the time specified:
  SMD NTC thermistors with nickel-barrier termination: 12 months

Handling

- NTC thermistors must not be dropped. Chip-offs must not be caused during handling of NTCs.
- Components must not be touched with bare hands. Gloves are recommended.
- Avoid contamination of thermistor surface during handling.
- Washing processes may damage the product due to the possible static or cyclic mechanical loads (e.g. ultrasonic cleaning). They may cause cracks to develop on the product and its parts, which might lead to reduced reliability or lifetime.

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.

Mounting

- When NTC thermistors are encapsulated with sealing material or overmolded with plastic material, there must be no mechanical stress caused by thermal expansion during the production process (curing/overmolding process) and during later operation. The upper category temperature of the thermistor must not be exceeded. Ensure that the materials used (sealing compound and plastic material) are chemically neutral.
- Electrode must not be scratched before/during/after the mounting process.
- Contacts and housing used for assembly with thermistor have to be clean before mounting.
- Ensure that adjacent materials are designed for operation at temperatures comparable to the surface temperature of the thermistor. Be sure that surrounding parts and materials can withstand the temperature.
- Avoid contamination of thermistor surface during processing.

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 thermistors (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.
- Be sure to provide an appropriate fail-safe function to prevent secondary product damage caused by malfunction (e.g. use VDR for limitation of overvoltage condition).

This listing does not claim to be complete, but merely reflects the experience of TDK Electronics AG.

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2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified.** In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or life-saving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
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Important notes

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