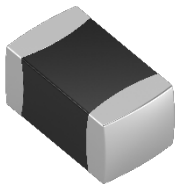
NTC thermistors for temperature measurement

SMD NTC thermistors for automotive applications

Series/Type:	**Soft termination series**
Ordering code:	**B57432V6502F362**
Date:	2024-09-03
Version:	1

Applications



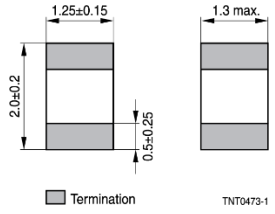
Temperature measurement and compensation in various automotive circuits, such as

- 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 converters, inverters, on-board chargers (OBC)
- thermal protection of semiconductors (GaN / SiC) in power modules

Features

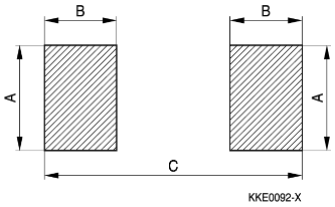
- Qualification based on AEC-Q200
- Multilayer SMD NTC thermistor with flexible soft termination and nickel barrier termination (NiSn)
- Soft termination provides improved resistance to mechanical stress compared to standard termination
- Accurate temperature measurement from -40 °C to 150°C
- Excellent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

Dimensional drawing



Dimensions in mm

Recommended geometry of solder pads



Case size [inch/mm]	A [mm]	B [mm]	C [mm]
0805/2012	1.3	1.2	3.4

Electrical specifications

Ordering code	Zero-power resistance (at +25 °C)	$B_{25/100}$	$B_{25/85}$	$B_{25/50}$
B57432V6502F362	5 kΩ ±1%	3455 K ±1%	(3435 K)	(3380 K)

General technical data

Operating temperature range	T_{op}	-40 … 150	°C
Maximum power (at 25 °C, on PCB)	P_{25} [1)]	210	mW
Rated temperature	T_R	25	°C
Dissipation factor (on PCB)	δ_{th} [1)]	approx. 3.5	mW/K
Thermal cooling time constant (on PCB)	τ_c [1)]	approx. 10	s
Heat capacity	C_{th} [1)]	approx. 35	mJ/K
Weight of component		approx. 13	mg

[1)] Depends on mounting situation

Resistance/temperature characteristic

NTC resistance temperature curve
R/T curve 8509
R at 25 °C 5000 [Ω] ±1 [%]
B (25/100) 3455 [K] ±1 [%]

Temp. [°C]	R Nom [Ω]	R Min [Ω]	R Max [Ω]	ΔR [±%]	ΔT [±°C]	α [%/K]
-40	95015.606	90948.311	99082.900	4.3	0.8	5.4
-35	72679.065	69794.043	75564.087	4.0	0.8	5.3
-30	56028.861	53971.925	58085.798	3.7	0.7	5.1
-25	43520.442	42047.317	44993.567	3.4	0.7	5.0
-20	34052.214	32993.221	35111.206	3.1	0.6	4.8
-15	26832.477	26068.942	27596.013	2.8	0.6	4.7
-10	21287.969	20736.341	21839.597	2.6	0.6	4.6
-5	17000.540	16601.630	17399.449	2.3	0.5	4.4
0	13662.990	13374.619	13951.362	2.1	0.5	4.3
5	11048.054	10839.994	11256.114	1.9	0.4	4.2
10	8986.451	8836.927	9135.975	1.7	0.4	4.1
15	7351.255	7244.503	7458.006	1.5	0.4	4.0
20	6046.682	5971.241	6122.124	1.2	0.3	3.9
25	5000.000	4950.000	5050.000	1.0	0.3	3.7
30	4155.640	4104.063	4207.216	1.2	0.3	3.6
35	3470.897	3421.400	3520.394	1.4	0.4	3.6
40	2912.765	2866.013	2959.517	1.6	0.5	3.5
45	2455.591	2411.919	2499.263	1.8	0.5	3.4
50	2079.330	2038.856	2119.804	1.9	0.6	3.3
55	1768.235	1730.935	1805.534	2.1	0.7	3.2
60	1509.875	1475.639	1544.110	2.3	0.7	3.1
65	1294.388	1263.054	1325.722	2.4	0.8	3.0
70	1113.912	1085.288	1142.535	2.6	0.9	3.0
75	962.150	936.035	988.265	2.7	0.9	2.9
80	834.038	810.228	857.847	2.9	1.0	2.8
85	725.482	703.781	747.184	3.0	1.1	2.8
90	633.163	613.382	652.944	3.1	1.2	2.7
95	554.375	536.339	572.411	3.3	1.2	2.6
100	486.906	470.453	503.359	3.4	1.3	2.6
105	428.938	413.918	443.957	3.5	1.4	2.5
110	378.974	365.252	392.696	3.6	1.5	2.4
115	335.775	323.227	348.323	3.7	1.6	2.4
120	298.313	286.828	309.799	3.9	1.6	2.3
125	265.732	255.208	276.256	4.0	1.7	2.3
130	237.315	227.661	246.970	4.1	1.8	2.2
135	212.463	203.597	221.330	4.2	1.9	2.2
140	190.671	182.518	198.823	4.3	2.0	2.1
145	171.512	164.007	179.016	4.4	2.1	2.1
150	154.626	147.710	161.543	4.5	2.2	2.1

Reliability data

- The tests of SMD NTC thermistors are based on AEC-Q200.
- The parts are mounted on standardized PCB.

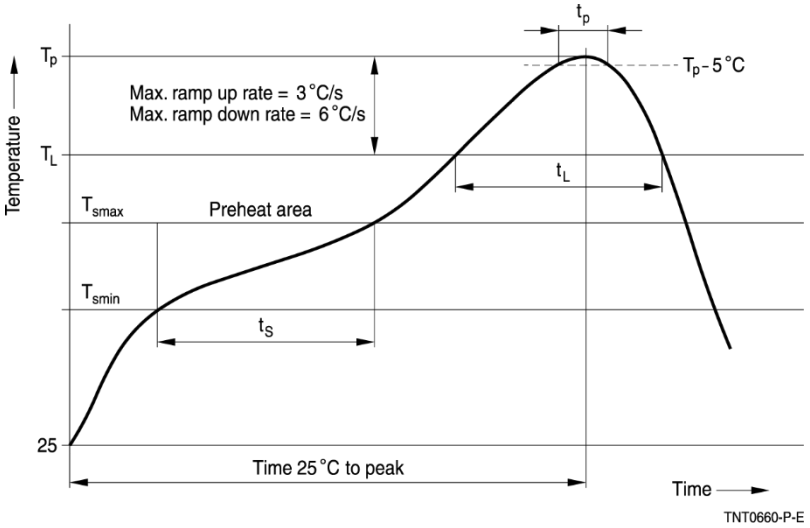
Test	Standard	Test conditions	$\Delta R_{25} / R_{25}$ (typical)	Remarks
Pre-stress and post-stress electrical test		Resistance at: 25 °C and 100 °C	-	
High temperature exposure (storage)	MIL-STD-202, method 108	Test temperature: 150 °C Duration: 1000 h Unpowered	< 1%	
Temperature cycling	JESD22, method JA-104	Lower test temperature: -40 °C Upper test temperature: 150 °C Number of cycles: 1000 Transfer time: < 10 s Dwell time: 15 min Air – Air	< 5%	Temperature cycling is performed acc. to MIL-STD-202, method 107. No warranty will be assumed for the reliability of the 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%	
Vibration	MIL-STD-202, method 204	Acceleration: 5 *g* Sweep time: 20 min Frequency range: 10 … 2000 Hz 3 x 12 cycles	< 5%	

Test	Standard	Test conditions	$\Delta R_{25} / R_{25}$ (typical)	Remarks
Resistance to soldering heat	MIL-STD-202, method 210	Dip: 260°C; 10 s 1 heat cycle	< 1%	
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	< 2%	
Terminal strength	AEC-Q200-006, method -006	Max. F: 17 N	< 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[1)]	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

[1)]Depending on package thickness.

Note:

- All temperatures refer to 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.

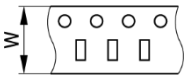
Recommended solder

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

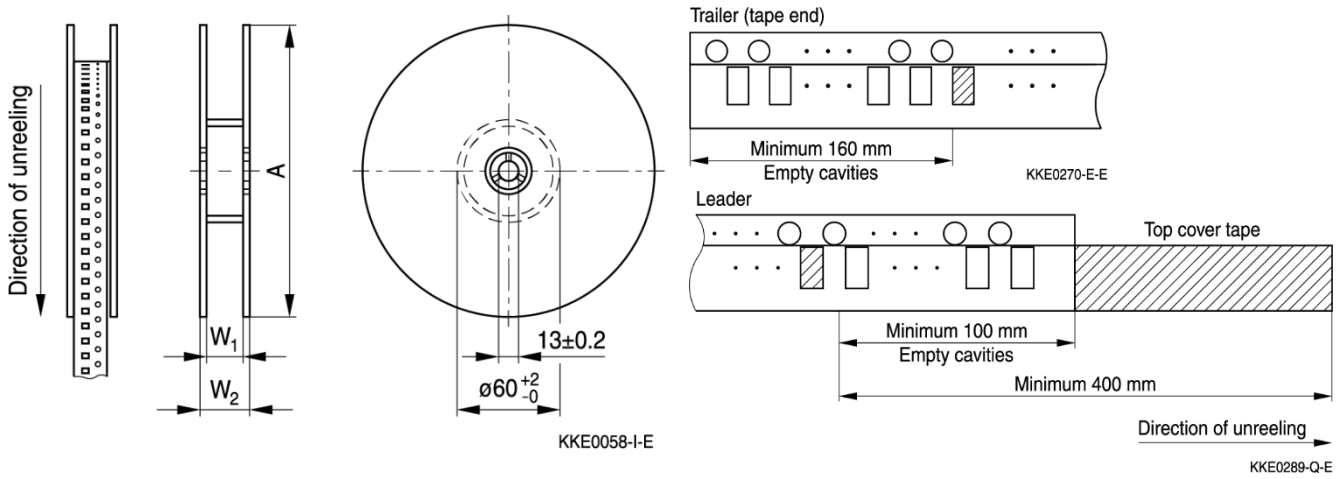
- Tape and reel packing according to IEC 60286-3
- Tape material: Blister

Tape dimensions and tolerances



Definition	Symbol	Dimension [mm]	Tolerance [mm]
Tape width	W	8.00	±0.30

Reel dimensions and tolerances



Definition	Symbol	Dimension [mm]	Tolerance [mm]
Reel diameter	A	180	+0/-3
Reel width (inside)	W1	8.4	+1.5/-0
Reel width (outside)	W2	14.4	max.

Packing unit: 4000 pcs./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 thermistors 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 over molded with plastic material, there must be no mechanical stress caused by thermal expansion during the production process (curing / over molding 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.

Display of ordering codes for TDK Electronics products

The ordering code for one and the same product can be represented differently in data sheets, data books, other publications, on the company website, or in order-related documents such as shipping notes, order confirmations and product labels. **The varying representations of the ordering codes are due to different processes employed and do not affect the specifications of the respective products**. Detailed information can be found on the Internet under www.tdk-electronics.tdk.com/orderingcodes.

Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application.** As a rule, we are either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether a product with the properties described in the product specification is suitable for use in a particular customer application.
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.
3. **The warnings, cautions and product-specific notes must be observed.**
4. In order to satisfy certain technical requirements, **some of the products described in this publication may contain substances subject to restrictions in certain jurisdictions (e.g. because they are classed as hazardous)**. Useful information on this will be found in our Material Data Sheets on the Internet (www.tdk-electronics.tdk.com/material). Should you have any more detailed questions, please contact our sales offices.
5. We constantly strive to improve our products. Consequently, **the products described in this publication may change from time to time**. The same is true of the corresponding product specifications. Please check therefore to what extent product descriptions and specifications contained in this publication are still applicable before or when you place an order.

   We also **reserve the right to discontinue production and delivery of products**. Consequently, we cannot guarantee that all products named in this publication will always be available. The aforementioned does not apply in the case of individual agreements deviating from the foregoing for customer-specific products.
6. Unless otherwise agreed in individual contracts, **all orders are subject to our General Terms and Conditions of Supply.**
7. **Our manufacturing sites serving the automotive business apply the IATF 16949 standard.** The IATF certifications confirm our compliance with requirements regarding the quality management system in the automotive industry. Referring to customer requirements and customer specific requirements (“CSR”) TDK always has and will continue to have the policy of respecting individual agreements. Even if IATF 16949 may appear to support the acceptance of unilateral requirements, we hereby like to emphasize that **only requirements mutually agreed upon can and will be implemented in our Quality Management System.** For clarification purposes we like to point out that obligations from IATF 16949 shall only become legally binding if individually agreed upon.

Important notes

8. The trade names EPCOS, CarXield, CeraCharge, CeraDiode, CeraLink, CeraPad, CeraPlas, CSMP, CTVS, DeltaCap, DigiSiMic, FilterCap, FormFit, InsuGate, LeaXield, MediPlas, MiniBlue, MiniCell, MKD, MKK, ModCap, MotorCap, PCC, PhaseCap, PhaseCube, PhaseMod, PhiCap, PiezoBrush, PlasmaBrush, PowerHap, PQSine, PQvar, SIFERRIT, SIFI, SIKOREL, SilverCap, SIMDAD, SiMic, SIMID, SineFormer, SIOV, SurfIND, ThermoFuse, WindCap, XieldCap are **trademarks registered or pending** in Europe and in other countries. Further information will be found on the Internet at www.tdk-electronics.tdk.com/trademarks.

Release 2024-02