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Temperature Dependent Platinum Thin Film Chip Resistor (RTD)

FEATURES

- Standardized characteristics according to IEC 60751
- AEC-Q200 qualified
- Short reaction times down to $t_{0.9} \leq 2$ s (in air)
- Outstanding stability of temperature characteristic
- Superior temperature cycling robustness

Pb-free

e3

RoHS COMPLIANT

HALOGEN FREE

DESIGN SUPPORT TOOLS AVAILABLE

3D Models | Design Tools | SPICE Models

APPLICATIONS

Temperature measurement and control in

- Automotive electronics
- Aviation electronics
- Industrial electronics

PTS AT SMD flat chip temperature dependent resistors are the perfect choice for temperature control of electronics operating under varying environmental conditions. The highly controlled platinum thin film manufacturing process guarantees an outstanding stability of temperature characteristics which ensures reliable operation even under harsh conditions. Typical applications include automotive, aviation and industrial electronics.

TECHNICAL SPECIFICATIONS

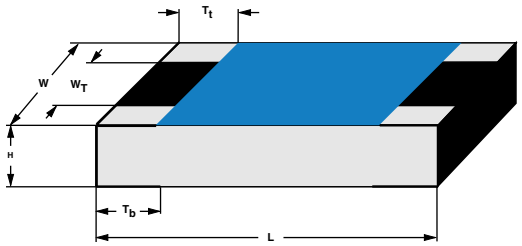
DESCRIPTION		PTS0603M	PTS0805M	PTS1206M
Resistance values R_0 at 0 °C		100 Ω	100 Ω, 500 Ω	100 Ω, 500 Ω, 1000 Ω
Temperature coefficient (0 °C to +100 °C), IEC60751		+3850 ppm/K		
Tolerance classes		F0.3, F0.6		
Temperature range		-55 °C to +175 °C		
Long term stability $\lvert\Delta R_0/R_0\rvert$; R_0 change after 1000 h at +155 °C		≤ 0.1 %		
Insulation resistance		> 10 MΩ		
Measurement current $I_{meas.}$ (DC) (1)	100 Ω	0.1 mA to 0.50 mA	0.1 mA to 1.0 mA	0.1 mA to 1.0 mA
	500 Ω	-	0.1 mA to 0.40 mA	0.1 mA to 0.40 mA
	1000 Ω	-	-	0.1 mA to 0.25 mA
Self-heating at 0 °C (2)	Calm air (v = 0.0 m/s)	≤ 0.9 K/mW	≤ 0.8 K/mW	≤ 0.7 K/mW
Thermal response time (2)	Flowing water (v = 0.4 m/s)	$t_{0.5} \leq 0.1$ s	$t_{0.5} \leq 0.2$ s	$t_{0.5} \leq 0.3$ s
		$t_{0.9} \leq 0.2$ s	$t_{0.9} \leq 0.3$ s	$t_{0.9} \leq 0.4$ s
	Flowing air (v = 3.0 m/s)	$t_{0.5} \leq 1.0$ s	$t_{0.5} \leq 1.5$ s	$t_{0.5} \leq 2.0$ s
		$t_{0.9} \leq 2.0$ s	$t_{0.9} \leq 3.0$ s	$t_{0.9} \leq 5.0$ s
Failure rate: $FIT_{observed}$		≤ 0.5 x 10^{-9}/h		

Notes

(1) Indicated measurement currents can be applied continuously with self-heating effect of less then 0.1 °C

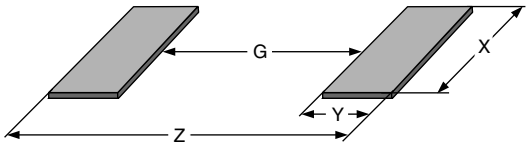
(2) Valid for sensor element only, in low dissipative mode. Response time and self-heating are influenced by mounting materials as substrate, solder lands, tracks and solders used

DIMENSIONS in millimeters



DIMENSIONS AND MASS							
TYPE	H	L	W	W_T	T_t	T_b	MASS (mg)
PTS 0603	0.45 + 0.1/- 0.05	1.55 +0.05 / -0.1	0.85 ± 0.1	> 75 % of W	0.3 + 0.15/- 0.2	0.3 + 0.15/- 0.2	1.9
PTS 0805	0.45 + 0.1 / - 0.05	2.0 ± 0.1	1.25 ± 0.15	> 75 % of W	0.4 ± 0.2	0.4 ± 0.2	4.6
PTS 1206	0.55 ± 0.1	3.1 + 0.1 / - 0.2	1.6 ± 0.15	> 75 % of W	0.5 ± 0.25	0.5 ± 0.25	9.2

SOLDER PAD DIMENSIONS in millimeters



RECOMMENDED SOLDERPAD DIMENSIONS								
TYPE	WAVE SOLDERING				REFLOW SOLDERING			
	G	Y	X	Z	G	Y	X	Z
PTS 0603	0.55	1.1	1.1	2.75	0.65	0.7	0.95	2.05
PTS 0805	0.8	1.25	1.50	3.2	0.9	0.9	1.4	2.7
PTS 1206	1.4	1.5	1.9	4.4	1.5	1.15	1.75	3.8

DESCRIPTION

A homogeneous film of platinum is deposited on a high grade (Al_2O_3) ceramic substrate and conditioned to achieve the correct temperature coefficient and stability. The sensor-elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure matte tin on nickel plating, the immunity against tin whisker growth has been proven under extensive testing.

QUALITY

The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100 % of the individual sensors. Only accepted products are laid directly into the paper tape in accordance with IEC 60286-3.

STORAGE

Solderability is specified for 2 years after production or re-qualification. The permitted storage time is 20 years.

ASSEMBLY

The Pt-sensors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase as shown in IEC61760-1. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system. The use of potting resins in close contact with the protective coating or terminations is not recommended.

For frequent high temperature usage, thermal compatible substrates and solder alloys should be selected to minimize any thermal mismatch.

All products comply with the CEFIC-EECA-EICTA list of legal restrictions on hazardous substances.

This includes full compatibility with the following directives:

- 2000/53/EC End of Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

APPROVALS

The Pt-sensors are tested in accordance with

- IEC 60751
- IEC 60068 series

The PTS AT are AEC-Q200 qualified.

PART NUMBER AND PRODUCT DESCRIPTION (1)

PART NUMBER (2): PTS0805M1B500RP100

P	T	S	0	8	0	5	M	1	B	5	0	0	R	P	1	0	0

TYPE	SIZE CODE	VERSION	TOLERANCE CLASS	RESISTANCE VALUE	PACKAGING (3)	SPECIAL
3 digits	4 digits	1 digit	2 digits	4 digits	2 digits	2 digits
PTS = platinum temperature sensor SMD	**0603** **0805** **1206**	**M** = AT (automotive)	**1B** = class F0.3 **2B** = class F0.6	**100R** = 100 Ω **500R** = 500 Ω **1K00** = 1000 Ω	**PU** **P1** **P5**	**00** = standard

PRODUCT DESCRIPTION (4): PTS 0805-B AT P1 500R

PTS	0805	-B	AT	P1	500R
TYPE	SIZE CODE	TOLERANCE CLASS	VERSION	PACKAGING (3)	RESISTANCE VALUE
PTS = platinum temperature sensor SMD	**0603** **0805** **1206**	**B** = class F0.3 **2B** = class F0.6	**AT** = automotive	**PU** **P1** **P5**	**100R** = 100 Ω **500R** = 500 Ω **1K** = 1000 Ω

Notes

(1) Products can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION

(2) The part number is shown to facilitate the introduction of a unified part numbering system

(3) Please refer to table PACKAGING

(4) We recommend that the Production Description is used to minimize the possibility of errors in order handling

PACKAGING

TYPE	CODE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	BOX/REEL	BOX/REEL DIAMETER
PTS 0603 PTS 0805 PTS 1206	PU	100	Paper tape acc. IEC 60286-3	8 mm	4 mm	Plastic box	114 mm
	P1	1000				Reel	180 mm/7"
	P5	5000					

TEST AND REQUIREMENTS - PERFORMANCE

TEST	CONDITIONS	REQUIREMENTS $\lvert\Delta R_0/R_0\rvert \leq \pm$	TYPICAL PERFORMANCE	
			$\lvert\Delta R_0/R_0\rvert \leq \pm$	$\Delta T \leq \pm$
High temperature exposure (storage)	AEC-Q200, 1000 h at 155 °C	0.1 %	0.015 %	0.04 °C
High temperature exposure (storage)	1000 h at 175 °C	0.2 %	0.018 %	0.05 °C
Temperature cycling	AEC-Q200, 1000 cycles -55 °C to +155 °C	0.5 %	0.04 %	0.10 °C
Biased humidity	1000 h, 1 mA biased at 85 °C / 85 % rh	0.5 %	0.015 %	0.04 °C
Operational life	1000 h, 1 mA biased at 125 °C	0.2 %	0.01 %	0.03 °C
Vibration	MIL-STD 202, method 204	0.1 %	0.02 %	0.05 °C
Mechanical shock	MIL-STD 202, method 213	0.1 %	0.02 %	0.05 °C
Resistance to soldering heat	Solder bath dipping 10 s at 260°C	0.25 %	0.05 %	0.13 °C
ESD	AEC-Q200-002, HBM (CD) 1.0 kV (0603), 1.5 kV (0805), 2.0 kV (1206)	0.2 %	0.01 %	0.03 °C
Board flex	AEC-Q200-005, 2 mm during 60 s	0.2 %	0.015 %	0.04 °C
Terminal strength	AEC-Q200-006, shear test 10 N / 17.7 N during 60 s	0.25 %	0.018 %	0.05 °C

FUNCTIONAL PERFORMANCE

The temperature resistance relationships of the PTS series follow different equations:

For the temperature range of -55 °C up to 0 °C:

$$R_T = R_0 \times (1 + A \times T + B \times T^2 + C \times (T - 100\ °C) \times T^3)$$

And for the temperature range of 0 °C up to +175 °C:

$$R_T = R_0 \times (1 + A \times T + B \times T^2)$$

R_T: Resistance as a function of temperature
R_0: Nominal resistance value at 0 °C
T: Temperature in °C

According to IEC 60751 the values of the coefficients are:

$A = 3.9083 \times 10^{-3}\ °C^{-1}$
$B = -5.775 \times 10^{-7}\ °C^{-2}$
$C = -4.183 \times 10^{-12}\ °C^{-4}$

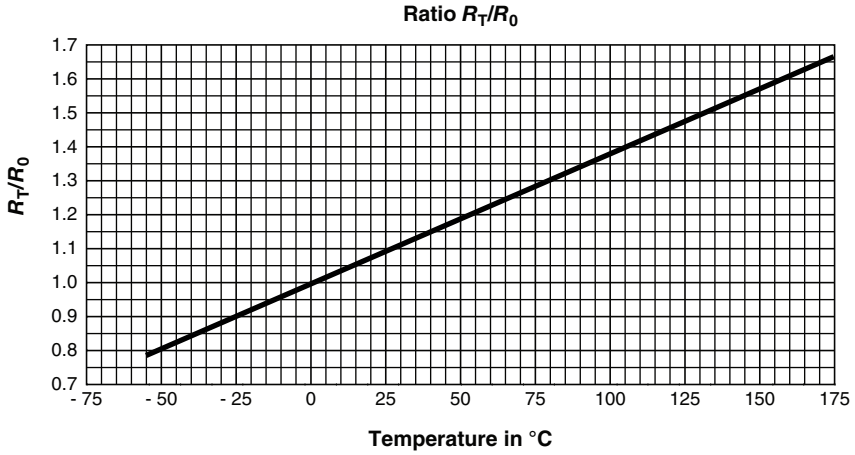
The tolerances values of the PTS AT series are classified by the following equations as specified by IEC 60751:

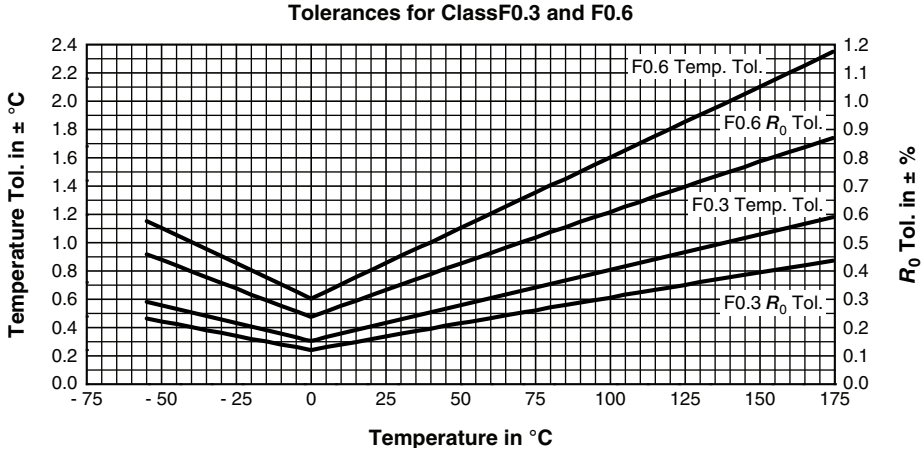
Class F0.3: $\Delta T_{F0.3} = \pm (0.3 + 0.005 \times |T|)$

Class F0.6: $\Delta T_{F0.6} = \pm (0.6 + 0.010 \times |T|)$

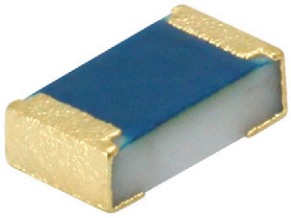
NOMINAL RESISTANCE VALUES AND TEMPERATURE TOLERANCE

TEMPERATURE in °C	NOMINAL RESISTANCE in Ω			TOLERANCE in K	
	R_0 = 100 Ω	R_0 = 500 Ω	R_0 = 1000 Ω	CLASS F0.3	CLASS F0.6
-55	78.319	391.59	783.19	± 0.58	± 1.15
-50	80.306	401.53	803.06	± 0.55	± 1.10
-25	90.192	450.96	901.92	± 0.43	± 0.85
0	**100.00**	**500.00**	**1000.00**	**± 0.30**	**± 0.60**
25	109.73	548.67	1097.35	± 0.43	± 0.85
50	119.40	596.99	1193.97	± 0.55	± 1.10
75	128.99	644.94	1289.87	± 0.68	± 1.35
100	138.51	692.53	1385.06	± 0.80	± 1.60
125	147.95	739.76	1479.51	± 0.93	± 1.85
150	157.33	786.63	1573.25	± 1.05	± 2.10
175	166.63	833.13	1666.27	± 1.18	± 2.35





Gold Terminated Platinum SMD Flat Chip Temperature Sensor



FEATURES

- Gold terminations for conductive gluing
- Standardized curve according IEC 60751
- Short reaction times down to $t_{0.9} \leq 3$ s (in air)
- Outstanding stability of temperature characteristic
- Superior temperature cycling robustness

Pb-free

e4

RoHS COMPLIANT

LINKS TO ADDITIONAL RESOURCES

3D Models Design Tools SPICE Models

PTS ATAU SMD flat chip temperature sensors are the perfect choice for temperature control of electronics operating under varying environmental conditions. The highly controlled platinum thin film manufacturing process guarantees an outstanding stability of temperature characteristics which ensures reliable operation even under harsh conditions. A final gold-plating on terminations enables the use for conductive adhesive gluing applications. Typical applications include automotive, aviation and industrial electronics.

APPLICATIONS

Temperature measurement and control in:

- Automotive electronics
- Aviation electronics
- Industrial electronics

TECHNICAL SPECIFICATIONS

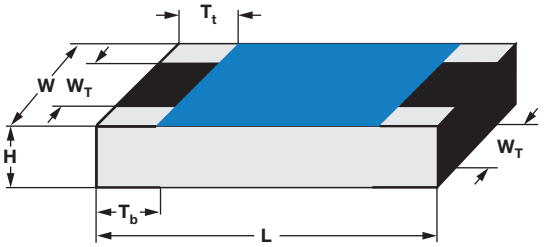
DESCRIPTION		PTS0603U	PTS0805U	PTS1206U
Resistance values R_0 at 0 °C		100 Ω	100 Ω, 500 Ω	100 Ω, 500 Ω, 1000 Ω
Temperature coefficient (0 °C to +100 °C)		+3850 ppm/K		
Tolerance classes		F0.3		
Temperature range		-55 °C to +175 °C		
Long term stability $\lvert\Delta R_0/R_0\rvert$; R_0 change after 1000 h at +155 °C		≤ 0.04 %		
Insulation resistance		> 10 MΩ		
Measurement current $I_{meas.}$ (DC) (1)	100 Ω	0.1 mA to 0.5 mA	0.1 mA to 1.0 mA	0.1 mA to 1.0 mA
	500 Ω	-	0.1 mA to 0.4 mA	0.1 mA to 0.4 mA
	1000 Ω	-	-	0.1 mA to 0.25 mA
Self-heating at 0 °C (2)	Calm air (v = 0.0 m/s)	≤ 0.9 K/mW	≤ 0.8 K/mW	≤ 0.7 K/mW
Thermal response time (2)	Flowing water (v = 0.4 m/s)	$t_{0.5} \leq 0.1$ s	$t_{0.5} \leq 0.2$ s	$t_{0.5} \leq 0.3$ s
		$t_{0.9} \leq 0.2$ s	$t_{0.9} \leq 0.3$ s	$t_{0.9} \leq 0.4$ s
	Flowing air (v = 3.0 m/s)	$t_{0.5} \leq 1.0$ s	$t_{0.5} \leq 1.5$ s	$t_{0.5} \leq 2.0$ s
		$t_{0.9} \leq 2.0$ s	$t_{0.9} \leq 3.0$ s	$t_{0.9} \leq 5.0$ s
Failure rate: $FIT_{observed}$		≤ 0.1 x 10^{-9}/h		

Notes

(1) Indicated measurement currents can be applied continuously with self-heating effect of less than 0.1 °C

(2) Valid for sensor element only

DIMENSIONS in millimeters



DIMENSIONS AND MASS							
TYPE	H	L	W	W_T	T_t	T_b	MASS (mg)
PTS0603 ATAU	0.43 + 0.1 / - 0.05	1.53 ± 0.05	0.85 ± 0.1	> 75 % of W	0.3 + 0.15 / - 0.2	0.3 + 0.15 / - 0.2	1.9
PTS0805 ATAU	0.45 + 0.1 / - 0.05	2.0 ± 0.1	1.25 ± 0.15	> 75 % of W	0.4 ± 0.2	0.4 ± 0.2	4.6
PTS1206 ATAU	0.55 ± 0.1	3.1 + 0.1 / - 0.2	1.6 ± 0.15	> 75 % of W	0.5 ± 0.25	0.5 ± 0.25	9.2

DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of platinum is deposited on a high grade (Al_2O_3) ceramic substrate and conditioned to achieve the correct temperature coefficient and stability. The sensor-elements are covered by a protective coating designed for electrical, mechanical, and climatic protection. The terminations receive a final gold over nickel plating.

QUALITY

The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100 % of the individual sensors. Only accepted products are laid directly into the paper tape in accordance with IEC 60286-3 (1).

STORAGE

Solderability is specified for 2 years after production or re-qualification. The permitted storage time is 20 years.

ASSEMBLY

The Pt-sensors are suitable for processing on automatic SMD assembly systems only. They are suitable for conductive adhesive gluing technology and automatic soldering using reflow technology as shown in IEC 61760-1. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system. The use of potting resins in close contact with the protective coating or terminations is not recommended. For frequent high temperature usage, thermal compatible substrates and high temperature solder alloys or conductive adhesives should be selected to minimize any thermal mismatch or degradation of the junctions.

MATERIALS

Vishay acknowledges the following systems for the regulation of hazardous substances:

- IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein (2)
- The Global Automotive Declarable Substance List (GADSL) (3)
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) (4) for its supply chain

Hence the products fully comply with the following directives:

- 2000/53/EC End-of-Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the Use of Hazardous Substances Directive (RoHS) with amendment 2015/863/EU
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

APPROVALS

The PTS ATAU sensors are tested in accordance with:

- IEC 60751 (1)
- IEC 60068 series
- AEC-Q200

Notes

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents
(2) The IEC 62474 list of declarable substances is maintained in a dedicated database
(3) The Global Automotive Declarable Substance List (GADSL) is maintained by the American Chemistry Council
(4) The SVHC list is maintained by the European Chemical Agency (ECHA)

PART NUMBER AND PRODUCT DESCRIPTION (1)

PART NUMBER: PTS0603U1B100RPU00

P	T	S	0	6	0	3	U	1	B	1	0	0	R	P	U	0	0

TYPE	SIZE CODE	VERSION	TOLERANCE CLASS	RESISTANCE VALUE	PACKAGING	SPECIAL
3 digits	4 digits	1 digit	2 digits	4 digits	2 digits	2 digits
PTS = platinum temperature sensor SMD	**0603** **0805** **1206**	**U** = AT AU (gold termination)	**1B** = class F0.3	**100R** = 100 Ω **500R** = 500 Ω **1K00** = 1000 Ω	**PU** **P1**	**00** = standard

PRODUCT DESCRIPTION: PTS 0603-B ATAU PU 100R

PTS	0603	-B	ATAU	P1	500R
TYPE	SIZE CODE	TOLERANCE CLASS	VERSION	PACKAGING (see Packaging table)	RESISTANCE VALUE
PTS = platinum temperature sensor SMD	**0603** **0805** **1206**	**B** = class F0.3	**ATAU** = automotive / gold termination	**PU** **P1**	**100R** = 100 Ω **500R** = 500 Ω **1K** = 1000 Ω

Note

(1) Products can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION

PACKAGING

TYPE	CODE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	BOX/REEL	BOX / REEL DIAMETER
PTS 0603 PTS 0805 PTS 1206	PU	100	Paper tape acc. IEC 60286-3	8 mm	4 mm	Box	114 mm
	P1	1000				Reel	180 mm / 7"

FUNCTIONAL PERFORMANCE

The temperature resistance relationships of the PTS series follow different equations:

For the temperature range of -55 °C up to 0 °C:

$$R_T = R_0 \times (1 + A \times T + B \times T^2 + C \times (T - 100\ °C) \times T^3)$$

and for the temperature range of 0 °C up to +175 °C:

$$R_T = R_0 \times (1 + A \times T + B \times T^2)$$

R_T: resistance as a function of temperature

R_0: nominal resistance value at 0 °C

T: temperature in °C

According to IEC 60751 the values of the coefficients are:

$$A = +3.9083 \times 10^{-3}\ °C^{-1}$$

$$B = -5.7750 \times 10^{-7}\ °C^{-2}$$

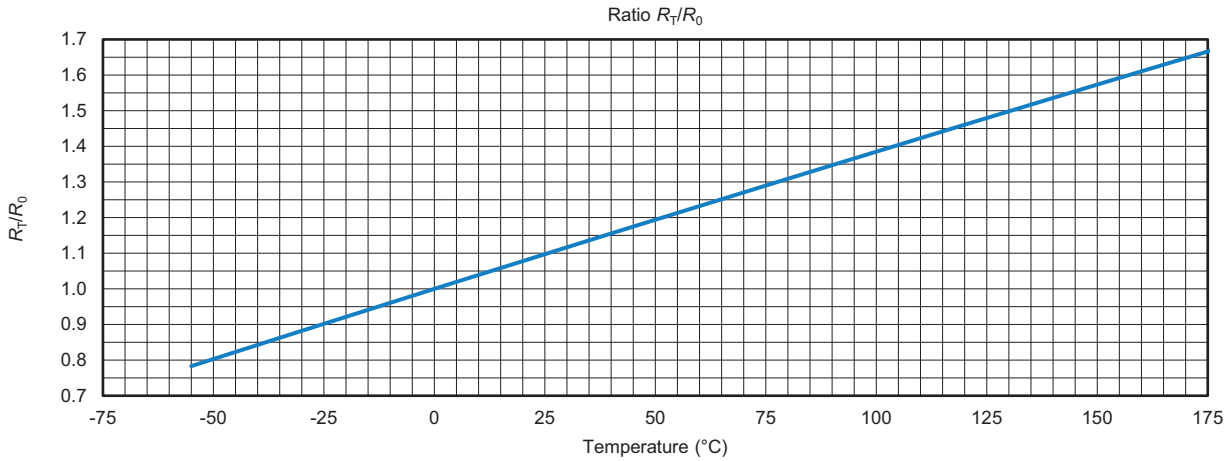
$$C = -4.1830 \times 10^{-12}\ °C^{-4}$$

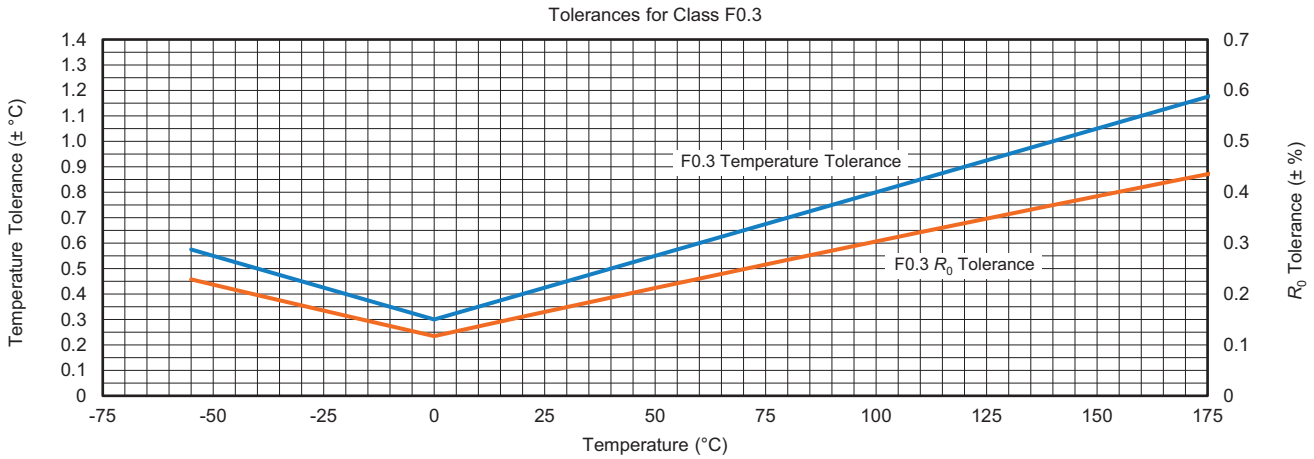
The tolerances values of the PTS AT series are classified by the following equations as specified by IEC 60751:

Class F0.3: $\Delta T_{F0.3} = \pm (0.3 + 0.005 \times |T|)$

NOMINAL RESISTANCE VALUES AND TEMPERATURE TOLERANCE

TEMPERATURE (°C)	NOMINAL RESISTANCE (Ω)			TOLERANCE (K)
	R_0 = 100 Ω	R_0 = 500 Ω	R_0 = 1000 Ω	CLASS F0.3
-55	78.32	391.59	783.19	± 0.58
-50	80.31	401.53	803.06	± 0.55
-25	90.19	450.96	901.92	± 0.43
0	**100.00**	**500.00**	**1000.00**	**± 0.30**
25	109.73	548.67	1097.35	± 0.43
50	119.40	596.99	1193.97	± 0.55
75	128.99	644.94	1289.87	± 0.68
100	138.51	692.53	1385.06	± 0.80
125	147.95	739.76	1479.51	± 0.93
150	157.33	786.63	1573.25	± 1.05
175	166.63	833.13	1666.27	± 1.18


Ratio R_T/R_0
R_T/R_0
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
-75
-50
-25
0
25
50
75
100
125
150
175
Temperature (°C)


Tolerances for Class F0.3
Temperature Tolerance (± °C)
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
F0.3 Temperature Tolerance
F0.3 R_0 Tolerance
R_0 Tolerance (± %)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-75
-50
-25
0
25
50
75
100
125
150
175
Temperature (°C)

Temperature Dependent Platinum Thin Film Chip Resistor (RTD)

FEATURES

- Standardized characteristics according to IEC 60751
- Advanced thin film technology
- Short reaction times down to $t_{0.9} \leq 2$ s (in air)
- Outstanding stability of temperature characteristic
- Supports lead (Pb)-free soldering

Pb-free

e3

RoHS COMPLIANT

HALOGEN FREE

APPLICATIONS

Temperature measurement and control in

- Aviation electronics
- Industrial electronics
- Medical electronics

DESIGN SUPPORT TOOLS

click logo to get started

Design Tools Available

PTS SMD flat chip temperature dependent resistors are the perfect choice for temperature control of electronics operating under varying environmental conditions. The highly controlled platinum thin film manufacturing process guarantees an outstanding stability of temperature characteristics which ensures reliable operation even under harsh conditions.

TECHNICAL SPECIFICATIONS

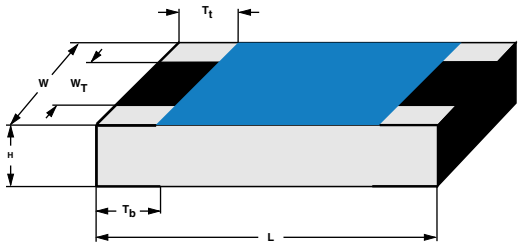
DESCRIPTION		PTS 0603	PTS 0805	PTS 1206
Resistance values R_0 at 0 °C		100 Ω	100 Ω, 500 Ω	100 Ω, 500 Ω, 1000 Ω
Temperature coefficient (0 °C to +100 °C), IEC60751		+3850 ppm/K		
Tolerance classes		F0.3, F0.6		
Operating temperature range		-55 °C to +155 °C		
Long term stability $\Delta R_0/R_0$; R_0 change after 1000 h at +155 °C		< ± 0.04 %		
Insulation resistance		> 10 MΩ		
Measurement current $I_{meas.}$ (DC) (2)	100 Ω	0.1 mA to 0.50 mA	0.1 mA to 1.0 mA	0.1 mA to 1.0 mA
	500 Ω	-	0.1 mA to 0.40 mA	0.1 mA to 0.40 mA
	1000 Ω	-	-	0.1 mA to 0.25 mA
Self-heating (1)	Still air (v = 0 m/s)	≤ 0.9 K/mW	≤ 0.8 K/mW	≤ 0.7 K/mW
Thermal response time (1)	Flowing water (v = 0.4 m/s)	$t_{0.5} \leq 0.1$ s	$t_{0.5} \leq 0.2$ s	$t_{0.5} \leq 0.3$ s
		$t_{0.9} \leq 0.2$ s	$t_{0.9} \leq 0.3$ s	$t_{0.9} \leq 0.4$ s
	Flowing air (v = 3.0 m/s)	$t_{0.5} \leq 1.0$ s	$t_{0.5} \leq 1.5$ s	$t_{0.5} \leq 2.0$ s
		$t_{0.9} \leq 2.0$ s	$t_{0.9} \leq 3.0$ s	$t_{0.9} \leq 5.0$ s

Notes

(1) Valid for sensor element only, in low dissipative mode. Response time and self-heating are influenced by mounting materials as substrate, solder lands, tracks and solders used

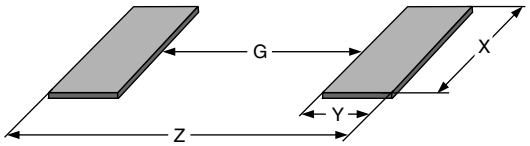
(2) Indicated measurement currents can be applied continuously with self-heating effect of less then 0.1 °C

DIMENSIONS in millimeters



DIMENSIONS - PTS sensor types, mass and relevant physical dimensions							
TYPE	**H**	**L**	**W**	**W_T**	**T_t**	**T_b**	**MASS (mg)**
PTS 0603	0.45 + 0.1/- 0.05	1.55 +0.05 / -0.1	0.85 ± 0.1	> 75 % of W	0.3 + 0.15/- 0.2	0.3 + 0.15/- 0.2	1.9
PTS 0805	0.45 + 0.1/- 0.05	2.0 ± 0.1	1.25 ± 0.15	> 75 % of W	0.4 ± 0.2	0.4 ± 0.2	4.6
PTS 1206	0.55 ± 0.1	3.1 + 0.1/- 0.2	1.6 ± 0.15	> 75 % of W	0.5 ± 0.25	0.5 ± 0.25	9.2

SOLDER PAD DIMENSIONS in millimeters



RECOMMENDED SOLDERPAD DIMENSIONS								
TYPE	**WAVE SOLDERING**				**REFLOW SOLDERING**			
	G	**Y**	**X**	**Z**	**G**	**Y**	**X**	**Z**
PTS 0603	0.55	1.1	1.1	2.75	0.65	0.7	0.95	2.05
PTS 0805	0.8	1.25	1.50	3.2	0.9	0.9	1.4	2.7
PTS 1206	1.4	1.5	1.9	4.4	1.5	1.15	1.75	3.8

DESCRIPTION

A homogeneous film of platinum is deposited on a high grade (Al_2O_3) ceramic substrate and conditioned to achieve the correct temperature coefficient and stability. The sensor-elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure matte tin on nickel plating, the immunity against tin whisker growth has been proven under extensive testing.

QUALITY

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual sensors. Only accepted products are laid directly into the paper tape in accordance with **IEC 60286-3**.

STORAGE

Solderability is specified for 2 years after production or re-qualification. The permitted storage time is 2 years.

ASSEMBLY

The PTS are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system. The use of potting resins in close contact with the coating or terminations is not allowed. For frequent high temperature usage, thermal compatible substrates and solder alloys should be used, to minimize any thermal mismatch with the component.

All products comply with the CEFIC-EECA-EICTA list of legal restrictions on hazardous substances.

This includes full compatibility with the following directives:

- 2000/53/EC End of Vehicle life Directive (ELV)
- 2000/53/EC Annex II to End of Vehicle Life Directive (ELV II)
- 2011/65/EU Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

APPROVALS

The PTS are tested in accordance with

- IEC 60751
- IEC 60068 series

PART NUMBER AND PRODUCT DESCRIPTION (1)

PART NUMBER (2): PTS060301B100RP100

P	T	S	0	6	0	3	0	1	B	1	0	0	R	P	1	0	0

TYPE	SIZE CODE	SPECIAL CHARACTER	TOLERANCE CLASS	RESISTANCE VALUE	PACKAGING (3)	SPECIAL
3 digits	4 digits	1 digit	2 digits	4 digits	2 digits	2 digits
PTS = platinum temperature sensor SMD	**0603** **0805** **1206**	**0** = neutral	**1B** = class F0.3 **2B** = class F0.6	**100R** = 100 Ω **500R** = 500 Ω **1K00** = 1000 Ω	**PU** **P1** **P5**	**00** = standard

PRODUCT DESCRIPTION (4): PTS 0603-B P1 100R

PTS	0603	-B	P1	100R
TYPE	SIZE CODE	TOLERANCE CLASS	PACKAGING (3)	RESISTANCE VALUE
PTS = platinum temperature sensor SMD	**0603** **0805** **1206**	**B** = class F0.3 **2B** = class F0.6	**PU** **P1** **P5**	**100R** = 100 Ω **500R** = 500 Ω **1K** = 1000 Ω

Notes

(1) Products can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION
(2) The part number is shown to facilitate the introduction of a unified part numbering system
(3) Please refer to table PACKAGING
(4) We recommend that the Production Description is used to minimize the possibility of errors in order handling

PACKAGING

TYPE	CODE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	BOX/REEL	BOX/REEL DIAMETER
PTS 0603 PTS 0805 PTS 1206	PU	100	Paper tape acc. IEC 60286-3	8 mm	4 mm	Box	114 mm
	P1	1000				Reel	180 mm/7"
	P5	5000					

FUNCTIONAL PERFORMANCE

The temperature resistance relationships of the PTS series follow different equations:

For the temperature range of -55 °C up to 0 °C:

$$R_T = R_0 \times (1 + A \times T + B \times T^2 + C \times (T - 100\ °C) \times T^3)$$

And for the temperature range of 0 °C up to +155 °C:

$$R_T = R_0 \times (1 + A \times T + B \times T^2)$$

R_T: Resistance as a function of temperature
R_0: Nominal resistance value at 0 °C
T: Temperature in °C

Coefficients according to IEC 60751:

$A = 3.9083 \times 10^{-3}\ °C^{-1}$
$B = -5.775 \times 10^{-7}\ °C^{-2}$
$C = -4.183 \times 10^{-12}\ °C^{-4}$

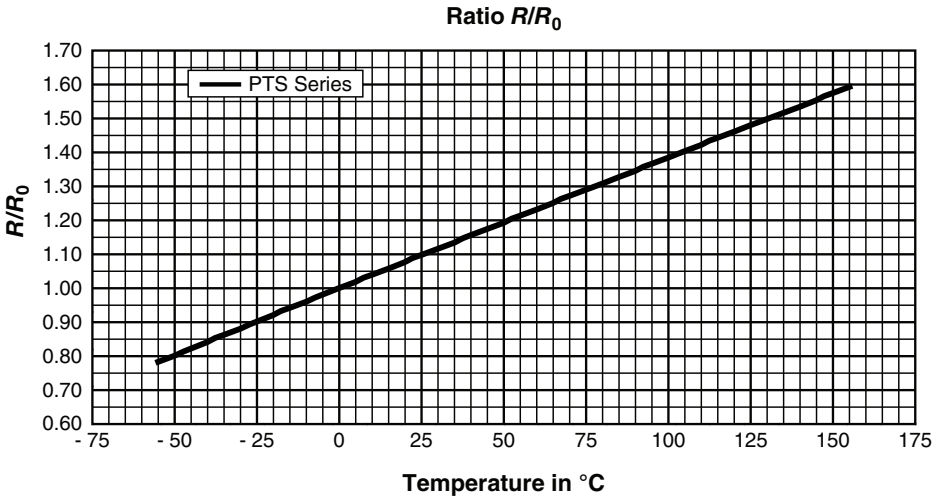
The tolerances values of the PTS series are classified by the following equations as specified by IEC 60751:

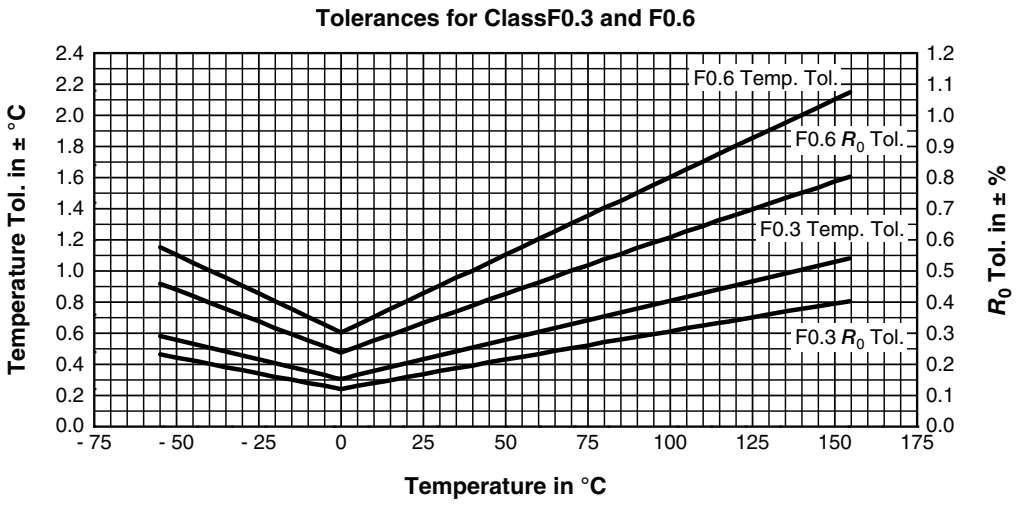
Class F0.3: $\Delta T_{F0.3} = \pm (0.30 + 0.005 \times |T|)$

Class F0.6: $\Delta T_{F0.6} = \pm (0.60 + 0.010 \times |T|)$

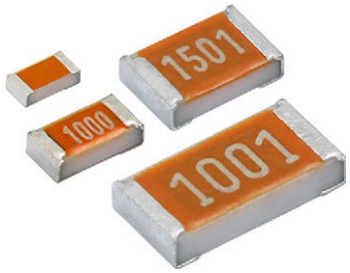
NOMINAL RESISTANCE VALUES AND TEMPERATURE TOLERANCE

TEMPERATURE	R_T/R_0 RATIO	NOMINAL RESISTANCE VALUES			CLASS F0.3	CLASS F0.6
		R_0 100 Ω	R_0 500 Ω	R_0 1000 Ω	$T_{Tol.}$	$T_{Tol.}$
(°C)		(Ω)	(Ω)	(Ω)	(°C)	(°C)
-55	0.78319	78.32	391.59	783.19	± 0.58	± 1.15
-50	0.80306	80.31	401.53	803.06	± 0.55	± 1.10
-45	0.82290	82.29	411.45	822.90	± 0.53	± 1.05
-40	0.84271	84.27	421.35	842.71	± 0.50	± 1.00
-35	0.86248	86.25	431.24	862.48	± 0.48	± 0.95
-30	0.88222	88.22	441.11	882.22	± 0.45	± 0.90
-25	0.90192	90.19	450.96	901.92	± 0.43	± 0.85
-20	0.92160	92.16	460.80	921.60	± 0.40	± 0.80
-15	0.94124	94.12	470.62	941.24	± 0.38	± 0.75
-10	0.96086	96.09	480.43	960.86	± 0.35	± 0.70
-5	0.98044	98.04	490.22	980.44	± 0.33	± 0.65
0	**1.00000**	**100.00**	**500.00**	**1000.00**	**± 0.30**	**± 0.60**
5	1.01953	101.95	509.76	1019.53	± 0.33	± 0.65
10	1.03903	103.90	519.51	1039.03	± 0.35	± 0.70
15	1.05849	105.85	529.25	1058.49	± 0.38	± 0.75
20	1.07794	107.79	538.97	1077.94	± 0.40	± 0.80
25	1.09735	109.73	548.67	1097.35	± 0.43	± 0.85
30	1.11673	111.67	558.36	1116.73	± 0.45	± 0.90
35	1.13608	113.61	568.04	1136.08	± 0.48	± 0.95
40	1.15541	115.54	577.70	1155.41	± 0.50	± 1.00
45	1.17470	117.47	587.35	1174.70	± 0.53	± 1.05
50	1.19397	119.40	596.99	1193.97	± 0.55	± 1.10
55	1.21321	121.32	606.60	1213.21	± 0.58	± 1.15
60	1.23242	123.24	616.21	1232.42	± 0.60	± 1.20
65	1.25160	125.16	625.80	1251.60	± 0.63	± 1.25
70	1.27075	127.08	635.38	1270.75	± 0.65	± 1.30
75	1.28987	128.99	644.94	1289.87	± 0.68	± 1.35
80	1.30897	130.90	654.48	1308.97	± 0.70	± 1.40
85	1.32803	132.80	664.02	1328.03	± 0.73	± 1.45
90	1.34707	134.71	673.53	1347.07	± 0.75	± 1.50
95	1.36608	136.61	683.04	1366.08	± 0.78	± 1.55
100	1.38506	138.51	692.53	1385.06	± 0.80	± 1.60
105	1.40400	140.40	702.00	1404.00	± 0.83	± 1.65
110	1.42293	142.29	711.46	1422.93	± 0.85	± 1.70
115	1.44182	144.18	720.91	1441.82	± 0.88	± 1.75
120	1.46068	146.07	730.34	1460.68	± 0.90	± 1.80
125	1.47951	147.95	739.76	1479.51	± 0.93	± 1.85
130	1.49832	149.83	749.16	1498.32	± 0.95	± 1.90
135	1.51710	151.71	758.55	1517.10	± 0.98	± 1.95
140	1.53584	153.58	767.92	1535.84	± 1.00	± 2.00
145	1.55456	155.46	777.28	1554.56	± 1.03	± 2.05
150	1.57325	157.33	786.63	1573.25	± 1.05	± 2.10
155	1.59191	159.19	795.96	1591.91	± 1.08	± 2.15


Ratio R/R_0
PTS Series
R/R_0
1.70
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
0.70
0.60
- 75
- 50
- 25
0
25
50
75
100
125
150
175
Temperature in °C


Tolerances for ClassF0.3 and F0.6
F0.6 Temp. Tol.
F0.6 R_0 Tol.
F0.3 Temp. Tol.
F0.3 R_0 Tol.
Temperature Tol. in ± °C
R_0 Tol. in ± %
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
- 75
- 50
- 25
0
25
50
75
100
125
150
175
Temperature in °C

SMD PTC - Nickel Thin Film Linear Thermistors



FEATURES

- Alumina substrate base with nickel based PTC thin film element
- 0402, 0603, 0805, and 1206 sizes available
- Available in tape and reel packaging
- Standard R_{25} tolerances: ± 0.5 %, ± 1 %, ± 5 %
- Operation range -55 °C to +150 °C
- High stability over the entire temperature range
- cULus recognized, file E148885 (UL category XGPU2 / XGPU8)
- AEC-Q200 qualified (grade 1), except TFPT0402

Pb Available

e3

RoHS* Available

HALOGEN FREE

ADDITIONAL RESOURCES

Design Tools

Note

* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

APPLICATIONS

Temperature compensation and sensing in

- Automotive
- Motor drives
- Lighting LED drivers
- Test and measuring equipment
- Air-flow sensor

QUICK REFERENCE DATA					
PARAMETER	**VALUE**				**UNIT**
DESCRIPTION	**TFPT0402**	**TFPT0603**	**TFPT0805**	**TFPT1206**	
Resistance value at 25 °C (2)	5	100 to 1K	100 to 5K	100 to 10K	Ω
Tolerance on R_{25}-value (2)	± 25	± 0.5; ± 1; ± 5			%
TCR at 25 °C	4110				ppm/K
Tolerance on TCR at 25 °C (1)	± 400				
Operating temperature range: at rated power at zero dissipation (4)	 -55 to +70 -55 to +150				°C
Dissipation factor δ (for information only) (5)	0.8	1.8	2.3	4	mW/K
Maximum rated power at 70 °C (P_{70}) (5)	100 (6)	75	100	125	mW
Maximum working voltage RCWV (3)	1.2	30	40	50	V
Climatic category (LCT/UCT/days)	55/150/56				-
Weight	0.65	2	5.5	10	mg
Failure rate $FIT_{observed}$	≤ 0.1 x 10^{-9}/h				

Notes

(1) Contact Vishay if closer TCR lot tolerance is desired
(2) Other R_{25}-values and tolerances are available upon request
(3) Rated continuous working voltage is maximum working voltage or $\sqrt{P_{70} \times R}$ whichever is less
(4) Zero power or zero dissipation is considered as measuring power max. 1 % of rated power P_{70}
(5) Please refer to APPLICATION INFORMATION
(6) Power levels are depending on way of mounting and substrates used. Higher power up to 200 mW at 25 °C (P_{25}) can be tolerated on uniform layer TFPT0402 5R

APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. The rated dissipation applies only if the permitted film temperature of 150 °C is not exceeded.

The TFPT0402 uniform layer linear thermistor with low resistance value can be used as an air-flow sensor in a controlled power mode where nickel film temperature changes can be related to air-flow speed.

STANDARD RESISTANCE VALUES at 25 °C in Ω

100	180	330	560	1.0K	1.8K	3.3K	5.0K	8.2K
120	220	390	680	1.2K	2.2K	3.9K	5.6K	10.0K
150	270	470	820	1.5K	2.7K	4.7K	6.8K	

Note

- Rated continuous working voltage is maximum working voltage or $\sqrt{P_{70} \times R}$ whichever is less

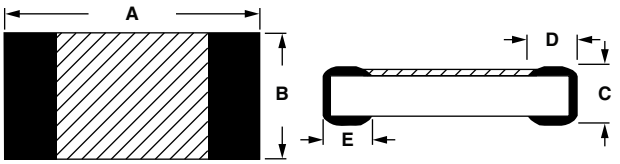
GLOBAL PART NUMBER INFORMATION

Global Part Numbering: TFPT1206L1002FM (preferred part number format)

T	F	P	T	1	2	0	6	L	1	0	0	2	F	M

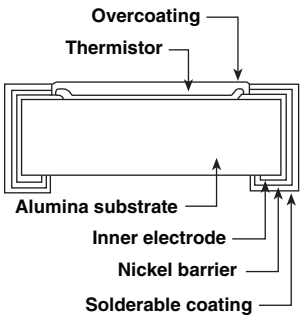
GLOBAL MODEL	CHARACTERISTIC	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING
TFPT0402 **TFPT0603** **TFPT0805** **TFPT1206**	**L** = linear **U** = uniform linear (0402)	**1002** = 10K **0050** = 5R (0402)	**D** = ± 0.5 % **F** = ± 1 % **J** = ± 5 % **V** = ± 25 % (0402)	**L** = lead (Pb)-free, T/R (10 000 pcs) 0402 **M** = lead (Pb)-free, T/R (5000 pcs) **V** = lead (Pb)-free, T/R (1000 pcs) **Z** = tin / lead, T/R (5000 pcs) **Y** = tin / lead, T/R (1000 pcs)

DIMENSIONS in millimeters



PART NUMBER	A	B	C	D	E
TFPT 0402	1.00 ± 0.05	0.50 ± 0.05	0.35 ± 0.07	0.20 ± 0.10	0.20 ± 0.10
TFPT 0603	1.55 ± 0.10	0.80 ± 0.10	0.45 ± 0.10	0.30 ± 0.20	0.30 ± 0.20
TFPT 0805	2.00 ± 0.15	1.25 ± 0.15	0.45 ± 0.10	0.40 ± 0.20	0.40 ± 0.20
TFPT 1206	3.05 ± 0.15	1.50 ± 0.15	0.55 ± 0.10	0.50 ± 0.25	0.50 ± 0.25

CONSTRUCTION



TESTS AND REQUIREMENTS (except TFPT0402)

TEST	CONDITIONS [1]	REQUIREMENTS MAX. $\lvert\Delta R_{25}/R_{25}\rvert$
High temperature exposure (storage)	AEC-Q200, 1000 h at 150 °C	0.25 %
Temperature cycling	AEC-Q200, 1000 cycles -55 °C / +125 °C	0.25 %
Biased humidity	1000 h, 1 mA biased at 85 °C / 85 % RH	0.25 %
	1000 h, 1 mA biased at 40 °C / 95 % RH	0.25 %
Operational life	1000 h, P_{70} max biased at 85 °C	0.25 %
Mechanical shock and vibration	MIL-STD 202, method 213 - 204	0.50 %
Resistance to soldering heat	MIL-STD 202, method 210, solder bath dipping 10 s at 260°C	0.25 %
ESD [2]	AEC-Q200-002, HBM (CD) 0.5 kV (0603), 1.0 kV (0805), 1.0 kV (1206)	0.25 %
Board flex	AEC-Q200-005, 2 mm during 60 s	0.25 %
Terminal strength	AEC-Q200-006, shear test 17.7 N during 60 s	0.25 %

Notes

(1) Environmental performance specifications use test procedures as outlined in MIL-R23648D, MIL-STD 202 and AEC-Q200

(2) TFPTs are ESD sensitive

AGENCY APPROVALS (except TFPT0402)

- cUL certificate
- ULus certificate

Note

- Agency approval documents

AVERAGE RATIO R/R_{25} TFPT ALL SIZES AND VALUES											
TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}
		-20	0.825	20	0.980	60	1.150	100	1.337	140	1.541
		-19	0.828	21	0.984	61	1.155	101	1.342	141	1.547
		-18	0.832	22	0.988	62	1.159	102	1.347	142	1.552
		-17	0.836	23	0.992	63	1.164	103	1.352	143	1.557
		-16	0.839	24	0.996	64	1.168	104	1.357	144	1.563
-55	0.702	-15	0.843	**25**	**1.000**	65	1.173	105	1.362	145	1.568
-54	0.705	-14	0.847	26	1.004	66	1.177	106	1.367	146	1.574
-53	0.708	-13	0.851	27	1.008	67	1.182	107	1.372	147	1.579
-52	0.712	-12	0.854	28	1.012	68	1.186	108	1.377	148	1.584
-51	0.715	-11	0.858	29	1.017	69	1.191	109	1.382	149	1.590
-50	0.719	-10	0.862	30	1.021	70	1.196	110	1.387	150	1.595
-49	0.722	-9	0.866	31	1.025	71	1.200	111	1.392		
-48	0.725	-8	0.869	32	1.029	72	1.205	112	1.397		
-47	0.729	-7	0.873	33	1.033	73	1.209	113	1.402		
-46	0.732	-6	0.877	34	1.037	74	1.214	114	1.407		
-45	0.736	-5	0.881	35	1.042	75	1.219	115	1.412		
-44	0.739	-4	0.885	36	1.046	76	1.223	116	1.417		
-43	0.743	-3	0.889	37	1.050	77	1.228	117	1.422		
-42	0.746	-2	0.892	38	1.054	78	1.232	118	1.427		
-41	0.749	-1	0.896	39	1.059	79	1.237	119	1.432		
-40	0.753	0	0.900	40	1.063	80	1.242	120	1.437		
-39	0.756	1	0.904	41	1.067	81	1.246	121	1.442		
-38	0.760	2	0.908	42	1.071	82	1.251	122	1.448		
-37	0.763	3	0.912	43	1.076	83	1.256	123	1.453		
-36	0.767	4	0.916	44	1.080	84	1.261	124	1.458		
-35	0.771	5	0.920	45	1.084	85	1.265	125	1.463		
-34	0.774	6	0.924	46	1.089	86	1.270	126	1.468		
-33	0.778	7	0.927	47	1.093	87	1.275	127	1.473		
-32	0.781	8	0.931	48	1.097	88	1.280	128	1.478		
-31	0.785	9	0.935	49	1.102	89	1.284	129	1.484		
-30	0.788	10	0.939	50	1.106	90	1.289	130	1.489		
-29	0.792	11	0.943	51	1.110	91	1.294	131	1.494		
-28	0.796	12	0.947	52	1.115	92	1.299	132	1.499		
-27	0.799	13	0.951	53	1.119	93	1.303	133	1.505		
-26	0.803	14	0.955	54	1.124	94	1.308	134	1.510		
-25	0.806	15	0.959	55	1.128	95	1.313	135	1.515		
-24	0.810	16	0.963	56	1.133	96	1.318	136	1.520		
-23	0.814	17	0.967	57	1.137	97	1.323	137	1.526		
-22	0.817	18	0.971	58	1.141	98	1.328	138	1.531		
-21	0.821	19	0.975	59	1.146	99	1.333	139	1.536		

RATIO FORMULA

$R_T = R_{25}$ x (9.0014 x 10^{-1} + 3.87235 x 10^{-3} (°C)$^{-1}$ x T + 4.86825 x 10^{-6} (°C)$^{-2}$ x T^2 + 1.37559 x 10^{-9} (°C)$^{-3}$ x T^3)
$T_{(°C)}$ = 28.54 x $(R_T/R_{25})^3$ - 158.5 x $(R_T/R_{25})^2$ + 474.8 x (R_T/R_{25}) - 319.85)

RATIO TOLERANCES		
LOW TEMP.	HIGH TEMP.	TOL.
-55 °C	+150 °C	± 4 %
-40 °C	+125 °C	± 3 %
-20 °C	+85 °C	± 2 %
0 °C	+55 °C	± 1 %
+12 °C	+40 °C	± 0.5 %

RATIO TOLERANCE EXAMPLES:

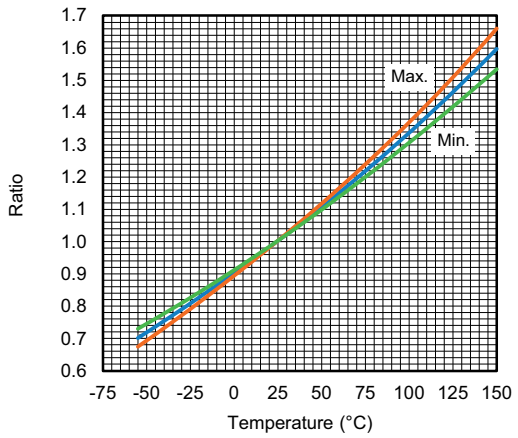
At 40 °C, ratio = 1.063 ± 0.5 % (0.005)
so, ratio = 1.058 to 1.068

At 125 °C, ratio = 1.460 ± 3 % (0.044)
so, ratio = 1.416 to 1.504

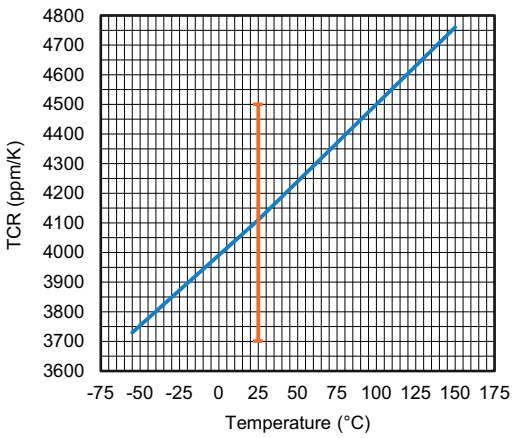
At intermediate temperatures, the ratios can be gradually adapted, for example at 105 °C the ratio tolerance will be ± 2.5 %.

For total resistance tolerance, the specific R_{25} tolerance needs to be multiplied with the ratio tolerance, for example a 100R 1 % at 25 °C will have a maximum resistance at 125 °C of 100R x 1.463 x 1.03 x 1.01 = 152.2 Ω.

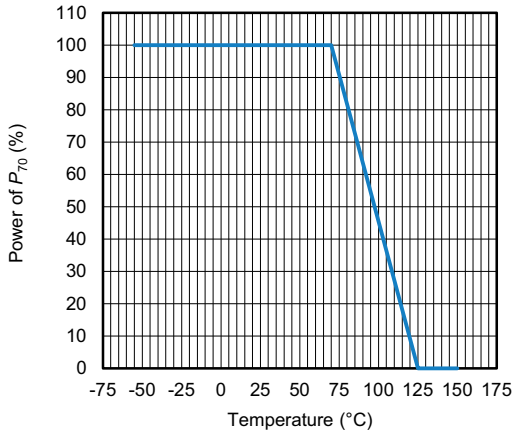
RATIO R_T/R_{25}



TCR TYPICAL VALUE



POWER DERATING



Note

- Zero power is considered as measuring power max. 1 % of rated power P_{70}

Radial Leaded PTC - Nickel Thin Film Linear Thermistors

FEATURES

- Nickel thin film PTC element
- High stability over the entire temperature range
- cUL recognized component: File E148885
- Epoxy coated UL 94 V-0 approved

e3
RoHS
COMPLIANT

APPLICATIONS

Temperature measurement, sensing, compensation, and control in industrial and consumer applications. For on-board or remote sensing.

DESCRIPTION

These thermistors are based on a Nickel thin film resistor technology as thermal sensitive material. The device consists of a thin film ceramic chip with two tinned copper clad steel wire leads.

MARKING

The thermistors are laser marked with value and tolerance reference on an epoxy based coating.
(Example: 102F = 10 x 10^2 = 1000 Ω 1 %)

MOUNTING

By soldering or welding in any position.

QUICK REFERENCE DATA

PARAMETER	VALUE		UNIT
DESCRIPTION	TFPTL10	TFPTL15	
Resistance value at 25 °C (2)	100 to 1K	100 to 5K	Ω
Tolerance on R_{25}-value (2)	± 1; ± 5		%
TCR at 25 °C	4110		ppm/K
Tolerance on TCR at 25 °C (1)	± 400		ppm/K
Operating temperature range: at rated power at zero dissipation	-55 to +70 -55 to +150		°C
Response time (in oil)	≈ 1.1	≈ 1.6	s
Dissipation factor δ (for information only)	2.9	3.4	mW/K
Maximum rated power at 70 °C (P_{70})	75	100	mW
Maximum working voltage RCWV (3)	30	40	V
Climatic category (LCT/UCT/days)	55/150/56		-
Weight	0.12	0.14	g

Notes

(1) Contact Vishay if closer TCR lot tolerance is desired
(2) Other R_{25}-values and tolerances are available upon request
(3) Rated continuous working voltage is maximum working voltage or $\sqrt{P_{70} \times R}$, whichever is less

STANDARD RESISTANCE VALUES at 25 °C in Ω

100	150	220	330	470	680	1K	1.5K	2.2K	3.3K	4.7K
120	180	270	390	560	820	1.2K	1.8K	2.7K	3.9K	5.0K

Note

- Other R_{25}-values and tolerances are available upon request

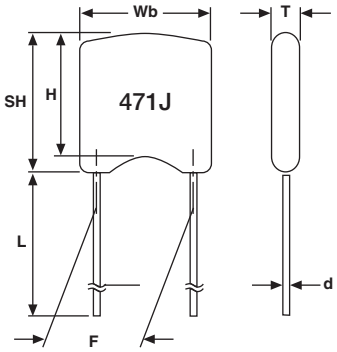
GLOBAL PART NUMBER INFORMATION

Global Part Numbering: TFPTL10L1001FL2B

T	F	P	T	L	1	0	L	1	0	0	1	F	L	2	B

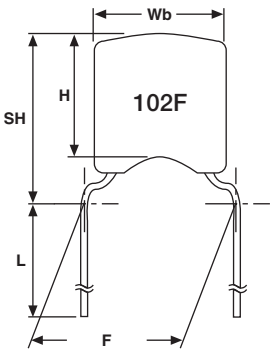
PRODUCT TYPE	SIZE	CHARACTERISTICS	RESISTANCE VALUE	TOLERANCE	LEAD CONFIGURATION	PACKAGING
TFPT Leaded	**10** **15**	**L** = Linear	**1000** = 100R **1001** = 1K **5001** = 5K	**F** = ± 1 % **J** = ± 5 %	**L2** **H5**	**B** = Bulk (500 pieces) **U** = Ammopack (2500 pieces) **T** = T/R (4000 pieces)

DIMENSIONS



L2

Component outline for
lead spacing 2.5 mm ± 0.8 mm
(straight leads)



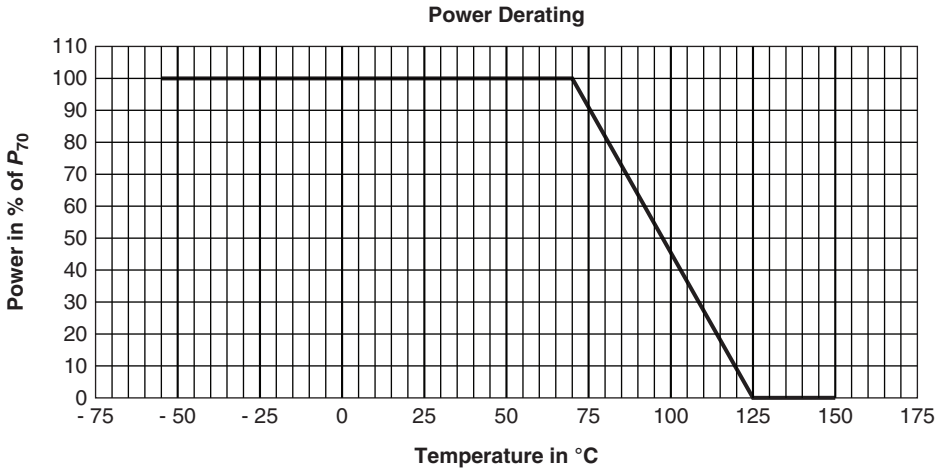
H5

Component outline for
lead spacing 5.0 mm ± 0.8 mm
(flat bent leads)

TFPTL DIMENSIONS in millimeters				
	SIZE L10		**SIZE L15**	
	L2	**H5**	**L2**	**H5**
$Wb_{max.}$	3.6		4.0	
$H_{max.}$	3.5		3.8	
$SH_{max.}$ (seating height)	5.0	6.2	5.2	6.5
d	0.5 ± 10 %			
L	25 min.			
F	2.5 ± 0.8	5.0 ± 0.8	2.5 ± 0.8	5.0 ± 0.8
$T_{max.}$	2.2		2.4	

Notes

- Bulk packed types have a standard lead length L = 25 mm minimum
- Thickness is defined as “T”



Note

- Zero power is considered as measuring power max. 1 % of rated power P_{70}

PERFORMANCE	
TEST	**MAXIMUM $\Delta R_{25}/R_{25}$ (1)**
Storage dry heat (5000 h at 125 °C)	± 0.25 %
High temperature exposure (1000 h at 150 °C)	± 0.3 %
Damp heat steady state, unloaded (1344 h at 40 °C/95 % RH)	± 0.2 %
Thermal cycling (15 min at -55 °C, 15 min at 150 °C, 100 cycles)	± 0.2 %
Thermal cycling (15 min at -55 °C, 15 min at 125 °C, 1000 cycles)	± 0.2 %
Short time overload (2.5 x P_{70} for 60s at 70 °C)	± 0.2 %
Long term dissipation (1000 h rated power at 70 °C)	± 0.2 %
Resistance to soldering heat (10 s at 260 °C)	± 0.25 %

Note

(1) TFPTs are ESD sensitive

AVERAGE RATIO R/R_{25} TFPTL ALL SIZES AND VALUES											
TEMP.	**R/R_{25}**	**TEMP.**	**R/R_{25}**	**TEMP.**	**R/R_{25}**	**TEMP.**	**R/R_{25}**	**TEMP.**	**R/R_{25}**	**TEMP.**	**R/R_{25}**
		-20	0.825	20	0.980	60	1.150	100	1.337	140	1.541
		-19	0.828	21	0.984	61	1.155	101	1.342	141	1.547
		-18	0.832	22	0.988	62	1.159	102	1.347	142	1.552
		-17	0.836	23	0.992	63	1.164	103	1.352	143	1.557
		-16	0.839	24	0.996	64	1.168	104	1.357	144	1.563
-55	0.702	-15	0.843	25	1.000	65	1.173	105	1.362	145	1.568
-54	0.705	-14	0.847	26	1.004	66	1.177	106	1.367	146	1.574
-53	0.708	-13	0.851	27	1.008	67	1.182	107	1.372	147	1.579
-52	0.712	-12	0.854	28	1.012	68	1.186	108	1.377	148	1.584
-51	0.715	-11	0.858	29	1.017	69	1.191	109	1.382	149	1.590
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-49	0.722	-9	0.866	31	1.025	71	1.200	111	1.392		
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-46	0.732	-6	0.877	34	1.037	74	1.214	114	1.407		
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-44	0.739	-4	0.885	36	1.046	76	1.223	116	1.417		
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-40	0.753	0	0.900	40	1.063	80	1.242	120	1.437		
-39	0.756	1	0.904	41	1.067	81	1.246	121	1.442		
-38	0.760	2	0.908	42	1.071	82	1.251	122	1.448		
-37	0.763	3	0.912	43	1.076	83	1.256	123	1.453		
-36	0.767	4	0.916	44	1.080	84	1.261	124	1.458		
-35	0.771	5	0.920	45	1.084	85	1.265	125	1.463		
-34	0.774	6	0.924	46	1.089	86	1.270	126	1.468		
-33	0.778	7	0.927	47	1.093	87	1.275	127	1.473		
-32	0.781	8	0.931	48	1.097	88	1.280	128	1.478		
-31	0.785	9	0.935	49	1.102	89	1.284	129	1.484		
-30	0.788	10	0.939	50	1.106	90	1.289	130	1.489		
-29	0.792	11	0.943	51	1.110	91	1.294	131	1.494		
-28	0.796	12	0.947	52	1.115	92	1.299	132	1.499		
-27	0.799	13	0.951	53	1.119	93	1.303	133	1.505		
-26	0.803	14	0.955	54	1.124	94	1.308	134	1.510		
-25	0.806	15	0.959	55	1.128	95	1.313	135	1.515		
-24	0.810	16	0.963	56	1.133	96	1.318	136	1.520		
-23	0.814	17	0.967	57	1.137	97	1.323	137	1.526		
-22	0.817	18	0.971	58	1.141	98	1.328	138	1.531		
-21	0.821	19	0.975	59	1.146	99	1.333	139	1.536		

RATIO FORMULA

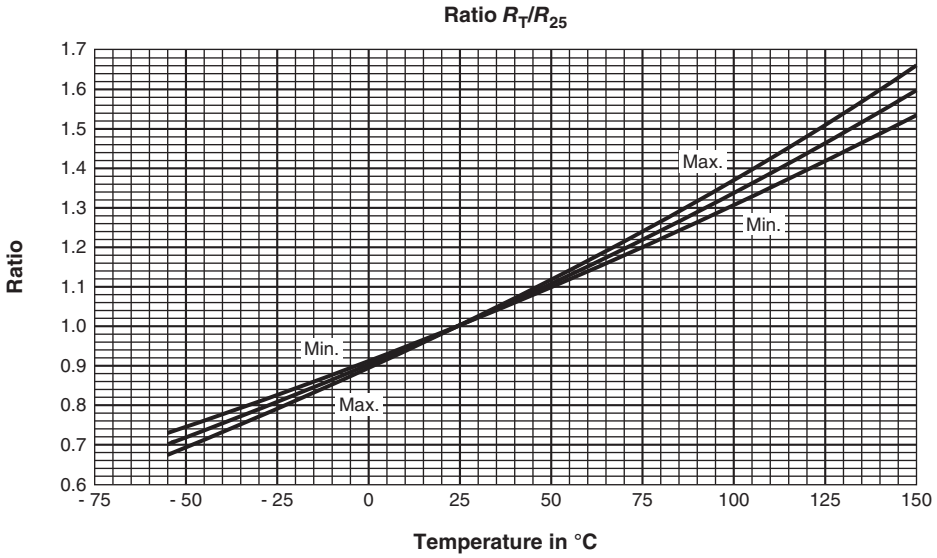
$R_T = R_{25}$ x (9.0014 x 10^{-1} + 3.87235 x 10^{-3} (°C)$^{-1}$ x T + 4.86825 x 10^{-6} (°C)$^{-2}$ x T^2 + 1.37559 x 10^{-9} (°C)$^{-3}$ x T^3)
$T_{(°C)}$ = 28.54 x $(R_T/R_{25})^3$ - 158.5 x $(R_T/R_{25})^2$ + 474.8 x (R_T/R_{25}) - 319.85)

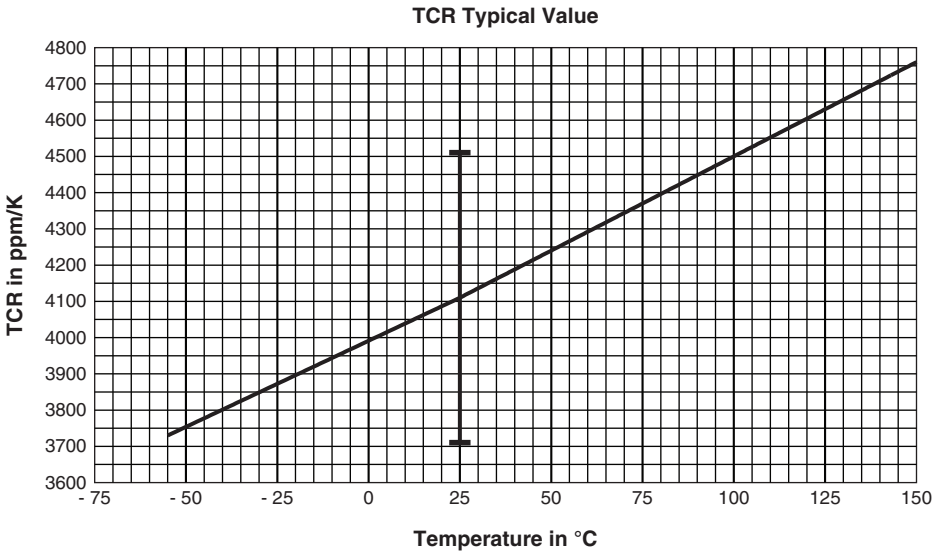
RATIO TOLERANCES		
LOW TEMP.	HIGH TEMP.	TOL.
-55 °C	+150 °C	± 4 %
-40 °C	+125 °C	± 3 %
-20 °C	+85 °C	± 2 %
0 °C	+55 °C	± 1 %
+12 °C	+40 °C	± 0.5 %

Ratio Tolerance Examples:

At 40 °C, ratio = 1.063 ± 0.5 % (0.005)
so, ratio = 1.058 to 1.068

At 125 °C, ratio = 1.460 ± 3 % (0.044)
so, ratio = 1.416 to 1.504





SENSORS - TEMPERATURE - NTC TEMPERATURE SENSORS

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCACAP Series for Refrigerator		NTC Thermistors, Refrigerator Sensors	10000	2	3984	0.5	-55 to +60
NTCACAP Series for Refrigerator		NTC Thermistors, Refrigerator Sensors	2700	2	3984	0.5	-55 to +60
NTCACAP Series for Refrigerator		NTC Thermistors, Refrigerator Sensors	5000	1	3984	0.5	-55 to +60
NTCAFLEX05 Series		NTC Thermistors, Flex Foil Sensors	10000	2	3435	1	-40 to +125
NTCAFLEX05 Series		NTC Thermistors, Flex Foil Sensors	10000	3	3960	1	-40 to +125
NTCAFLEX05 Series		NTC Thermistors, Flex Foil Sensors	47000	3	3960	1	-40 to +125
NTCAFLEX05 Series		NTC Thermistors, Flex Foil Sensors	122000	1	3590	1	-40 to +125
NTCAIMME3		NTC Thermistors, Miniature Immersion Sensor	10000	3	3984	0.5	-25 to +105
NTCAIMME3C90042		NTC Thermistors, Steel Capped Sensors	12000	4	3730	1.5	-25 to +110
NTCALUG01A Series		NTC Thermistors, Standard Lug Sensors	4700	3	3984	0.5	-40 to +150
NTCALUG01A Series		NTC Thermistors, Standard Lug Sensors	10000	1	3435	1	-40 to +150
NTCALUG01A Series		NTC Thermistors, Standard Lug Sensors	10000	1	3984	0.5	-40 to +150
NTCALUG01A Series		NTC Thermistors, Standard Lug Sensors	10000	2	3984	0.5	-40 to +150
NTCALUG01A Series		NTC Thermistors, Standard Lug Sensors	10000	3	3984	0.5	-40 to +150
NTCALUG01A Series		NTC Thermistors, Standard Lug Sensors	10000	5	3984	0.5	-40 to +150
NTCALUG01A Series		NTC Thermistors, Standard Lug Sensors	47000	3	4090	1.5	-40 to +150
NTCALUG01A Series		NTC Thermistors, Standard Lug Sensors	100000	1	4190	1.5	-40 to +150
NTCALUG01A Series		NTC Thermistors, Standard Lug Sensors	100000	2	4190	1.5	-40 to +150
NTCALUG01T		NTC Thermistors, Standard Lug Sensors, 150 °C	10000	1	3984	0.5	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCALUG01T		NTC Thermistors, Standard Lug Sensors, 150 °C	10000	1	3435	1	-40 to +150
NTCALUG01T		NTC Thermistors, Standard Lug Sensors, 150 °C	10000	2	3984	0.5	-40 to +150
NTCALUG02A Series		NTC Thermistors, Low Thermal Gradient Lug Sensors	4700	2	3984	0.5	-55 to +125
NTCALUG02A Series		NTC Thermistors, Low Thermal Gradient Lug Sensors	4700	1	3984	0.5	-55 to +125
NTCALUG02A Series		NTC Thermistors, Low Thermal Gradient Lug Sensors	5000	2	3984	0.5	-55 to +125
NTCALUG02A Series		NTC Thermistors, Low Thermal Gradient Lug Sensors	10000	2	3984	0.5	-55 to +125
NTCALUG02A Series		NTC Thermistors, Low Thermal Gradient Lug Sensors	10000	1	3984	0.5	-55 to +125
NTCALUG02A Series		NTC Thermistors, Low Thermal Gradient Lug Sensors	10000	1	3435	1	-55 to +125
NTCALUG02A Series		NTC Thermistors, Low Thermal Gradient Lug Sensors	100000	3	4190	1.5	-55 to +125
NTCALUG03A / LUG39A Mini Lug Series		NTC Thermistors, Mini Lug Sensors	10000	2	3984	0.5	-40 to +125
NTCALUG03A / LUG39A Mini Lug Series		NTC Thermistors, Mini Lug Sensors	10000	3	3984	0.5	-40 to +125
NTCALUG03A / LUG39A Mini Lug Series		NTC Thermistors, Mini Lug Sensors	12000	3	3740	1.5	-40 to +125
NTCALUG03A / LUG39A Mini Lug Series		NTC Thermistors, Mini Lug Sensors	47000	3	3740	1.5	-40 to +125
NTCALUG54A M5		NTC Thermistors, Standard Lug Sensors	10000	2	3984	0.5	-40 to +150
NTCALUG54A M5		NTC Thermistors, Standard Lug Sensors	10000	2	3435	1	-40 to +150
NTCALUG54A M5		NTC Thermistors, Standard Lug Sensors	10000	3	3984	0.5	-40 to +150
NTCALUG85A M6 Series		NTC Thermistors, Standard Lug Sensors	10000	2	3984	0.5	-40 to +150
NTCALUG85A M6 Series		NTC Thermistors, Standard Lug Sensors	10000	2	3435	1	-40 to +150
NTCALUG91A M4 Series		NTC Thermistors, Standard Lug Sensors	10000	2	3984	0.5	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCALUG91A M4 Series		NTC Thermistors, Standard Lug Sensors	10000	2	3435	1	-40 to +150
NTCALUG91A M4 Series		NTC Thermistors, Standard Lug Sensors	10000	3	3984	0.5	-40 to +150
NTCAPIPE3C9		NTC Thermistors, Special Long Lead Sensors	10000	3	3984	0.5	-40 to +105
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	1000	5	3528	0.5	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	2200	5	3977	0.75	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	4700	1	3977	0.75	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	4700	2	3977	0.75	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	4700	5	3977	0.75	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	10000	1	3977	0.75	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	10000	2	3977	0.75	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	10000	5	3977	0.75	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	12000	5	3740	1.5	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	15000	5	3740	1.5	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	47000	5	4090	1.5	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	100000	1	4190	1.5	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	100000	2	4190	1.5	-25 to +100

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	100000	5	4190	1.5	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	150000	5	4370	2.5	-25 to +100
NTCASCWE3		NTC Thermistors, Screw Threaded Sensors	470000	5	4570	2	-25 to +100
NTCASCWE3C70001		NTC Thermistors, Screw Threaded Insulated Leads Sensors	10000	2	3984	0.5	-40 to +125
NTCASRFE3C90406 Ice Cube Sensor		NTC Thermistors, Ice Cube Sensors	10000	1.92	3984	0.5	-55 to +50
NTCC100E4		Leadless NTC Thermistor Dies	2200	1	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	2200	2	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	2200	3	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	2200	5	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	2700	1	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	2700	2	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	2700	3	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	2700	5	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	3300	1	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	3300	2	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	3300	3	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	3300	5	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	4700	1	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	4700	2	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	4700	3	3977	0.75	-40 to +125

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCC100E4		Leadless NTC Thermistor Dies	4700	5	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	5000	1	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	5000	2	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	5000	3	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	5000	5	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	6000	1	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	6000	2	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	6000	3	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	6000	5	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	6800	1	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	6800	2	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	6800	3	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	6800	5	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	8000	1	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	8000	2	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	8000	3	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	8000	5	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	10000	1	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	10000	2	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	10000	3	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	10000	5	3977	0.75	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	12000	1	3740	2	-40 to +125

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCC100E4		Leadless NTC Thermistor Dies	12000	2	3740	2	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	12000	3	3740	2	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	12000	5	3740	2	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	15000	1	3740	2	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	15000	2	3740	2	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	15000	3	3740	2	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	15000	5	3740	2	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	22000	1	3740	2	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	22000	2	3740	2	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	22000	3	3740	2	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	22000	5	3740	2	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	33000	1	4090	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	33000	2	4090	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	33000	3	4090	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	33000	5	4090	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	47000	1	4090	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	47000	2	4090	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	47000	3	4090	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	47000	5	4090	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	68000	1	4190	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	68000	2	4190	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	68000	3	4190	1.5	-40 to +125

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCC100E4		Leadless NTC Thermistor Dies	68000	5	4190	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	100000	1	4190	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	100000	2	4190	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	100000	3	4190	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	100000	5	4190	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	150000	1	4370	2.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	150000	2	4370	2.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	150000	3	4370	2.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	150000	5	4370	2.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	220000	1	4370	2.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	220000	2	4370	2.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	220000	3	4370	2.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	220000	5	4370	2.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	330000	1	4570	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	330000	2	4570	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	330000	3	4570	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	330000	5	4570	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	470000	1	4570	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	470000	2	4570	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	470000	3	4570	1.5	-40 to +125
NTCC100E4		Leadless NTC Thermistor Dies	470000	5	4570	1.5	-40 to +125
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	4700	1	3435	1	-55 to +175

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	4700	2	3435	1	-55 to +175
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	4700	3	3435	1	-55 to +175
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	4700	5	3435	1	-55 to +175
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	12000	1	3740	1	-55 to +175
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	12000	2	3740	1	-55 to +175
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	12000	3	3740	1	-55 to +175
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	12000	5	3740	1	-55 to +175
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	20000	1	3865	1	-55 to +175
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	20000	2	3865	1	-55 to +175
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	20000	3	3865	1	-55 to +175
NTCC200E4, NTCC300E4		Leadless NTC Thermistor Die Suitable For Wire Bonding	20000	5	3865	1	-55 to +175
NTCC200E4C90008		Leadless NTC Thermistor Die Intended for Wire Bonding	5063	7.43	3435	1	-55 to +175
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	4700	1	3435	1	-55 to +175
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	4700	2	3435	1	-55 to +175
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	4700	3	3435	1	-55 to +175

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	4700	5	3435	1	-55 to +175
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	5000	1	3435	1	-55 to +175
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	5000	2	3435	1	-55 to +175
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	5000	3	3435	1	-55 to +175
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	5000	5	3435	1	-55 to +175
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	20000	1	3865	1	-55 to +175
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	20000	2	3865	1	-55 to +175
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	20000	3	3865	1	-55 to +175
NTCC201E4		Enhanced Leadless NTC Thermistor Die Suitable For Wire Bonding	20000	5	3865	1	-55 to +175
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	3.3	5	2880	3	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	4.7	5	2880	3	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	6.8	5	2880	3	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	10	5	2990	3	-40 to +125

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	15	5	3041	3	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	22	5	3136	3	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	33	5	3390	3	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	47	5	3390	3	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	68	5	3390	3	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	100	5	3560	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	150	5	3560	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	220	5	3560	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	330	5	3560	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	470	5	3560	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	680	5	3560	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	1000	2	3528	0.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	1000	3	3528	0.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	1000	5	3528	0.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	1500	2	3528	0.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	1500	3	3528	0.5	-40 to +125

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	1500	5	3528	0.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	2000	2	3528	0.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	2000	3	3528	0.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	2000	5	3528	0.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	2200	2	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	2200	3	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	2200	5	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	2700	2	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	2700	3	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	2700	5	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	3300	2	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	3300	3	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	3300	5	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	4700	2	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	4700	3	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	4700	5	3977	0.75	-40 to +125

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	5000	2	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	5000	3	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	5000	5	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	6800	2	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	6800	3	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	6800	5	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	10000	2	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	10000	3	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	10000	5	3977	0.75	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	12000	2	3740	2	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	12000	3	3740	2	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	12000	5	3740	2	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	15000	2	3740	2	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	15000	3	3740	2	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	15000	5	3740	2	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	22000	2	3740	2	-40 to +125

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	22000	3	3740	2	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	22000	5	3740	2	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	33000	2	4090	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	33000	3	4090	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	33000	5	4090	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	47000	2	4090	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	47000	3	4090	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	47000	5	4090	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	50000	2	4190	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	50000	3	4190	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	50000	5	4190	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	68000	2	4190	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	68000	3	4190	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	68000	5	4190	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	100000	2	4190	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	100000	3	4190	1.5	-40 to +125

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	100000	5	4190	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	150000	2	4370	2.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	150000	3	4370	2.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	150000	5	4370	2.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	220000	2	4370	2.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	220000	3	4370	2.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	220000	5	4370	2.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	330000	2	4570	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	330000	3	4570	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	330000	5	4570	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	470000	2	4570	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	470000	3	4570	1.5	-40 to +125
NTCLE100E3		NTC Thermistors, Radial Leaded, Standard Precision	470000	5	4570	1.5	-40 to +125
NTCLE101E3...SB0		NTC Thermistors, Radial Leaded Special Accuracy	4700	2.19	3977	0.75	-40 to +125
NTCLE101E3...SB0		NTC Thermistors, Radial Leaded Special Accuracy	10000	2.19	3977	0.75	-40 to +125
NTCLE101E3...SB0		NTC Thermistors, Radial Leaded Special Accuracy	47000	2.23	4090	1.5	-40 to +125

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLE101E3...SB0		NTC Thermistors, Radial Leaded Special Accuracy	100000	2.29	4190	1.5	-40 to +125
NTCLE101E3C90172, NTCLE101E3C90173		NTC Thermistors, Radial Leaded with Low B25/85 Values	5000	1	3324	1	-55 to +125
NTCLE101E3C90172, NTCLE101E3C90173		NTC Thermistors, Radial Leaded with Low B25/85 Values	10000	1	3435	1	-55 to +125
NTCLE201E3...SB, NTCLE300E3...SB		NTC Thermistors, 2-Point Mini Chip Sensor, Flexible Leads	3000	2.18	3977	0.75	-40 to +125
NTCLE201E3...SB, NTCLE300E3...SB		NTC Thermistors, 2-Point Mini Chip Sensor, Flexible Leads	5000	2.18	3977	0.75	-40 to +125
NTCLE201E3...SB, NTCLE300E3...SB		NTC Thermistors, 2-Point Mini Chip Sensor, Flexible Leads	10000	2.18	3977	0.75	-40 to +125
NTCLE201E3C90028		NTC Thermistors, Long Non-Insulated Leads	10000	5	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	2000	1	3528	0.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	2000	2	3528	0.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	2000	3	3528	0.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	2000	5	3528	0.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	2700	1	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	2700	2	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	2700	3	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	2700	5	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	4700	1	3977	0.75	-40 to +125

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	4700	2	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	4700	3	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	4700	5	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	5000	1	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	5000	2	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	5000	3	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	5000	5	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	10000	1	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	10000	2	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	10000	3	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	10000	5	3977	0.75	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	12000	1	3740	2	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	12000	2	3740	2	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	12000	3	3740	2	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	12000	5	3740	2	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	22000	1	3740	2	-40 to +125

Series	Product Image	Description	Resistance at 25 °C	R_{25} Tolerance	$B_{25/85}$	$B_{25/85}$ Tolerance	Operating Temperature Range
			(Ω)	(±%)	(K)	(±%)	(°C)
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	22000	2	3740	2	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	22000	3	3740	2	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	22000	5	3740	2	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	47000	1	4090	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	47000	2	4090	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	47000	3	4090	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	47000	5	4090	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	68000	1	4190	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	68000	2	4190	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	68000	3	4190	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	68000	5	4190	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	100000	1	4190	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	100000	2	4190	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	100000	3	4190	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	100000	5	4190	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	470000	1	4570	1.5	-40 to +125

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	470000	2	4570	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	470000	3	4570	1.5	-40 to +125
NTCLE203E3		NTC Thermistors, Radial Leaded, Accuracy Line	470000	5	4570	1.5	-40 to +125
NTCLE203E3...SB0		NTC Thermistors, 2-Point Radial Leaded, Automotive Grade	2060	1.93	3528	0.5	-55 to +150
NTCLE203E3...SB0		NTC Thermistors, 2-Point Radial Leaded, Automotive Grade	2252	2.2	3984	0.5	-55 to +150
NTCLE203E3...SB0		NTC Thermistors, 2-Point Radial Leaded, Automotive Grade	2780	2.2	4090	0.75	-55 to +150
NTCLE203E3...SB0		NTC Thermistors, 2-Point Radial Leaded, Automotive Grade	3000	2.2	3984	0.5	-55 to +150
NTCLE203E3...SB0		NTC Thermistors, 2-Point Radial Leaded, Automotive Grade	5000	2.2	3984	0.5	-55 to +150
NTCLE203E3...SB0		NTC Thermistors, 2-Point Radial Leaded, Automotive Grade	10000	2.2	3984	0.5	-55 to +150
NTCLE203E3...SB0		NTC Thermistors, 2-Point Radial Leaded, Automotive Grade	30000	2.2	3935	0.75	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	2100	1	3511	1	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	2100	2	3511	1	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	2100	3	3511	1	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	2100	5	3511	1	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	10000	1	3435	1	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	10000	2	3435	1	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	10000	3	3435	1	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	10000	5	3435	1	-55 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	10000	1	3984	0.5	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	10000	2	3984	0.5	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	10000	3	3984	0.5	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	10000	5	3984	0.5	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	12000	1	3740	1	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	12000	2	3740	1	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	12000	3	3740	1	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	12000	5	3740	1	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	30000	1	3935	0.75	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	30000	2	3935	0.75	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	30000	3	3935	0.75	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	30000	5	3935	0.75	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	100000	1	4190	1.5	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	100000	2	4190	1.5	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	100000	3	4190	1.5	-55 to +150
NTCLE213E3		NTC Thermistor, Epoxy Coated Mini Sensor	100000	5	4190	1.5	-55 to +150
NTCLE301E4C90059		NTC Thermistors, Long Insulated Leads	2765	2.93	3977	0.75	-40 to +125
NTCLE305E4...SB		NTC Thermistors, 2-Point Micro Chip Sensor Insulated Leads	2060	1.92	3511	1	-40 to +125
NTCLE305E4...SB		NTC Thermistors, 2-Point Micro Chip Sensor Insulated Leads	5000	2.19	3984	0.5	-40 to +125
NTCLE305E4...SB		NTC Thermistors, 2-Point Micro Chip Sensor Insulated Leads	10000	2.19	3984	0.5	-40 to +125
NTCLE317E4103SBA		NTC Thermistors, Long Insulated Leads 150 °C With Very Low Thermal	10000		3984	0.5	-55 to +150

Series	Product Image	Description	Resistance at 25 °C	R_{25} Tolerance	$B_{25/85}$	$B_{25/85}$ Tolerance	Operating Temperature Range
			(Ω)	(±%)	(K)	(±%)	(°C)
		Gradient					
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	2100	1	3511	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	2100	2	3511	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	2100	3	3511	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	2100	5	3511	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	5000	1	3435	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	5000	2	3435	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	5000	3	3435	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	5000	5	3435	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	10000	1	3984	0.5	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	10000	2	3984	0.5	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	10000	3	3984	0.5	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	10000	5	3984	0.5	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	10000	1	3435	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	10000	2	3435	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	10000	3	3435	1	-55 to +185

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	10000	5	3435	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	30000	1	3935	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	30000	2	3935	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	30000	3	3935	1	-55 to +185
NTCLE350E4		NTC Thermistors, Insulated Leads for 185 °C Applications	30000	5	3935	1	-55 to +185
NTCLE400		NTC Thermistors, Epoxy PVC Long Leads Sensors	2200	3	3977	0.75	-40 to +85
NTCLE400		NTC Thermistors, Epoxy PVC Long Leads Sensors	4700	3	3977	0.75	-40 to +85
NTCLE400		NTC Thermistors, Epoxy PVC Long Leads Sensors	5000	3	3977	0.75	-40 to +85
NTCLE400		NTC Thermistors, Epoxy PVC Long Leads Sensors	10000	3	3977	0.75	-40 to +85
NTCLE400		NTC Thermistors, Epoxy PVC Long Leads Sensors	47000	3	4090	1.5	-40 to +85
NTCLE400		NTC Thermistors, Epoxy PVC Long Leads Sensors	100000	3	4190	1.5	-40 to +85
NTCLE413		NTC Thermistors, Mini Epoxy PVC Twin Insulated Leads	4700	3	3984	0.5	-40 to +105
NTCLE413		NTC Thermistors, Mini Epoxy PVC Twin Insulated Leads	5000	3	3984	0.5	-40 to +105
NTCLE413		NTC Thermistors, Mini Epoxy PVC Twin Insulated Leads	10000	1	3435	1	-40 to +105
NTCLE413		NTC Thermistors, Mini Epoxy PVC Twin Insulated Leads	10000	5	3435	1	-40 to +105
NTCLE413		NTC Thermistors, Mini Epoxy PVC Twin Insulated Leads	10000	3	3984	0.5	-40 to +105

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLE413		NTC Thermistors, Mini Epoxy PVC Twin Insulated Leads	47000	3	4090	1.5	-40 to +105
NTCLE413		NTC Thermistors, Mini Epoxy PVC Twin Insulated Leads	100000	3	4190	1.5	-40 to +105
NTCLE428		NTC Thermistors, Mini Epoxy PVC Single Insulated Leads	4700	3	3984	0.5	-40 to +105
NTCLE428		NTC Thermistors, Mini Epoxy PVC Single Insulated Leads	5000	3	3984	0.5	-40 to +105
NTCLE428		NTC Thermistors, Mini Epoxy PVC Single Insulated Leads	10000	1	3435	1	-40 to +105
NTCLE428		NTC Thermistors, Mini Epoxy PVC Single Insulated Leads	10000	3	3984	0.5	-40 to +105
NTCLE428		NTC Thermistors, Mini Epoxy PVC Single Insulated Leads	47000	3	4090	1.5	-40 to +105
NTCLG100E2		NTC Thermistors, Glass Encapsulated High Temperature Sensors	10000	5	3977	1.3	-40 to +200
NTCLG100E2		NTC Thermistors, Glass Encapsulated High Temperature Sensors	20000	5	3977	1.3	-40 to +200
NTCLG100E2		NTC Thermistors, Glass Encapsulated High Temperature Sensors	30000	5	3977	1.3	-40 to +200
NTCLG100E2		NTC Thermistors, Glass Encapsulated High Temperature Sensors	100000	5	3977	1.3	-40 to +200
NTCLG100E2		NTC Thermistors, Glass Encapsulated High Temperature Sensors	220000	5	3797	3	-40 to +200
NTCLP100		NTC Thermistors, Pipe PVC Long Leads Sensors	2200	3	3977	0.75	-40 to +85
NTCLP100		NTC Thermistors, Pipe PVC Long Leads Sensors	4700	3	3977	0.75	-40 to +85
NTCLP100		NTC Thermistors, Pipe PVC Long Leads Sensors	5000	3	3977	0.75	-40 to +85
NTCLP100		NTC Thermistors, Pipe PVC Long Leads Sensors	10000	3	3977	0.75	-40 to +85

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCLP100		NTC Thermistors, Pipe PVC Long Leads Sensors	47000	3	4090	1.5	-40 to +85
NTCLP100		NTC Thermistors, Pipe PVC Long Leads Sensors	100000	3	4190	1.5	-40 to +85
NTCLP450E3		NTC Thermistor Sensors - Pipe Type with Fast Time Response	100000	3	4190	1.5	-40 to +105
NTCLS100		NTC Thermistors, Sleeved Long PVC Leads Sensors	2200	3	3977	0.75	-40 to +85
NTCLS100		NTC Thermistors, Sleeved Long PVC Leads Sensors	4700	3	3977	0.75	-40 to +85
NTCLS100		NTC Thermistors, Sleeved Long PVC Leads Sensors	5000	3	3977	0.75	-40 to +85
NTCLS100		NTC Thermistors, Sleeved Long PVC Leads Sensors	10000	3	3977	0.75	-40 to +85
NTCLS100		NTC Thermistors, Sleeved Long PVC Leads Sensors	47000	3	4090	1.5	-40 to +85
NTCLS100		NTC Thermistors, Sleeved Long PVC Leads Sensors	100000	3	4190	1.5	-40 to +85
NTCS....E3...SMT		SMD NTC Thermistors With Enhanced Stability	100000	1	3590	1	-40 to +125
NTCS....E3...SMT		SMD NTC Thermistors With Enhanced Stability	122000	1	3590	1	-40 to +125
NTCS....E3...SMT		SMD NTC Thermistors With Enhanced Stability	210000	1	3590	1	-40 to +125
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	4700	3	3595	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	4700	5	3595	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	10000	1	3490	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	10000	2	3490	3	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	10000	3	3490	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	10000	5	3490	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	10000	3	3950	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	10000	5	3950	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	15000	3	3965	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	15000	5	3965	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	22000	3	3590	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	22000	5	3590	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	33000	3	3670	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	33000	5	3670	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	47000	1	4075	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	47000	2	4075	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	47000	3	4075	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	47000	5	4075	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	68000	3	3910	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	68000	5	3910	3	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	100000	1	3950	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	100000	2	3950	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	100000	3	3950	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	100000	5	3950	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	470000	3	3807	3	-40 to +150
NTCS0402E3.....T		SMD 0402, Glass Protected NTC Thermistors	470000	5	3807	3	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	1000	3	3170	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	1000	5	3170	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	1500	3	3280	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	1500	5	3280	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2000	1	3420	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2000	2	3420	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2000	3	3420	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2000	5	3420	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2200	1	3520	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2200	2	3520	1	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2200	3	3520	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2200	5	3520	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2700	1	3600	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2700	2	3600	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2700	3	3600	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	2700	5	3600	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	4700	1	3830	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	4700	2	3830	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	4700	3	3830	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	4700	5	3830	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	5000	1	3480	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	5000	2	3480	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	5000	3	3480	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	5000	5	3480	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	1	3435	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	2	3435	1	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	3	3435	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	5	3435	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	1	3610	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	2	3610	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	3	3610	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	5	3610	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	1	3960	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	2	3960	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	3	3960	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	10000	5	3960	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	15000	1	3600	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	15000	2	3600	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	15000	3	3600	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	15000	5	3600	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	22000	1	3730	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	22000	2	3730	1	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	22000	3	3730	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	22000	5	3730	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	33000	1	3860	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	33000	2	3860	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	33000	3	3860	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	33000	5	3860	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	47000	1	3960	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	47000	2	3960	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	47000	3	3960	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	47000	5	3960	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	68000	1	3985	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	68000	2	3985	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	68000	3	3985	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	68000	5	3985	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	100000	1	4100	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	100000	2	4100	1	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	100000	3	4100	1	-40 to +150
NTCS0603E3.....T		SMD 0603, Glass Protected NTC Thermistors	100000	5	4100	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	1000	3	3370	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	1000	5	3370	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	1500	3	3420	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	1500	5	3420	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	2200	1	3600	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	2200	2	3600	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	2200	3	3600	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	2200	5	3600	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	4700	1	3500	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	4700	2	3500	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	4700	3	3500	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	4700	5	3500	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	5000	1	3480	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	5000	2	3480	1	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	5000	3	3480	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	5000	5	3480	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	1	3430	3	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	2	3430	3	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	3	3430	3	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	5	3430	3	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	1	3570	3	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	2	3570	3	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	3	3570	3	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	5	3570	3	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	1	3940	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	2	3940	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	3	3940	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	10000	5	3940	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	15000	1	3700	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	15000	2	3700	1	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	15000	3	3700	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	15000	5	3700	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	22000	1	3800	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	22000	2	3800	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	22000	3	3800	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	22000	5	3800	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	33000	1	3920	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	33000	2	3920	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	33000	3	3920	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	33000	5	3920	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	47000	1	3960	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	47000	2	3960	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	47000	3	3960	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	47000	5	3960	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	68000	1	4100	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	68000	2	4100	1	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	68000	3	4100	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	68000	5	4100	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	100000	1	3590	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	100000	2	3590	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	100000	3	3590	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	100000	5	3590	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	100000	1	4100	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	100000	2	4100	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	100000	3	4100	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	100000	5	4100	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	330000	1	3930	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	330000	2	3930	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	330000	3	3930	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	330000	5	3930	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	470000	1	4025	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	470000	2	4025	1	-40 to +150

Series	Product Image	Description	Resistance at 25 °C (Ω)	R_{25} Tolerance (±%)	$B_{25/85}$ (K)	$B_{25/85}$ Tolerance (±%)	Operating Temperature Range (°C)
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	470000	3	4025	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	470000	5	4025	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	680000	1	4125	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	680000	2	4125	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	680000	3	4125	1	-40 to +150
NTCS0805E3.....T		SMD 0805, Glass Protected NTC Thermistors	680000	5	4125	1	-40 to +150
NTCSMELFE3		SMD MELF SOD80, Glass Encapsulated NTC Thermistors	10000	5	3977	1.3	-40 to +150
NTCSMELFE3		SMD MELF SOD80, Glass Encapsulated NTC Thermistors	20000	5	3977	1.3	-40 to +150
NTCSMELFE3		SMD MELF SOD80, Glass Encapsulated NTC Thermistors	30000	5	3977	1.3	-40 to +150
NTCSMELFE3		SMD MELF SOD80, Glass Encapsulated NTC Thermistors	100000	5	3977	1.3	-40 to +150
NTHS Series		NTC Thermistors, SMD 0402, 0603, 0805, 1206 Chip					-40 to +150
T, M, C		NTC Thermistors, Radial Leaded and Coated					-40 to +150

PTC Thermistors, Mini Radial Leaded for Over-Temperature Protection

FEATURES

- Well-defined protection temperature levels
- Fast response time
- Accurate resistance for ease of circuit design
- Excellent long term behavior ($\Delta T \leq 1$ °C after 1000 h at T_n + 15 °C)
- Wide range of protection temperatures (80 °C to 150 °C)
- Small size and rugged
- Coated leaded (bare pellets available)
- AEC-Q200 qualified

RoHS COMPLIANT

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance at 25 °C (R_{25})	20 to 120	Ω
Nominal working temperature T_n	80 to 150	°C
Maximum voltage	30	V
Operating temperature range (1)	-40 to +165	°C
Dissipation factor	5	mW/K
Thermal time constant (still air)	6	s
Weight	≈ 0.12	g

Note

(1) Max operating temperature range is T_n +15 °C, indicated value is for T_n = 150 °C

APPLICATIONS

Over-temperature protection and control in:

- Industrial electronics, motor drives, and lighting drivers
- Power supplies, converters, and heat-sink
- Motor protection

DESCRIPTION

These PTC sensing thermistors consist of a medium resistivity doped barium titanate ceramic with copper clad steel wires lead (Pb)-free soldered to the Ag metalized pellet. A high temperature silicone coating covers the sensing body and has a temperature marking character.

PACKAGING

PTC thermistors are available in 500 pieces bulk packed or 2000 pieces tape on reel.

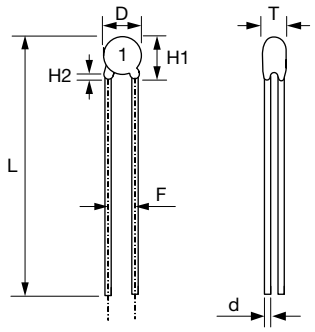
NOMINAL WORKING TEMPERATURES AND ORDERING INFORMATION			
NOMINAL WORKING TEMPERATURE	VISHAY SAP ORDERING NUMBER		
T_n (°C)	BULK	TAPE AND REEL	MARKING CODE
80	PTCSL03T081DB1E	PTCSL03T081DT1E	8
90	PTCSL03T091DB1E	PTCSL03T091DT1E	9
100	PTCSL03T101DB1E	PTCSL03T101DT1E	0
110	PTCSL03T111DB1E	PTCSL03T111DT1E	1
120	PTCSL03T121DB1E	PTCSL03T121DT1E	2
130	PTCSL03T131DB1E	PTCSL03T131DT1E	3
140	PTCSL03T141DB1E	PTCSL03T141DT1E	4
150	PTCSL03T151DB1E	PTCSL03T151DT1E	5

Note

- 2E pitch version in bulk or tape and reel available on request

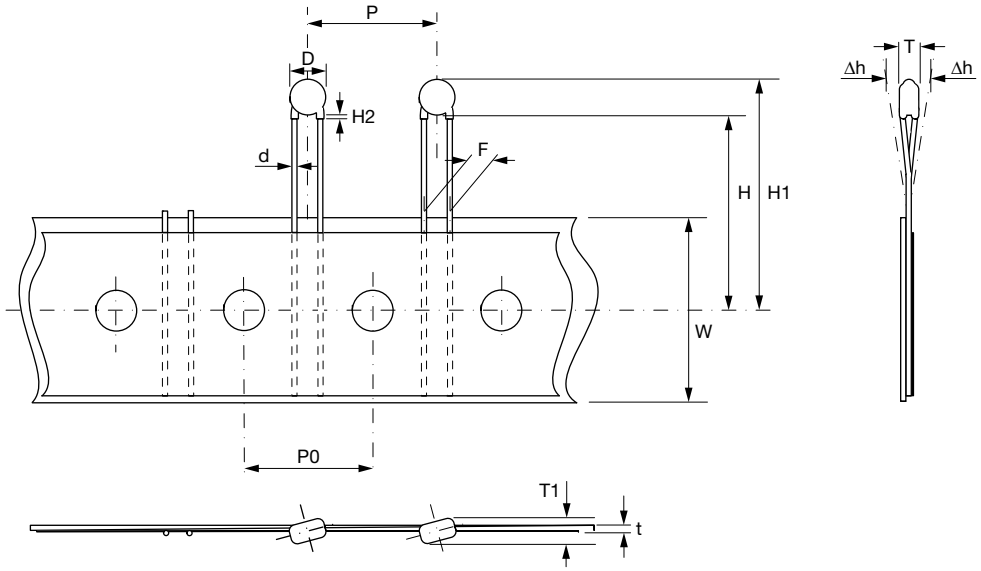
ELECTRICAL CHARACTERISTICS		
PARAMETER	**VALUES**	**UNIT**
Resistance at 25 °C	20 to 120	Ω
Maximum resistance between -20 °C and (T_n - 20) °C	250	Ω
Maximum resistance at -40 °C	300	Ω
Maximum resistance at (T_n - 5) °C	550	Ω
Minimum resistance at (T_n + 5) °C	1330	Ω
Minimum resistance at (T_n + 15) °C	4000	Ω
Maximum voltage	30	V (AC or DC)

DIMENSIONS in millimeters



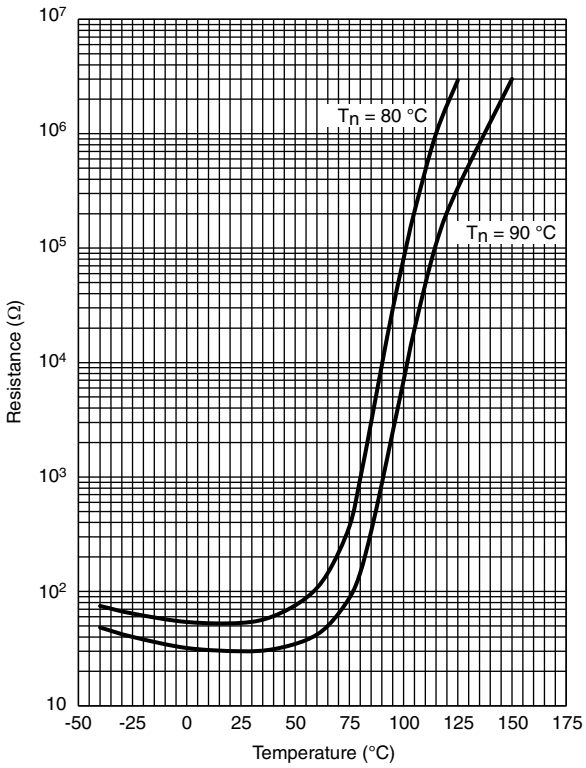
COMPONENT DIMENSIONS in millimeters	
D	3.3 ± 0.4
H1	4.7 ± 1.5
H2	1.5 ± 1.0
d	0.5 ± 0.05
L	30 ± 3
F	2.5 + 1.0 / -0.5
T	2.1 ± 0.3

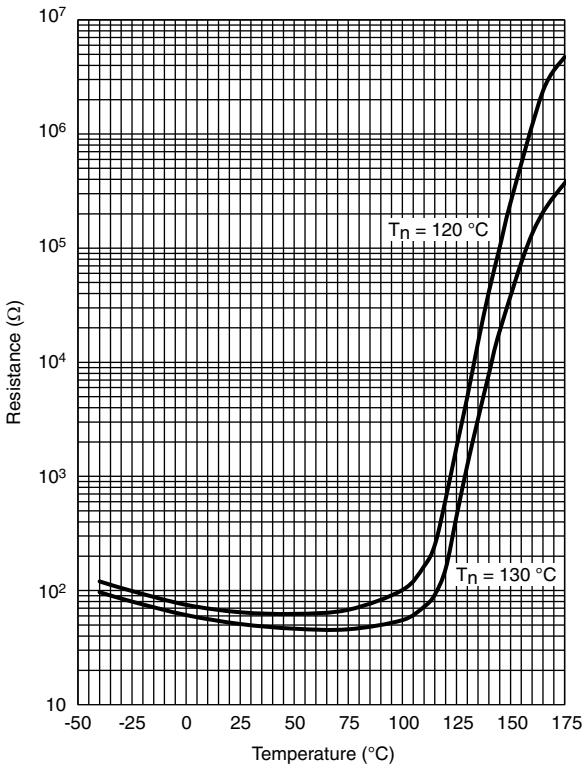
TAPING DATA DIMENSIONS in millimeters (based on IEC 60286-2)		
D	Body diameter	3.3 ± 0.4
d	Lead diameter	0.5 ± 0.05
F	Lead to lead center distance	2.5 + 0.5 / - 0.2
H	Component seating plane to tape-center	18.0 + 2.0
H1	Component top to tape-center	25 max.
Δh	Component alignment	0 ± 2
P	Component pitch	12.7
T	Total thickness	2.1 ± 0.3
T1	Total thickness in line of tape	3.5 max.
t	Total tape thickness	0.9 max.

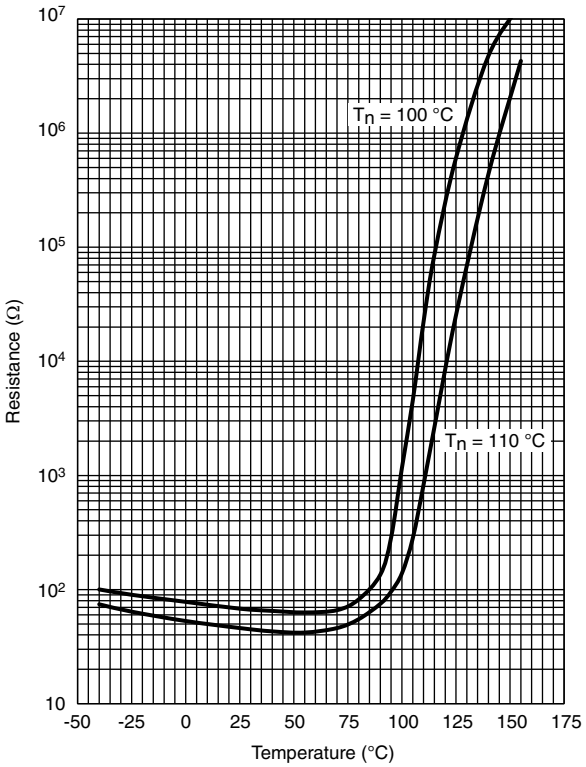


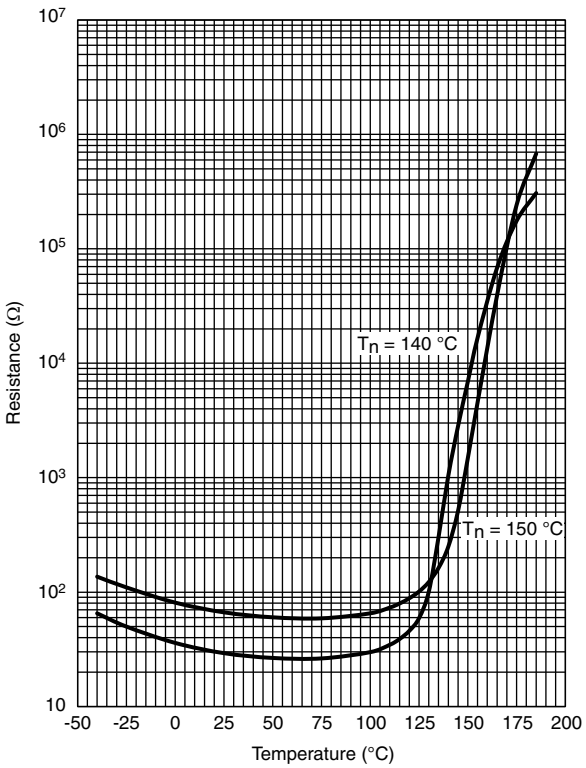
RESISTANCE VS. TEMPERATURE

Typical (≤ 5 V_{DC})









NTC Thermistors, Flex Foil Sensors

FEATURES

- Rapid response time on surface down to 2 s
- Suitable for narrow space applications
- High flexibility of the foil
- Insulated and humidity resistant
- A strain relief hole is included in the flex design to avoid traction to the sensor head
- Gold plated terminations
- AEC-Q200 qualified

RoHS COMPLIANT

APPLICATIONS

- Consumer appliances and white goods
- Power supply (heat-sinks)
- Battery, displays, LED
- Industrial applications, robotics
- Boilers
- EV and HV batteries

DESCRIPTION

- Miniature NTC thermistor body mounted on an insulated flex foil and topped with an insulating epoxy glob top
- For flat surface temperature sensing with low thermal mass and rapid response time

MOUNTING

- The stiff flat sensing area can be pressed against a flat surface by means of insulating material (silicone foam), by spring force or by taping it with a double sided temperature resistant adhesive
- The sensor contacts can be connected to a PCB counter-connector or wire-to-wire connector or soldered to conductors, or crimped with FFC connectors and ZiF connectors
- A mating connector can be for example a 0.5 mm pitch 7 poles connector for FPC, with top contacts, accepting 4 mm FPC width, ZIF or non-ZIF versions. The poles (1 + 2) and (6 + 7) can be used for the electrical connection. For example in SMT versions: TE 1734839-7, Molex 054550-0771, Molex 052745-0797
- Consult Vishay for other screw sizes, lead length, insulation, connector crimping or other features

Note

- FFC/FPC = Flexible Film Circuit/Flexible Printed Circuit

QUICK REFERENCE DATA

PARAMETER	VALUE	UNIT
Resistance value at 25 °C	10K to 122K	Ω
Tolerance on R_{25}-value	± 1; ± 2; ± 3	%
$B_{25/85}$-value	3435 to 3960	K
Tolerance on $B_{25/85}$-value	± 1	%
Operating temperature range at zero power	-40 to +125	°C
Thermal time constant by heating (1) (3)	2	s
Thermal gradient (3)	< 0.02	K/K
Minimum dielectric withstanding voltage (2)	500	V_{AC}
Minimum insulation resistance	10	MΩ
Maximum dissipation at 25 °C	60	mW
Weight (without connector)	0.06	g

Notes

(1) Measured from 25 °C air to 125 °C heated plate, pressed on the surface

(2) Withstanding voltage up to 4 kV_{AC} between the NTC and the bottom stiffener

(3) Thermal time constant and thermal gradient are dependent on the way of mounting

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$ -TOL (± %)	DESCRIPTION	SAP MATERIAL AND ORDERING NUMBER
10 000	2	3435	1	NTC Flex05 10K 2 % 3435K 25 mm	NTCAFLEX05103GL
10 000	3	3960	1	NTC Flex05 10K 3 % 3960K 25 mm	NTCAFLEX05103HH
47 000	3	3960	1	NTC Flex05 47K 3 % 3960K 25 mm	NTCAFLEX05473HH
122 000	1	3590	1	NTC Flex05 122K 1 % 3590 K 25 mm	NTCAFLEX05124FM

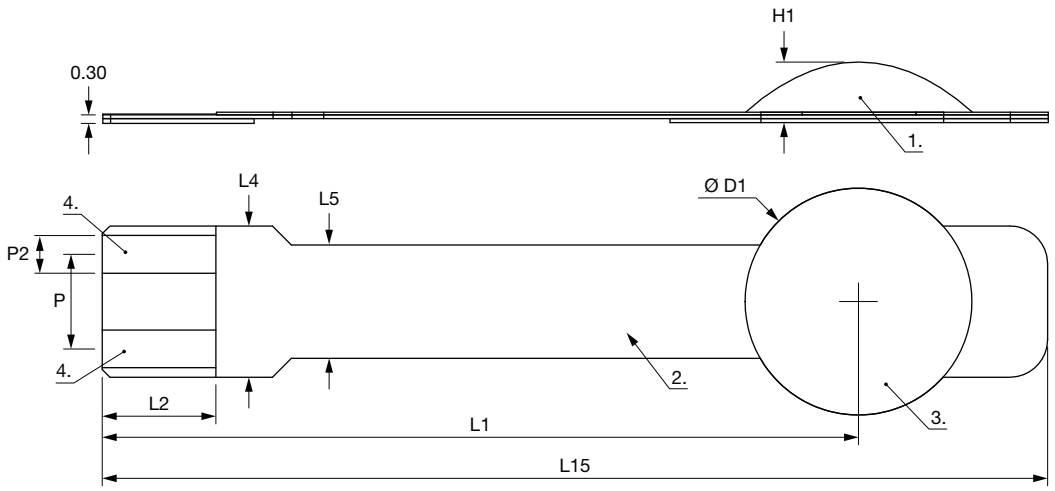
SAP CODIFICATION

Part Number: NTCAFLEX05473HH

N	T	C	A	F	L	E	X	0	5	4	7	3	H	H	

MODEL	ASSEMBLY	FLEX SENSOR	MECHANICAL EXECUTION	RESISTANCE VALUE	TOLERANCE ON R_{25}	B-VALUE RANGE	OPTION
NTC	**A**	**FLEX**	**05**	**103** = 10 x 10^3 Ω **473** = 47 x 10^3 Ω **124** = 12.2 x 10^4 Ω	**F** = ± 1 % **G** = ± 2 % **H** = ± 3 %	**L** (low) = 3000 ≤ $B_{25/85}$ < 3500 **M** (medium) = 3500 ≤ $B_{25/85}$ < 3750 **H** (high) = 3750 ≤ $B_{25/85}$ < 4000 **X** (very high) = 4000 ≤ $B_{25/85}$ < 4250	**Blank**

MECHANICAL DATA



DIMENSIONS in millimeters								
L1	**L15**	**L2**	**Ø D1**	**L4**	**L5**	**H1**	**P**	**P2**
20 ± 1	25 ± 1	3 ± 0.5	6 ± 0.5	4 ± 1	3 ± 1	1.40 ± 0.2	2.50	1

1. NTC on flex foil circuit, sensing area on the flat bottom side
2. Flex foil circuit
3. High quality modified epoxy glob top
4. Conductive tracks, gold plated

RELIABILITY TEST (following IEC 60068 test methods)		
TEST	**PROCEDURE**	**REQUIREMENT**
Dry heat, steady state	125 °C; 1000 h	$\Delta R/R \leq 3$ %
Damp heat, steady state	56 days at 40 °C 90 % to 95 % RH	$\Delta R/R \leq 3$ %
Rapid change of temperature	-40 °C to +125 °C; 100 cycles	$\Delta R/R \leq 3$ %

NTC Thermistors, Standard Lug Sensors

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | SPICE Models | Related Documents

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C (1)	4.7K to 100K	Ω
Tolerance on R_{25}-value (1)	± 1 to ± 5	%
$B_{25/85}$-value (1)	3435 to 4190	K
Tolerance on $B_{25/85}$-value	± 0.5 to ± 1.5	%
Operating temperature range at: Zero dissipation	-40 to +150	°C
Dissipation factor (2)	≈ 23	mW/K
Thermal time constant (2)	≈ 7.5	s
Min. dielectric withstanding voltage between terminals and lug	1500	V_{AC}
Min. insulation resistance between terminals and lug at 500 V_{DC}	100	MΩ
Climatic category (LCT / UCT / days)	40 / 150 / 56	
Weight	1.5 to 2.3	g

Notes

(1) Other R_{25}-values, $B_{25/85}$-values, and tolerances are available upon request

(2) Measured with screw mounted on an aluminum heatsink of 100 cm^2, thickness 1.5 mm, in still air at T_{amb} = +25 °C

AGENCY APPROVALS

- cUL certificate XGPU8.E148885
- ULus certificate XGPU2.E148885

FEATURES

- Easy mounting using ring tongue terminal
- Rugged construction
- Cable of PTFE insulation according to NEMA HP-3, type E, rated 600 V_{RMS} (1), cable test voltage 3.4 kV
- AEC-Q200 qualified (grade 1)
- cULus recognized, file E148885 (UL category XGPU2/XGPU8)

Pb-free Available

RoHS COMPLIANT

Note

(1) Formerly MIL-W-16878/4, type E

APPLICATIONS

Suitable for surface sensing applications, especially when a good electrical insulation and a good thermal contact with the chassis is required.

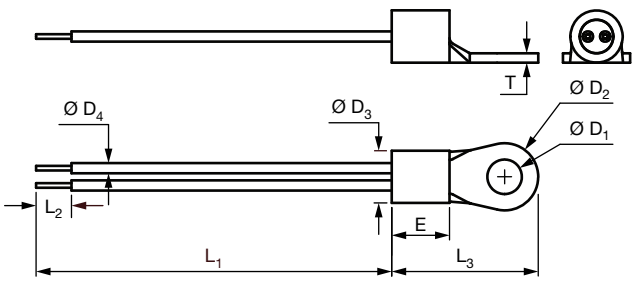
DESCRIPTION

A NTC thermistor chip is soldered to AWG#24 stranded silver plated copper leads with PTFE insulation and insulated with epoxy coating. The insulated sensor is attached to a tin plated copper ring lug. The lead wires are stripped, twisted and dipped in a tin-silver solder alloy.

PACKAGING

The thermistors are packed in cardboard boxes; the smallest packaging quantity is 500 units.

DIMENSIONS in millimeters



L_1	L_2	Ø D_1	Ø D_2	Ø D_3	T	L_3	E	D_4
Refer to the ordering table	3.8 ± 1	3.7 + 0.2 / - 0	7.2 ± 0.2	5.6 + 0.3 / - 0.2	1.0	15.70 ± 0.3	6.2 ± 0.2	1.12 ± 0.1

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25} TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$ TOL. (± %)	L_1 (mm)	DESCRIPTION	UL RECOG.	SAP MATERIAL AND ORDERING NUMBER	
							RoHS-COMPLIANT WITH EXEMPTION (1)	RoHS-COMPLIANT
4700	3	3984	0.5	38.1 ± 3.8	NTC Lug01 4.7K 3 % 3984K PTFE AWG#24 38 mm		NTCALUG01A472H	NTCALUG01A472HA
10 000	1	3435	1	38.1 ± 3.8	NTC Lug01 10K 1 % 3435K PTFE AWG#24 38 mm	✓	NTCALUG01A103FL	NTCALUG01A103FLA
10 000	1	3984	0.5	38.1 ± 3.8	NTC Lug01 10K 1 % 3984K PTFE AWG#24 38 mm	✓	NTCALUG01A103F	NTCALUG01A103FA
10 000	1	3984	0.5	80 ± 5	NTC Lug01 10K 1 % 3984K PTFE AWG#24 80 mm	✓	NTCALUG01A103F800	NTCALUG01A103F800A
10 000	1	3435	1	80 ± 5	NTC Lug01 10K 1 % 3435K PTFE AWG#24 80 mm	✓	NTCALUG01A103F800L	NTCALUG01A103F804A
10 000	1	3984	0.5	160 + 10 / - 5	NTC Lug01 10K 1 % 3984K PTFE AWG#24 160 mm	✓	NTCALUG01A103F161	NTCALUG01A103F161A
10 000	1	3435	1	160 + 10 / - 5	NTC Lug01 10K 1 % 3435K PTFE AWG#24 160 mm	✓	NTCALUG01A103F161L	NTCALUG01A103F165A
10 000	2	3984	0.5	38.1 ± 3.8	NTC Lug01 10K 2 % 3984K PTFE AWG#24 38 mm	✓	NTCALUG01A103G	NTCALUG01A103GA
10 000	3	3984	0.5	38.1 ± 3.8	NTC Lug01 10K 3 % 3984K PTFE AWG#24 38 mm	✓	NTCALUG01A103H	NTCALUG01A103HA
10 000	5	3984	0.5	38.1 ± 3.8	NTC Lug01 10K 5 % 3984K PTFE AWG#24 38 mm	✓	NTCALUG01A103J (2)	NTCALUG01A103JA
47 000	3	4090	1.5	38.1 ± 3.8	NTC Lug01 47K 3 % 4090K PTFE AWG#24 38 mm		NTCALUG01A473H	NTCALUG01A473HA
100 000	1	4190	1.5	38.1 ± 3.8	NTC Lug01 100K 1 % 4190K PTFE AWG#24 38 mm		NTCALUG01A104F	NTCALUG01A104FA
100 000	2	4190	1.5	38.1 ± 3.8	NTC Lug01 100K 2 % 4190K PTFE AWG#24 38 mm		NTCALUG01A104G	NTCALUG01A104GA

Notes

Preferred versions for new designs

(1) RoHS exemption 7(c)-I: electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezo-electronic devices, or in a glass or ceramic matrix compound

(2) NTCALUG01A103J identical to NTCALUGE2C90169 = 2381 645 90169

NTC Thermistors, Standard Lug Sensors, 150 °C

FEATURES

- **150 °C long term stability** (5000 h dry heat)
- Easy mounting using ring tongue terminal
- Rugged construction
- Cable with ETFE insulation according to NEMA HP-3, type Z, rated 600 V_{RMS}, cable test voltage **3.4 kV**
- AEC-Q200 qualified (grade 1)
- cULus recognized, file E148885 (UL category XGPU2/XGPU8)

Pb-free Available

RoHS COMPLIANT

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | SPICE Models | Related Documents

QUICK REFERENCE DATA		
PARAMETER	**VALUE**	**UNIT**
Resistance value at 25 °C (1)	10K	Ω
Tolerance on R_{25}-value (1)	± 1 to ± 2	%
$B_{25/85}$-value (1)	3435, 3984	K
Tolerance on $B_{25/85}$-value	± 0.5 to ± 1	%
Operating temperature range at zero dissipation	-40 to +150	°C
Min. dielectric withstanding voltage between terminals and lug	2700	V_{AC}
Min. insulation resistance between terminals and lug at 500 V_{DC}	100	MΩ
Weight	2.0 to 3.2	g

Note

(1) Other R_{25}-values, $B_{25/85}$-values, and tolerances are available upon request

AGENCY APPROVALS

- cUL certificate XGPU8.E148885
- ULus certificate XGPU2.E148885

APPLICATIONS

Suitable for surface sensing applications, especially when a good electrical insulation and a good thermal contact with the chassis is required for:

- Automotive equipment
- EV and battery management
- Power electronics, heat sink
- Consumer appliances

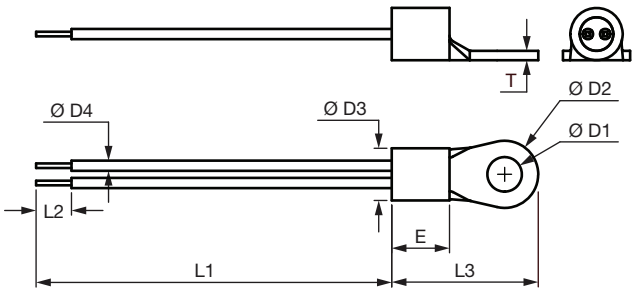
DESCRIPTION

A NTC thermistor chip is soldered to AWG#26 multi-stranded silver plated copper leads with ETFE insulation and insulated with epoxy coating. The insulated sensor is attached to a tin plated copper ring lug via a middle buffer layer. The lead wires are twisted.

PACKAGING

The thermistors are packed in cardboard boxes; the smallest packaging quantity is 200 units.

DIMENSIONS in millimeters



L_1	L_2	Ø D_1	Ø D_2	Ø D_3	T	L_3	E	D_4
Refer to the ordering table	3.8 ± 1	3.7 +0.2 / -0	7.2 ± 0.2	5.6 +0.3 / -0.2	1.0	15.70 ± 0.3	6.2 ± 0.2	0.93 ± 0.1

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	L_1 (mm)	DESCRIPTION	UL RECOG.	SAP MATERIAL AND ORDERING NUMBER	
							RoHS-COMPLIANT WITH EXEMPTION (1)	RoHS-COMPLIANT (2)
10 000	1	3984	0.5	150 ± 10	NTC Lug01T 10K 1 % 3984 K 150 °C ETFE AWG26 150 mm	✓	NTCALUG01T103F	NTCALUG01T103FA
10 000	1	3435	1.0	150 ± 10	NTC Lug01T 10K 1 % 3435 K 150 °C ETFE AWG26 150 mm	✓	NTCALUG01T103FL	NTCALUG01T103FLA
10 000	2	3984	0.5	40 ± 5	NTC Lug01T 10K 2 % 3984 K 150 °C ETFE AWG26 40 mm	✓	NTCALUG01T103G400	NTCALUG01T103G400A
10 000	2	3984	0.5	150 ± 10	NTC Lug01T 10K 2 % 3984 K 150 °C ETFE AWG26 150 mm	✓	**NTCALUG01T103G**	**NTCALUG01T103GA**
10 000	2	3984	0.5	200 ± 10	NTC Lug01T 10K 2 % 3984 K 150 °C ETFE AWG26 200 mm	✓	NTCALUG01T103G201	NTCALUG01T103G201A
10 000	2	3984	0.5	500 ± 10	NTC Lug01T 10K 2 % 3984 K 150 °C ETFE AWG26 500 mm	✓	NTCALUG01T103G501	NTCALUG01T103G501A

Notes

Preferred versions for new designs

(1) RoHS exemption 7(c)-I: electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezo-electronic devices, or in a glass or ceramic matrix compound.
(e2) The end conductor is dipped in tin-silver alloy solder

(2) RoHS I, RoHS II, RoHS III, without exemption, and lead (Pb)-free.
(e4) The end conductor is multistranded silver plated copper

NTC Thermistors, Low Thermal Gradient Lug Sensors

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | SPICE Models | Related Documents

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C (1)	4.7K to 100K	Ω
Tolerance on R_{25}-value (1)	± 1; ± 2; ± 3	%
$B_{25/85}$ value (1)	3435 to 4190	K
Tolerance on $B_{25/85}$-value	± 0.5; ± 1.0; ± 1.5	%
Operating temperature range at zero power	-55 to +125	°C
Thermal time constant τ	≈ 5	s
Dissipation factor	10	mW/K
Thermal gradient (2)	< 0.05	K/K
Min. dielectric withstanding voltage between terminals and lug	1500	V_{AC}
Min. insulation resistance between terminals and lug at 500 V_{DC}	100	MΩ
Climatic category (LCT / UCT / days)	55 / 125 / 56	
Weight	≈ 1.0	g

Notes

(1) Other R_{25}-values, $B_{25/85}$-values, and tolerances are available upon request

(2) The thermal gradient is the difference per °C between the true temperature of the surface to be sensed and the temperature measured by the sensor

AGENCY APPROVALS

- cUL certificate XGPU8.E148885
- ULus certificate XGPU2.E148885

FEATURES

- Low thermal gradient due to the use of nickel conductor and low profile closed ring tongue
- AEC-Q200 qualified (grade 1)
- cULus recognized, file E148885 (UL category XGPU2/XGPU8)
- Mounting: assembly screw mounting

Pb-free Available

RoHS COMPLIANT

APPLICATIONS

Thermistors used for accurate surface temperature sensing and control in:

- Computer equipment
- Power electronics, heat-sink temperature control
- Consumer appliances
- Industrial equipment
- Automotive equipment

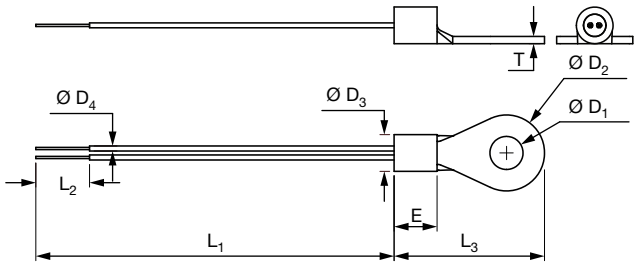
DESCRIPTION

Vishay thermistor chip NTC with epoxy coating and middle buffer layer mounted in a tin plated copper ring lug with PEEK insulated leads AWG#30 (Ø 0.25 mm), mono-stranded silver-plated nickel.

PACKAGING

The thermistors are packed in cardboard boxes; the smallest packaging quantity is 500 units.

DIMENSIONS in millimeters



L_1	L_2	L_3	Ø D_1	Ø D_2	Ø D_3	Ø D_4	E	T
Refer to the ordering table	6 ± 1	16.8 ± 0.3	3.7 + 0.2 / - 0	8.5 ± 0.2	4.1 + 0.4 / - 0.1	0.56 ± 0.1	4.8 ± 0.2	0.8

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	L_1 (mm)	UL RECOG. c UL us	SAP MATERIAL AND ORDERING NUMBER	
						RoHS-COMPLIANT WITH EXEMPTION (1)	RoHS-COMPLIANT
4700	2	3984	0.5	45 ± 3		NTCALUG02A472G	NTCALUG02A472GA
4700	1	3984	0.5	45 ± 3		NTCALUG02A472F	NTCALUG02A472FA
5000	2	3984	0.5	45 ± 3	✓	**NTCALUG02A502G**	**NTCALUG02A502GA**
10 000	2	3984	0.5	45 ± 3	✓	**NTCALUG02A103G (2)**	**NTCALUG02A103GA**
10 000	1	3984	0.5	45 ± 3	✓	NTCALUG02A103F	NTCALUG02A103FA
10 000	1	3984	0.5	80 +5 / -3	✓	NTCALUG02A103F800	NTCALUG02A103F800A
10 000	1	3984	0.5	160 +5 / -3	✓	NTCALUG02A103F161	NTCALUG02A103F161A
10 000	1	3435	1.0	45 ± 3	✓	NTCALUG02A103FL	NTCALUG02A103FLA
10 000	1	3435	1.0	80 +5 / -3	✓	NTCALUG02A103F800L	NTCALUG02A103F804A
10 000	1	3435	1.0	160 +5 / -3	✓	NTCALUG02A103F161L	NTCALUG02A103F165A
100 000	3	4190	1.5	45 ± 3		NTCALUG02A104H	NTCALUG02A104HA

Notes

Preferred versions for new designs

(1) RoHS exemption 7(c)-I: electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezo-electronic devices, or in a glass or ceramic matrix compound

(2) Is also known under material number NTCALUGE4C90294

NTC Thermistors, Mini Lug Sensors

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | SPICE Models | Related Documents

QUICK REFERENCE DATA		
PARAMETER	**VALUE**	**UNIT**
Resistance value at 25 °C	10K to 47K	Ω
Tolerance on R_{25}-value	± 2 to ± 3	%
$B_{25/85}$-value	3740 to 3984	K
Tolerance on $B_{25/85}$-value	± 0.5 to ± 1.5	%
Operating temperature range: At zero dissipation	 -40 to +125	°C
Response time	≈ 3.5	s
Thermal time constant τ	≈ 5	s
Dissipation factor δ	10	mW/K
Min. dielectric withstanding voltage between terminals and lug	1000	V_{AC}
Climatic category (LCT / UCT / days)	40 / 125 / 56	-
Weight without connector with connector	 ~ 0.5 ~ 0.6	 g g

AGENCY APPROVALS

- cUL certificate XGPU8.E148885
- ULus certificate XGPU2.E148885

FEATURES

Pb-free Available

RoHS COMPLIANT

- Fast time response for surface applications compared to industry standard NTC lug sensors
- Reduced thermal gradient, due to the use of small dimensions and nickel conductor, allowing for an accurate surface temperature measurement
- The sensor is not suitable for being permanently in contact with water or liquids
- Small size connector and small lug ring tongue terminal, allowing for temperature sensing at locations where only limited space is available
- Optional connector, rated +85 °C, tin plated (e3)
- AEC-Q200 qualified available (grade 1)
- cULus recognized, file E148885 (UL category XGPU2/XGPU8)

APPLICATIONS

Thermistors used for surface temperature sensing and control in:

- Computer equipment
- MOSFETS, IC's, power electronics, heatsink temperature control, LED emitter heat-sink control
- Consumer appliances
- Industrial equipment
- Automotive equipment

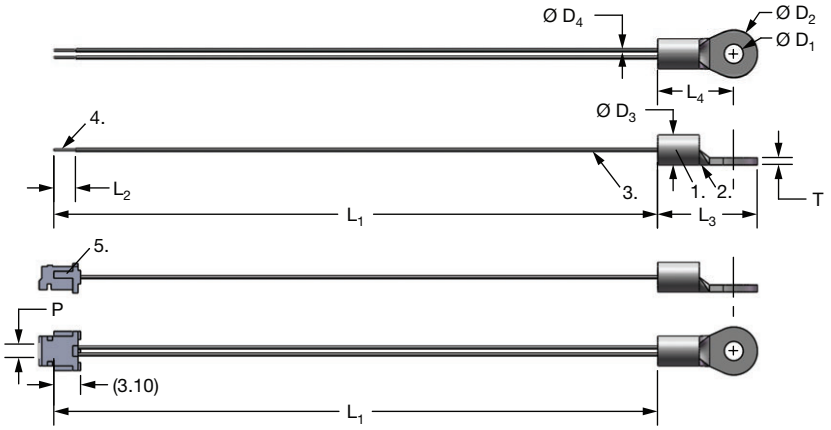
DESCRIPTION

Miniature insulated chip thermistor with a negative temperature coefficient soldered to AWG#32 silver plated nickel and insulated cables, and mounted inside a mini lug tin plated copper barrel.

PACKAGING

Available in plastic bags.

DIMENSIONS in millimeters



MODEL	L_1	L_2	L_3	L_4	$L_1 + L_3$ (item without connector)	Ø D_1	Ø D_2	Ø D_3	Ø D_4	T	PITCH P
NTCALUG03A	70 ± 5	4 ± 1	11.5 ± 0.5	8.8 ± 0.3	81.5 ± 5	2.2 ± 0.3	5.5 ± 0.3	3.4 ± 0.3	0.35 ± 0.1	0.8 ± 0.1	1.5 ± 0.3
NTCALUG39A	70 ± 5	4 ± 1	11.5 ± 0.5	8.8 ± 0.3	81.5 ± 5	3.2 ± 0.3	5.5 ± 0.3	3.4 ± 0.3	0.35 ± 0.1	0.8 ± 0.1	1.5 ± 0.3

Notes

1. Vishay thermistor chip NTC, with epoxy coating
2. Metal ring lug, tin plated
3. Insulated leads: AWG#32, monostranded, diam 0.20 mm, silver plated nickel, ETFE insulated, diameter 0.35 mm
4. End wire stripped
5. 2-poles JST ZHR-2 connector crimped

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	DESCRIPTION	UL RECOG. c UL us	SAP MATERIAL AND ORDERING NUMBER	
						RoHS-COMPLIANT WITH EXEMPTION (1)	RoHS-COMPLIANT
10 000	2	3984	0.5	NTC Mini Lug M2 10K 2 % 3984 K 0.5 %	✓	NTCALUG03A103G	NTCALUG03A103GA
10 000	2	3984	0.5	NTC Mini Lug M3 10K 2 % 3984 K 0.5 %	✓	NTCALUG39A103G	NTCALUG39A103GA
10 000	2	3984	0.5	NTC Mini Lug M2 10K 2 % 3984 K 0.5 % with connector	✓	NTCALUG03A103GC	NTCALUG03A103GCA
10 000	2	3984	0.5	NTC Mini Lug M3 10K 2 % 3984 K 0.5 % with connector	✓	NTCALUG39A103GC	NTCALUG39A103GCA
10 000	3	3984	0.5	NTC Mini Lug M2 10K 3 % 3984 K 0.5 %	✓	NTCALUG03A103H	NTCALUG03A103HA
10 000	3	3984	0.5	NTC Mini Lug M2 10K 3 % 3984 K 0.5 % with connector	✓	NTCALUG03A103HC	NTCALUG03A103HCA
12 000	3	3740	1.5	NTC Mini Lug M2 12K 3 %		NTCALUG03A123H	NTCALUG03A123HA
12 000	3	3740	1.5	NTC Mini Lug M2 12K 3 % with connector		NTCALUG03A123HC	NTCALUG03A123HCA
47 000	3	3740	1.5	NTC Mini Lug M2 47K 3 %		NTCALUG03A473H	NTCALUG03A473HA
47 000	3	3740	1.5	NTC Mini Lug M2 47 kΩ 3 % with connector		NTCALUG03A473HC	NTCALUG03A473HCA

Notes

Preferred versions for new designs

(1) RoHS exemption 7(c)-I: electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezo-electronic devices, or in a glass or ceramic matrix compound

MOUNTING CONNECTOR

- **Important mounting and handling instructions**
- For the type with connector, the JST ZHR-2 connector can mate with following counter-connectors [1]:

A. One of the PCB connector - through hole:
- JST B 2B-ZR (top entry)
- JST S 2B-ZR (side entry)
- JST B 2B-ZR-3.4 (top entry, for 1.6 mm board)
- JST S 2B-ZR-3.4 (side entry, for 1.6 mm board)

B. One of the PCB board connector - SMT surface mount:
- JST S 2B-ZR-SM2-TF (SM2 side entry)
- JST B 2B-ZR-SM3-TF (SM3 top entry)
- JST S 2B-ZR-SM3A-TF (SM3 side entry)
- JST B 2B-ZR-SM4-TF (SM4 top entry)
- JST S 2B-ZR-SM4A-TF (SM4 side entry)

C. The wire-to-wire connector:
- JST ZMR-02 housing (x 1) + JST SMM-003T-P0.5 terminals (x 2)

Note

[1] Additional details and dimensions can be found in JST ZH and JST ZM datasheets

NTC Thermistors, Standard Lug Sensors

FEATURES

- Easy mounting using ring tongue terminal
- Rugged construction
- Cable of PTFE insulation according to NEMA HP-3, type E, rated 600 V_{RMS} (1)
- AEC-Q200 qualified (grade 1)
- cULus recognized, file E148885 (UL category XGPU2/XGPU8)

Pb-free Available

e4

RoHS COMPLIANT

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | SPICE Models | Related Documents

QUICK REFERENCE DATA		
PARAMETER	**VALUE**	**UNIT**
Resistance value at 25 °C (1)	10K	Ω
Tolerance on R_{25}-value (1)	± 2 to ± 3	%
$B_{25/85}$-value (1)	3435 to 3984	K
Tolerance on $B_{25/85}$-value	± 0.5 to ± 1	%
Operating temperature range at: Zero dissipation	 -40 to +150	°C
Dissipation factor (2)	≈ 23	mW/K
Thermal time constant (2)	≈ 7.5	s
Min. dielectric withstanding voltage between terminals and lug	1500	V_{AC}
Min. insulation resistance between terminals and lug at 500 V_{DC}	100	MΩ
Climatic category (LCT / UCT / days)	40 / 150 / 56	
Weight	1.6 to 4.3	g

Notes

(1) Other R_{25}-values, $B_{25/85}$-values, and tolerances are available upon request

(2) Measured with screw mounted on an aluminum heatsink of 100 cm^2, thickness 1.5 mm, in still air at T_{amb} = 25 °C

AGENCY APPROVALS

- cUL certificate XGPU8.E148885
- ULus certificate XGPU2.E148885

Note

(1) Formerly MIL-W-16878/4, type E, cable test voltage 3.4 kV

APPLICATIONS

Suitable for surface sensing applications, especially when a good electrical insulation and a good thermal contact with the chassis is required.

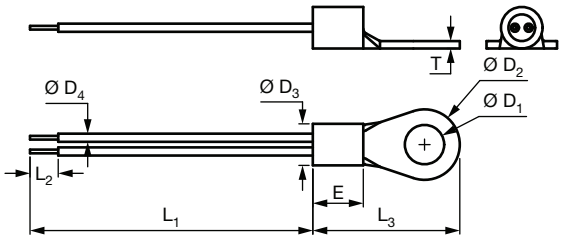
DESCRIPTION

A NTC thermistor chip is soldered to AWG#24 stranded silver plated copper leads with PTFE insulation and insulated with epoxy coating. The insulated sensor is attached to a tin plated copper ring lug. The lead wires are stripped.

PACKAGING

The thermistors are packed in cardboard boxes.

DIMENSIONS in millimeters



L_1	L_2	Ø D_1	Ø D_2	Ø D_3	T	L_3	E	D_4
Refer to the ordering table	2.5 ± 1	5.3 +0.2 / -0	9.5 ± 0.2	5.6 +0.3 / -0.2	1.0	19.8 ± 0.4	6.8 ± 0.3	1.12 ± 0.1

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	L_1 (mm)	DESCRIPTION	UL RECOG.	SAP MATERIAL AND ORDERING NUMBER	
							RoHS-COMPLIANT WITH EXEMPTION (1)	RoHS-COMPLIANT
10 000	2	3984	0.5	38.1 ± 3.8	NTC Lug54 M5 10K 2 % 3984 K PTFE AWG#24 38 mm	✓	NTCALUG54A103G	NTCALUG54A103GA
10 000	2	3435	1	38.1 ± 3.8	NTC Lug54 M5 10K 2 % 3435 K PTFE AWG#24 38 mm	✓	NTCALUG54A103GL	NTCALUG54A103GLA
10 000	2	3984	0.5	350 +10 / -5	NTC Lug54 M5 10K 2 % 3984 K PTFE AWG#24 350 mm	✓	NTCALUG54A103G351	NTCALUG54A103G351A
10 000	3	3984	0.5	150 +10 / -5	NTC Lug54 M5 10K 3 % 3984 K PTFE AWG#24 150 mm	✓	NTCALUG54A103H151	NTCALUG54A103H151A

Notes

Preferred versions for new designs

(1) RoHS exemption 7(c)-I: electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezo-electronic devices, or in a glass or ceramic matrix compound

NTC Thermistors, Standard Lug Sensors

FEATURES

- Easy mounting using ring tongue terminal
- Rugged construction
- Cable of PTFE insulation according to NEMA HP-3, type E, rated 600 V_{RMS} (1)
- AEC-Q200 qualified (grade 1)
- cULus recognized, file E148885 (UL category XGPU2/XGPU8)

Pb-free Available

e4

RoHS COMPLIANT

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | SPICE Models | Related Documents

QUICK REFERENCE DATA		
PARAMETER	**VALUE**	**UNIT**
Resistance value at 25 °C (1)	10K	Ω
Tolerance on R_{25}-value (1)	± 2	%
$B_{25/85}$-value (1)	3435 to 3984	K
Tolerance on $B_{25/85}$-value	± 0.5 to ± 1	%
Operating temperature range at: Zero dissipation	 -40 to +150	°C
Dissipation factor (2)	≈ 23	mW/K
Thermal time constant (2)	≈ 7.5	s
Min. dielectric withstanding voltage between terminals and lug	1500	V_{AC}
Min. insulation resistance between terminals and lug at 500 V_{DC}	100	MΩ
Climatic category (LCT / UCT / days)	40 / 150 / 56	
Weight	1.6 to 4.3	g

Notes

(1) Other R_{25}-values, $B_{25/85}$-values, and tolerances are available upon request

(2) Measured with screw mounted on an aluminum heatsink of 100 cm^2, thickness 1.5 mm, in still air at T_{amb} = 25 °C

AGENCY APPROVALS

- cUL certificate XGPU8.E148885
- ULus certificate XGPU2.E148885

Note

(1) Formerly MIL-W-16878/4, type E, cable test voltage 3.4 kV

APPLICATIONS

Suitable for surface sensing applications, especially when a good electrical insulation and a good thermal contact with the chassis is required.

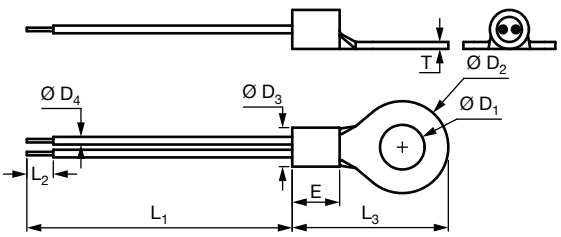
DESCRIPTION

A NTC thermistor chip is soldered to AWG#24 stranded silver plated copper leads with PTFE insulation and insulated with epoxy coating. The insulated sensor is attached to a tin plated copper ring lug. The lead wires are stripped.

PACKAGING

The thermistors are packed in cardboard boxes.

DIMENSIONS in millimeters



L_1	L_2	Ø D_1	Ø D_2	Ø D_3	T	L_3	E	D_4
Refer to the ordering table	3.8 ± 1	6.4 + 0.4 / - 0	13.2 ± 0.3	5.6 + 0.3 / - 0.2	1.0	22.4 ± 0.4	6.8 ± 0.3	1.12 ± 0.1

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	L_1 (mm)	DESCRIPTION	UL RECOG.	SAP MATERIAL AND ORDERING NUMBER	
							RoHS-COMPLIANT WITH EXEMPTION (1)	RoHS-COMPLIANT
10 000	2	3984	0.5	38.1 ± 3.8	NTC Lug85 M6 10K 2 % 3984 K PTFE AWG#24 38 mm	✓	NTCALUG85A103G	NTCALUG85A103GA
10 000	2	3435	1	38.1 ± 3.8	NTC Lug85 M6 10K 2 % 3435 K PTFE AWG#24 38 mm	✓	NTCALUG85A103GL	NTCALUG85A103GLA
10 000	2	3984	0.5	150 +10 / -5	NTC Lug85 M6 10K 2 % 3984 K PTFE AWG#24 150 mm	✓	NTCALUG85A103G151	NTCALUG85A103G151A

Notes

Preferred versions for new designs

(1) RoHS exemption 7(c)-I: electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezo-electronic devices, or in a glass or ceramic matrix compound

NTC Thermistors, Standard Lug Sensors

FEATURES

- Easy mounting using ring tongue terminal
- Rugged construction
- Cable of PTFE insulation according to NEMA HP-3, type E, rated 600 V_{RMS} (1)
- AEC-Q200 qualified (grade 1)
- cULus recognized, file E148885 (UL category XGPU2/XGPU8)

Pb-free Available

e4

RoHS COMPLIANT

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | SPICE Models | Related Documents

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C (1)	10K	Ω
Tolerance on R_{25}-value (1)	± 2 to ± 3	%
$B_{25/85}$-value (1)	3435 to 3984	K
Tolerance on $B_{25/85}$-value	± 0.5 to ± 1	%
Operating temperature range at: Zero dissipation	 -40 to +150	°C
Dissipation factor (2)	≈ 23	mW/K
Thermal time constant (2)	≈ 7.5	s
Min. dielectric withstanding voltage between terminals and lug	1500	V_{AC}
Min. insulation resistance between terminals and lug at 500 V_{DC}	100	MΩ
Climatic category (LCT / UCT / days)	40 / 150 / 56	
Weight	1.6 to 4.3	g

Notes

(1) Other R_{25}-values, $B_{25/85}$-values, and tolerances are available upon request

(2) Measured with screw mounted on an aluminum heatsink of 100 cm^2, thickness 1.5 mm, in still air at T_{amb} = 25 °C

AGENCY APPROVALS

- cUL certificate XGPU8.E148885
- ULus certificate XGPU2.E148885

Note

(1) Formerly MIL-W-16878/4, type E, cable test voltage 3.4 kV

APPLICATIONS

Suitable for surface sensing applications, especially when a good electrical insulation and a good thermal contact with the chassis is required.

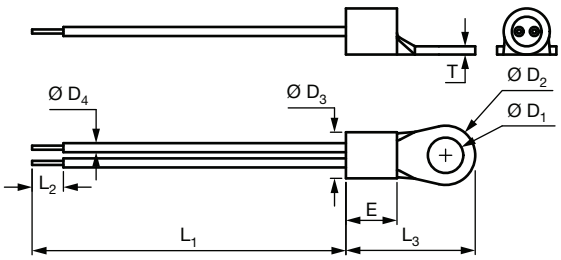
DESCRIPTION

A NTC thermistor chip is soldered to AWG#24 stranded silver plated copper leads with PTFE insulation and insulated with epoxy coating. The insulated sensor is attached to a tin plated copper ring lug. The lead wires are stripped.

PACKAGING

The thermistors are packed in cardboard boxes.

DIMENSIONS in millimeters



L_1	L_2	Ø D_1	Ø D_2	Ø D_3	T	L_3	E	D_4
Refer to the ordering table	3.8 ± 1	4.3 + 0.2 / - 0	7.2 ± 0.2	5.6 + 0.3 / - 0.2	1.0	15.70 ± 0.3	6.2 ± 0.2	1.12 ± 0.1

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	L_1 (mm)	DESCRIPTION	UL RECOG.	SAP MATERIAL AND ORDERING NUMBER	
							RoHS-COMPLIANT WITH EXEMPTION (1)	RoHS-COMPLIANT
10 000	2	3984	0.5	38.1 ± 3.8	NTC Lug91 M4 10K 2 % 3984 K PTFE AWG#24 38 mm	✓	NTCALUG91A103G	NTCALUG91A103GA
10 000	2	3435	1	38.1 ± 3.8	NTC Lug91 M4 10K 2 % 3435 K PTFE AWG#24 38 mm	✓	NTCALUG91A103GL	NTCALUG91A103GLA
10 000	2	3984	0.5	300 +10 / -5	NTC Lug91 M4 10K 2 % 3984 K PTFE AWG#24 300 mm	✓	NTCALUG91A103G301	NTCALUG91A103G301A
10 000	3	3984	0.5	150 +10 / -5	NTC Lug91 M4 10K 3 % 3984 K PTFE AWG#24 150 mm	✓	NTCALUG91A103H151	NTCALUG91A103H151A

Notes

Preferred versions for new designs

(1) RoHS exemption 7(c)-I: electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezo-electronic devices, or in a glass or ceramic matrix compound

Leadless NTC Thermistor Die Suitable for Wire Bonding

FEATURES

- Flat chip contacted top and bottom (gold: NTCC300E4 series or silver: NTCC200E4 series)
- Green thermistor - does not use RoHS exemptions
- Wide temperature range from -55 °C to +175 °C
- Highly resistant to thermal shocks
- Ideal for wire bonding (aluminum or gold depending on metalization type)
- Resistance to leaching
- Delivered on blister tape
- AEC-Q200 qualified

Pb-free
e4
RoHS COMPLIANT
HALOGEN FREE
GREEN (5-2008)

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	4.7K to 20K	Ω
Tolerance on R_{25}-value	± 1; ± 2; ± 3; ± 5	%
$B_{25/85}$-value	3435 to 3865	K
Tolerance on $B_{25/85}$-value	± 1	%
Operating temperature range	-55 to +175	°C
Response time (63.2 %) 25 °C to 85 °C still air (for info)	3	s
Dissipation factor δ in still air (for info, non-mounted die)	3	mW
Maximum power dissipation	50	mW
Weight	3	mg

APPLICATIONS

- High temperature sensing, control and compensation. E.g. IGBT modules (inverters in EV and HEV vehicles)
- IC and semiconductor protecting
- DC/AC power inverters and HIC overheat protecting

MARKING

The thermistors have no marking and have electrode termination design without orientation.

MOUNTING

The thermistors are primarily intended for wire bonding. The parameters of the assembly process should be chosen in accordance with the lead-wire material.
The mounting process should be in compliance with the following guidelines and recommendations:

Die bonding:

- Gold electrode: silver epoxy gluing
- Silver electrode: (vacuum) reflow soldering - silver epoxy gluing - nano silver sintering

Soldering process under reducing atmosphere (e.g. forming or formic gases) and ultrasonic cleaning processes can be applied under the condition that NTC die is not damaged. Consult Vishay for further assistance.

Wire bonding:

- The gold electrode has been tested for gold wire bonding with a wire diameter of max. 32 µm
- The silver electrode has been tested for aluminum wire bonding with a wire diameter of max. 300 µm

Encapsulation:

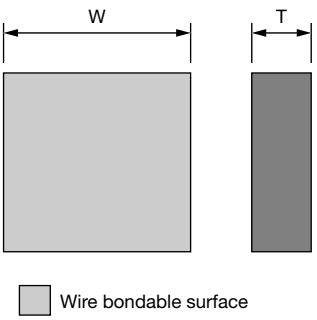
- In order to preserve the characteristics of the bonded die at long term an encapsulation is mandatory
- The encapsulation is defined by the user. Silicon and epoxy encapsulations have been tested. For recommendations on compatible encapsulants contact Vishay

ELECTRICAL DATA AND ORDERING INFORMATION					
R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	DESCRIPTION	SAP MATERIAL AND ORDERING NUMBER (1)
4700	1, 2, 3, 5	3435	1	Bare die with top / bottom silver terminations	NTCC200E4472*T
12 000	1, 2, 3, 5	3740	1	Bare die with top / bottom silver terminations	NTCC200E4123*T
20 000	1, 2, 3, 5	3865	1	Bare die with top / bottom silver terminations	NTCC200E4203*T
4700	1, 2, 3, 5	3435	1	Bare die with top / bottom gold terminations	NTCC300E4472*T
12 000	1, 2, 3, 5	3740	1	Bare die with top / bottom gold terminations	NTCC300E4123*T
20 000	1, 2, 3, 5	3865	1	Bare die with top / bottom gold terminations	NTCC300E4203*T

Note

(1) In order to define R_{25}-tolerance, replace * in SAP part number by F (± 1 %), G (± 2 %), H (± 3 %), or J (± 5 %)

DIMENSIONS in millimeters



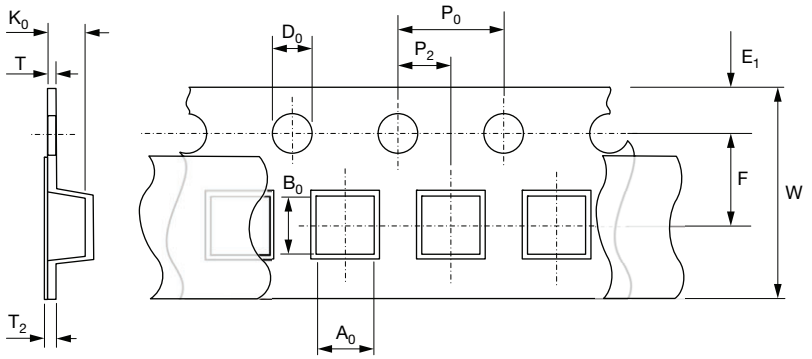
PARAMETER	VALUE
W	2 ± 0.1
T	0.7 max.

Note

- Non-dimensioned details do not affect the performance of the thermistors

PACKAGING

The components are delivered on 8 mm embossed blister tape (0.3 mm conductive PS) conforming to EIA-481 and IEC 60286-3, with 2000 parts per reel.



PARAMETER	VALUE
A_0	2.2 ± 0.1
B_0	2.2 ± 0.1
K_0	1.0 ± 0.1
W	8 ± 0.3
F	3.5 ± 0.05
E_1	1.75 ± 0.1
P_0	4.0 ± 0.1
P_2	2.0 ± 0.05
D_0	1.5 ± 0.1
T	0.35 max.
T_2	0.50 max.

Enhanced Leadless NTC Thermistor Die Suitable for Wire Bonding

FEATURES

- Flat chip contacted top and bottom (NTCC201E4 series)
- Green thermistor - does not use RoHS exemptions
- Wide temperature range from -55 °C to +175 °C (resistant to repetitive short periods at 200 °C, as for example, 10 times 10 s)
- Highly resistant to mounting conditions
- Ideal for aluminum wire
- Resistance to leaching during reflow soldering process
- Delivered on blister tape
- AEC-Q200 qualified

Pb-free
e4
RoHS COMPLIANT
HALOGEN FREE
GREEN (5-2008)

LINKS TO ADDITIONAL RESOURCES

SPICE Models

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	4.7K to 20K	Ω
Tolerance on R_{25}-value	± 1; ± 2; ± 3; ± 5	%
$B_{25/85}$-value	3435 to 3865	K
Tolerance on $B_{25/85}$-value	± 1	%
Operating temperature range	-55 to +175	°C
Response time (63.2 %) 25 °C to 85 °C still air (for info)	3	s
Dissipation factor δ in still air (for info, non-mounted die)	3	mW
Maximum power dissipation	50	mW
Weight	3	mg

APPLICATIONS

- High temperature sensing, control and compensation in power semiconductor modules (e.g. IGBT, MOSFET, Diodes, …), inverters in EV/HEV vehicles, and windmills
- IC and semiconductor protecting
- DC/AC power inverters and HIC overheat protecting

:

MARKING

The thermistors have no marking and have electrode termination design without orientation.

MOUNTING

The thermistors are primarily intended for wire bonding or sintering. Contact specifications (thickness material) and bonding parameters are available on request. The parameters of the assembly process should be chosen in accordance with the lead-wire material.
The mounting process should be in compliance with the following guidelines and recommendations:

Die bonding: reflow soldering under vacuum or with formic acid / forming gases, with SAC or HMP / silver epoxy gluing / nano silver paste sintering.

Cleaning:

- Detergent spraying
- Ultrasonic cleaning is allowed if limited in time to 5 minutes

Wire bonding:

- The silver electrode has been tested for aluminum wire bonding with a wire diameter of max. 300 µm

Encapsulation:

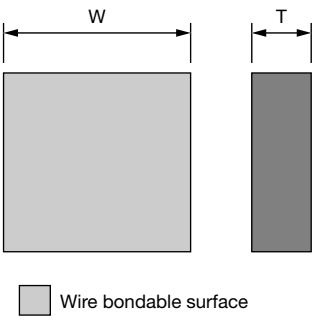
- In order to preserve the characteristics of the bonded die at long term an encapsulation is mandatory
- The encapsulation is defined by the user. Silicon and epoxy encapsulations have been tested. For recommendations on compatible encapsulants contact Vishay

ELECTRICAL DATA AND ORDERING INFORMATION					
R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	DESCRIPTION	SAP MATERIAL AND ORDERING NUMBER (1)
4700	1, 2, 3, 5	3435	1	Bare die with top / bottom silver terminations	NTCC201E4472*T
5000	1, 2, 3, 5	3435	1	Bare die with top / bottom silver terminations	NTCC201E4502*T
20 000	1, 2, 3, 5	3865	1	Bare die with top / bottom silver terminations	NTCC201E4203*T

Note

(1) In order to define R_{25}-tolerance, replace * in SAP part number by F (± 1 %), G (± 2 %), H (± 3 %), or J (± 5 %)

DIMENSIONS in millimeters



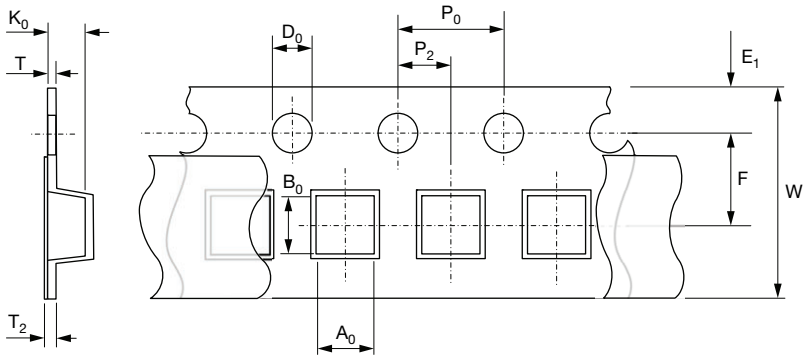
PARAMETER	VALUE	
W	2.0 ± 0.1	
T	NTCC201E4472*T	0.6 ± 0.1
	NTCC201E4502*T	0.66 ± 0.1
	NTCC201E4203*T	0.71 ± 0.1

Note

- Non-dimensioned details do not affect the performance of the thermistors

PACKAGING

The components are delivered on 8 mm embossed blister tape (0.3 mm conductive PS) conforming to EIA-481 and IEC 60286-3, with 2000 parts per reel.



PARAMETER	VALUE
A_0	2.2 ± 0.1
B_0	2.2 ± 0.1
K_0	1.0 ± 0.1
W	8 ± 0.3
F	3.5 ± 0.05
E_1	1.75 ± 0.1
P_0	4.0 ± 0.1
P_2	2.0 ± 0.05
D_0	1.5 ± 0.1
T	0.35 max.
T_2	0.50 max.

NTC Thermistors, 2-Point Mini Chip Sensor, Flexible Leads

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | Related Documents

FEATURES

- Accuracy of 0.5 °C between 0 °C and 50 °C
- Small 2.4 mm diameter
- High stability over a long life
- Long and flexible leads for special mounting or assembly requirements
- AEC-Q200 qualified

Pb-free Available

RoHS COMPLIANT

APPLICATIONS

- Temperature measurement, sensing and control in automotive, industrial and consumer electronic equipment

DESCRIPTION

These negative temperature coefficient thermistors consist of a mini-chip soldered between two AWG#30 ETFE insulated (LE300) or non-insulated (LE201) 0.3 mm nickel leads and coated with a solid ocher color epoxy lacquer

PACKAGING

The thermistors are packed in cardboard boxes; the smallest packing quantity is 1000 units

MARKING

The coated body has no markings

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	3K to 10K	Ω
Tolerance on R_{25}-value	± 2.18	%
$B_{25/85}$-value	3977	K
Tolerance on $B_{25/85}$-value	± 0.75	%
Operating temperature range at zero dissipation	-40 to +125	°C
Accuracy for T measured between 0 °C and 50 °C	± 0.5	°C
Maximum power dissipation at 55 °C	100	mW
Min. dielectric withstanding voltage between terminals and coated body	500	V_{AC}
Weight	≈ 0.2	g

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	SAP MATERIAL AND ORDERING NUMBER	
				RoHS-COMPLIANT WITH EXEMPTION (1)	RoHS-COMPLIANT
3000	2.18	3977	0.75	NTCLE201E3302SB	NTCLE201E3302SBA
5000	2.18	3977	0.75	NTCLE201E3502SB	NTCLE201E3502SBA
10 000	2.18	3977	0.75	NTCLE201E3103SB	NTCLE201E3103SBA
3000	2.18	3977	0.75	NTCLE300E3302SB	NTCLE300E3302SBA
5000	2.18	3977	0.75	NTCLE300E3502SB	NTCLE300E3502SBA
10 000	2.18	3977	0.75	NTCLE300E3103SB	NTCLE300E3103SBA

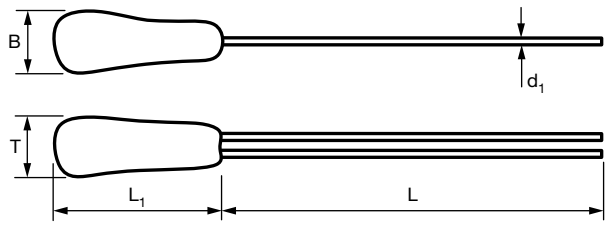
Notes

Preferred versions for new designs

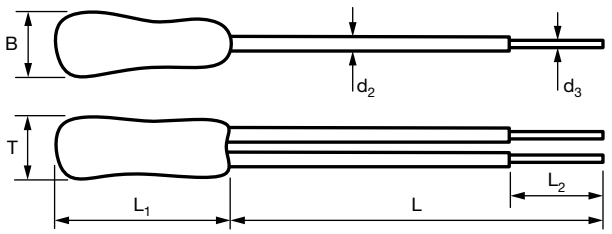
(1) RoHS exemption 7(c)-I: electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezo-electronic devices, or in a glass or ceramic matrix compound

DIMENSIONS in millimeters

Component outline for NTCLE201E3...

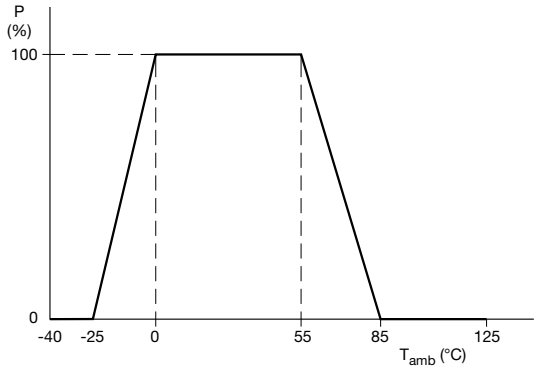


Component outline for NTCLE300E3...



T	B	L	L_1	L_2	Ø d_1	Ø d_2	Ø d_3
2.4 max.	2.4 max.	38 ± 2	8.0 max.	6 ± 1	0.30 ± 0.03	0.58 max.	0.25 ± 0.025

DERATING



Power derating curve

Note

- Zero power is considered as measuring power max. 1 % of max. power

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES						
T_{OPER} (°C)	R_T/R_{25}	T-TOL. (± K)	TCR (%/K)	R_T-VALUE (kΩ) NTCLE201E3...SB(A) OR NTCLE300E3...SB(A)		
				302	502	103
-40	33.21	0.68	-6.57	99.63	166.1	332.1
-35	23.99	0.66	-6.36	71.97	120.0	239.9
-30	17.52	0.64	-6.15	52.56	87.60	175.2
-25	12.93	0.62	-5.95	38.79	64.65	129.3
-20	9.636	0.59	-5.76	28.91	48.18	96.36
-15	7.250	0.57	-5.58	21.75	36.25	72.50
-10	5.505	0.55	-5.40	16.51	27.52	55.05
-5	4.216	0.52	-5.24	12.65	21.08	42.16
0	3.255	0.50	-5.08	9.766	16.28	32.56
5	2.534	0.50	-4.92	7.602	12.67	25.34
10	1.987	0.50	-4.78	5.962	9.936	19.87
15	1.570	0.50	-4.64	4.710	7.849	15.70
20	1.249	0.50	-4.50	3.746	6.244	12.49
25	**1.000**	**0.50**	**-4.37**	**3.000**	**5.000**	**10.00**
30	0.8059	0.50	-4.25	2.418	4.030	8.059
35	0.6535	0.50	-4.13	1.960	3.267	6.535
40	0.5330	0.50	-4.02	1.599	2.665	5.330
45	0.4372	0.50	-3.91	1.312	2.186	4.372
50	0.3605	0.50	-3.80	1.082	1.803	3.606
55	0.2989	0.55	-3.70	0.8966	1.494	2.989
60	0.2490	0.61	-3.60	0.7470	1.245	2.490
65	0.2084	0.66	-3.51	0.6253	1.042	2.084
70	0.1753	0.72	-3.42	0.5259	0.8765	1.753
75	0.1481	0.77	-3.33	0.4443	0.7405	1.481
80	0.1256	0.83	-3.25	0.3769	0.6282	1.256
85	0.1070	0.89	-3.16	0.3211	0.5352	1.070
90	0.09154	0.95	-3.09	0.2746	0.4577	0.9154
95	0.07860	1.02	-3.01	0.2358	0.3930	0.7860
100	0.06773	1.08	-2.94	0.2032	0.3387	0.6773
105	0.05858	1.14	-2.87	0.1757	0.2929	0.5858
110	0.05083	1.21	-2.80	0.1525	0.2542	0.5083
115	0.04426	1.27	-2.73	0.1328	0.2213	0.4426
120	0.03866	1.34	-2.67	0.1160	0.1933	0.3866
125	0.03387	1.41	-2.61	0.1016	0.1694	0.3387

NTC Thermistors, 2-Point Radial Leaded, Automotive Grade

FEATURES

- High accuracy over a wide temperature range
- High stability over a long life
- Exceptional thermal shock withstanding performance
- AEC-Q200 qualified
- Mounting: radial
- Fulfills the ELV 2000/53/EC

RoHS COMPLIANT

LINKS TO ADDITIONAL RESOURCES

Design Tools | Models | Related Documents

APPLICATIONS

- Temperature measurement, sensing and control, temperature compensation in Automotive and Industrial applications
- Applications as EGR, ECT, IAT, and TMAP sensors

DESCRIPTION

These thermistors consist of a NTC ceramic chip with two solid tin plated nickel leads. The thermistor body is coated with a blue insulating lacquer.

PACKAGING

The thermistors are packed in bulk (quantity = 500 pieces). Tape and reel available on request.

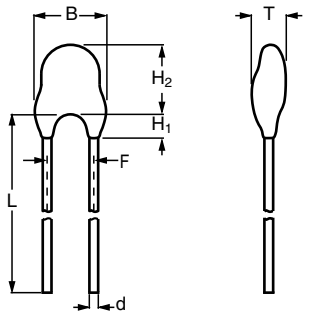
QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	2.06K to 30K	Ω
Tolerance on R_{25}-value	± 1.93 to ± 2.20	%
$B_{25/85}$-value	3528 to 4090	K
Tolerance on $B_{25/85}$-value	± 0.5 to ± 0.75	%
Operating temperature range	-55 to +150	°C
Temperature accuracy between 25 °C and 85 °C	± 0.5	°C
Maximum dissipation	100	mW
Response time (in stirred air)	7	s
Min. dielectric withstanding voltage between terminals and body	500	V_{RMS}
Weight	0.1	g

AGENCY APPROVALS

- cUL certificate
- ULus certificate

ELECTRICAL DATA AND ORDERING INFORMATION					
R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	UL RECOGNIZED (Y / N)	SAP MATERIAL AND ORDERING NUMBER
2060	1.93	3528	0.50	N	NTCLE203E3202SB0
2252	2.20	3984	0.50	N	NTCLE203E3222SB0
2780	2.20	4090	0.75	N	NTCLE203E3272SB0
3000	2.20	3984	0.50	N	NTCLE203E3302SB0
5000	2.20	3984	0.50	N	NTCLE203E3502SB0
10 000	2.20	3984	0.50	Y	NTCLE203E3103SB0
30 000	2.20	3935	0.75	N	NTCLE203E3303SB0

DIMENSIONS in millimeters



B max.	4.2
T max.	4.0
H_1	2.0 ± 1.0
H_2 max.	6.0
L	41 ± 1
d	0.5 ± 0.05
F	2.54

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 2060 Ω

PART NUMBER: NTCLE203E3202SB0

TEMP. (°C)	RESISTANCE (Ω)	R_T/R_{25}	R-TOL. (± %)	α (%/K)	T-TOL. (± °C)	$R_{MIN.}$ (Ω)	$R_{MAX.}$ (Ω)
-55.0	126 160	61.243	4.14	-6.82	0.61	120 931	131 389
-50.0	90 317	43.843	3.96	-6.55	0.60	86 740	93 893
-45.0	65 498	31.795	3.78	-6.30	0.60	63 020	67 976
-40.0	48 085	23.342	3.61	-6.06	0.60	46 347	49 823
-35.0	35 712	17.336	3.45	-5.84	0.59	34 479	36 945
-30.0	26 816	13.018	3.30	-5.62	0.59	25 932	27 700
-25.0	20 347	9.8772	3.15	-5.42	0.58	19 706	20 988
-20.0	15 592	7.5688	3.01	-5.23	0.57	15 123	16 060
-15.0	12 060	5.8546	2.87	-5.05	0.57	11 715	12 406
-10.0	9412.5	4.5692	2.74	-4.87	0.56	9155.1	9670.0
-5.0	7408.5	3.5963	2.61	-4.71	0.55	7215.3	7601.7
0.0	5878.3	2.8536	2.49	-4.55	0.55	5732.2	6024.4
5.0	4700.2	2.2816	2.37	-4.40	0.54	4588.9	4811.4
10.0	3785.7	1.8377	2.25	-4.26	0.53	3700.4	3871.0
15.0	3070.5	1.4905	2.14	-4.12	0.52	3004.7	3136.3
20.0	2507.0	1.2170	2.04	-3.99	0.51	2456.0	2558.1
25.0	2060.0	1.0000	1.93	-3.87	0.50	2020.2	2099.8
30.0	1702.9	0.82666	1.87	-3.75	0.50	1671.0	1734.8
35.0	1416.0	0.68736	1.82	-3.64	0.50	1390.2	1441.7
40.0	1183.7	0.57461	1.77	-3.53	0.50	1162.8	1204.6
45.0	994.40	0.48272	1.72	-3.44	0.50	977.30	1011.5
50.0	839.19	0.40737	1.68	-3.35	0.50	825.13	853.25
55.0	711.20	0.34524	1.63	-3.27	0.50	699.57	722.83
60.0	605.10	0.29374	1.60	-3.19	0.50	595.44	614.76
65.0	516.72	0.25083	1.56	-3.12	0.50	508.65	524.78
70.0	442.75	0.21493	1.53	-3.06	0.50	435.99	449.52
75.0	380.60	0.18476	1.50	-2.99	0.50	374.90	386.30
80.0	328.16	0.15930	1.47	-2.94	0.50	323.34	332.98
85.0	283.76	0.13775	1.44	-2.88	0.50	279.67	287.84
90.0	246.02	0.11943	1.44	-2.83	0.51	242.49	249.55
95.0	213.85	0.10381	1.50	-2.78	0.54	210.64	217.07
100.0	186.34	0.090458	1.57	-2.73	0.57	183.42	189.26
105.0	162.75	0.079005	1.63	-2.68	0.61	160.10	165.40
110.0	142.46	0.069155	1.69	-2.64	0.64	140.05	144.87
115.0	124.96	0.060662	1.75	-2.60	0.67	122.77	127.15
120.0	109.84	0.053321	1.81	-2.56	0.71	107.85	111.83
125.0	96.737	0.046960	1.87	-2.52	0.74	94.930	98.545
130.0	85.358	0.041436	1.92	-2.48	0.77	83.715	87.000
135.0	75.454	0.036628	1.98	-2.45	0.81	73.961	76.947
140.0	66.817	0.032436	2.03	-2.41	0.84	65.460	68.175
145.0	59.269	0.028772	2.08	-2.38	0.88	58.035	60.504
150.0	52.661	0.025564	2.13	-2.35	0.91	51.537	53.785

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 2252 Ω, 3 kΩ, 5 kΩ AND 10 kΩ								
TEMP. (°C)	PART NUMBER NTCLE203E3222SB0 RESISTANCE (Ω)	PART NUMBER NTCLE203E3302SB RESISTANCE (Ω)	PART NUMBER NTCLE203E3502SB0 RESISTANCE (Ω)	PART NUMBER NTCLE203E3103SB0 RESISTANCE (Ω)	R_T/R_{25}	*R*-TOL. (± %)	α (%/K)	T-TOL. (± °C)
-55.0	214 790	286 132	476 887	953 774	95.377	4.70	-7.37	0.64
-50.0	149 571	199 251	332 085	664 169	66.417	4.49	-7.11	0.63
-45.0	105 475	140 509	234 182	468 363	46.836	4.29	-6.86	0.62
-40.0	75 279	100 282	167 137	334 274	33.427	4.10	-6.63	0.62
-35.0	54 346	72 397	120 661	241 323	24.132	3.91	-6.41	0.61
-30.0	39 665	52 840	88 066	176 133	17.613	3.74	-6.19	0.60
-25.0	29 253	38 970	64 950	129 900	12.9900	3.57	-5.99	0.60
-20.0	21 791	29 028	48 381	96 761	9.6761	3.41	-5.79	0.59
-15.0	16 387	21 829	36 382	72 765	7.2765	3.25	-5.61	0.58
-10.0	12 435	16 565	27 609	55 218	5.5218	3.10	-5.43	0.57
-5.0	9518.7	12 680	21 134	42 268	4.2268	2.96	-5.26	0.56
0.0	7347.0	9787.3	16 312	32 624	3.2624	2.82	-5.10	0.55
5.0	5715.9	7614.4	12 691	25 381	2.5381	2.68	-4.94	0.54
10.0	4480.8	5969.1	9948.4	19 897	1.9897	2.55	-4.80	0.53
15.0	3538.2	4713.4	7855.6	15 711	1.5711	2.43	-4.65	0.52
20.0	2813.4	3747.8	6246.4	12 493	1.2493	2.31	-4.52	0.51
25.0	2252.0	3000.0	5000.0	10 000	1.0000	2.19	-4.39	0.50
30.0	1814.2	2416.8	4028.0	8056.0	0.80560	2.13	-4.26	0.50
35.0	1470.5	1958.9	3264.9	6529.7	0.65297	2.07	-4.14	0.50
40.0	1198.9	1597.2	2661.9	5323.9	0.53239	2.01	-4.03	0.50
45.0	983.06	1309.6	2182.6	4365.3	0.43653	1.96	-3.92	0.50
50.0	810.43	1079.6	1799.4	3598.7	0.35987	1.90	-3.81	0.50
55.0	671.61	894.68	1491.1	2982.3	0.29823	1.85	-3.71	0.50
60.0	559.36	745.14	1241.9	2483.8	0.24838	1.80	-3.61	0.50
65.0	468.11	623.60	1039.3	2078.7	0.20787	1.76	-3.51	0.50
70.0	393.57	524.30	873.83	1747.7	0.17477	1.71	-3.42	0.50
75.0	332.38	442.78	737.96	1475.9	0.14759	1.67	-3.34	0.50
80.0	281.91	375.54	625.90	1251.8	0.12518	1.63	-3.25	0.50
85.0	240.09	319.83	533.05	1066.1	0.10661	1.59	-3.17	0.50
90.0	205.29	273.48	455.79	911.59	0.091159	1.66	-3.09	0.54
95.0	176.21	234.74	391.23	782.46	0.078246	1.74	-3.02	0.58
100.0	151.81	202.23	337.06	674.11	0.067411	1.81	-2.94	0.62
105.0	131.26	174.85	291.42	582.84	0.058284	1.88	-2.87	0.66
110.0	113.88	151.70	252.84	505.68	0.050568	1.95	-2.81	0.70
115.0	99.130	132.06	220.09	440.19	0.044019	2.02	-2.74	0.74
120.0	86.569	115.32	192.21	384.41	0.038441	2.09	-2.68	0.78
125.0	75.836	101.02	168.37	336.748	0.033675	2.15	-2.62	0.82
130.0	66.632	88.764	147.94	295.881	0.029588	2.22	-2.56	0.87
135.0	58.716	78.219	130.36	260.729	0.026073	2.28	-2.50	0.91
140.0	51.886	69.120	115.20	230.400	0.023040	2.34	-2.45	0.96
145.0	45.975	61.246	102.08	204.152	0.020415	2.40	-2.39	1.00
150.0	40.845	54.411	90.685	181.370	0.018137	2.45	-2.34	1.05

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 2780 Ω							
PART NUMBER: NTCLE203E3272SB0							
TEMP. (°C)	RESISTANCE (Ω)	R_T/R_{25}	R-TOL. (± %)	α (%/K)	T-TOL. (± °C)	$R_{MIN.}$ (Ω)	$R_{MAX.}$ (Ω)
-55.0	303 640	109.22	6.11	-7.57	0.81	285 073	322 207
-50.0	209 337	75.301	5.79	-7.31	0.79	197 211	221 464
-45.0	146 159	52.575	5.48	-7.06	0.78	138 143	154 176
-40.0	103 294	37.156	5.19	-6.82	0.76	97 933	108 654
-35.0	73 853	26.566	4.91	-6.60	0.74	70 228	77 477
-30.0	53 394	19.206	4.64	-6.38	0.73	50 918	55 870
-25.0	39 017	14.035	4.38	-6.17	0.71	37 309	40 724
-20.0	28 803	10.361	4.13	-5.97	0.69	27 614	29 992
-15.0	21 472	7.7237	3.89	-5.78	0.67	20 637	22 306
-10.0	16 157	5.8119	3.66	-5.60	0.65	15 566	16 748
-5.0	12 267	4.4127	3.43	-5.42	0.63	11 846	12 688
0.0	9394.1	3.3792	3.22	-5.25	0.61	9091.6	9696.6
5.0	7253.3	2.6091	3.01	-5.09	0.59	7034.7	7471.8
10.0	5644.6	2.0304	2.81	-4.94	0.57	5485.7	5803.4
15.0	4425.9	1.5921	2.62	-4.79	0.55	4309.9	4542.0
20.0	3495.6	1.2574	2.44	-4.65	0.52	3410.4	3580.7
25.0	2780.0	1.0000	2.26	-4.51	0.50	2717.3	2842.7
30.0	2225.7	0.80060	2.19	-4.38	0.50	2176.9	2274.4
35.0	1793.3	0.64506	2.13	-4.26	0.50	1755.1	1831.5
40.0	1453.8	0.52294	2.07	-4.14	0.50	1423.7	1483.8
45.0	1185.5	0.42644	2.01	-4.02	0.50	1161.6	1209.3
50.0	972.20	0.34971	1.96	-3.91	0.50	953.19	991.22
55.0	801.63	0.28836	1.90	-3.81	0.50	786.38	816.88
60.0	664.44	0.23901	1.85	-3.70	0.50	652.14	676.74
65.0	553.50	0.19910	1.80	-3.60	0.50	543.53	563.48
70.0	463.32	0.16666	1.75	-3.51	0.50	455.19	471.45
75.0	389.64	0.14016	1.71	-3.42	0.50	382.98	396.30
80.0	329.14	0.11840	1.67	-3.33	0.50	323.66	334.62
85.0	279.24	0.10045	1.62	-3.25	0.50	274.71	283.77
90.0	237.89	0.08557	1.74	-3.16	0.55	233.74	242.04
95.0	203.48	0.07319	1.86	-3.09	0.60	199.69	207.26
100.0	174.71	0.062846	1.97	-3.01	0.66	171.27	178.16
105.0	150.58	0.054164	2.08	-2.94	0.71	147.44	153.71
110.0	130.24	0.046849	2.19	-2.87	0.76	127.39	133.09
115.0	113.04	0.040662	2.30	-2.80	0.82	110.45	115.64
120.0	98.44	0.035411	2.40	-2.73	0.88	96.082	100.80
125.0	86.007	0.030938	2.50	-2.67	0.94	83.859	88.155
130.0	75.377	0.027114	2.59	-2.61	0.99	73.421	77.333
135.0	66.261	0.023835	2.69	-2.55	1.06	64.479	68.043
140.0	58.418	0.021014	2.78	-2.49	1.12	56.792	60.043
145.0	51.648	0.018578	2.87	-2.44	1.18	50.165	53.132
150.0	45.788	0.016471	2.96	-2.38	1.24	44.433	47.144

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 30 kΩ							
PART NUMBER: NTCLE203E3303SB0							
TEMP. (°C)	RESISTANCE (Ω)	R_T/R_{25}	R-TOL. (± %)	α (%/K)	T-TOL. (± °C)	$R_{MIN.}$ (Ω)	$R_{MAX.}$ (Ω)
-55.0	2 557 277	85.243	5.87	-7.10	0.83	2 407 214	2 707 340
-50.0	1 803 830	60.128	5.56	-6.87	0.81	1 703 566	1 904 094
-45.0	1 286 911	42.897	5.26	-6.64	0.79	1 219 190	1 354 632
-40.0	928 204	30.940	4.98	-6.43	0.77	881 990	974 418
-35.0	676 539	22.551	4.71	-6.22	0.76	644 692	708 387
-30.0	498 097	16.603	4.45	-6.03	0.74	475 947	520 248
-25.0	370 280	12.343	4.20	-5.84	0.72	354 739	385 821
-20.0	277 825	9.2608	3.96	-5.66	0.70	266 831	288 819
-15.0	210 316	7.0105	3.73	-5.48	0.68	202 478	218 154
-10.0	160 574	5.3525	3.50	-5.31	0.66	154 947	166 202
-5.0	123 604	4.1201	3.29	-5.15	0.64	119 536	127 672
0.0	95 895	3.1965	3.09	-5.00	0.62	92 937	98 854
5.0	74 960	2.4987	2.89	-4.85	0.59	72 797	77 124
10.0	59 021	1.9674	2.70	-4.71	0.57	57 430	60 612
15.0	46 794	1.5598	2.51	-4.58	0.55	45 619	47 969
20.0	37 348	1.2449	2.33	-4.44	0.52	36 477	38 219
25.0	30 000	1.0000	2.16	-4.32	0.50	29 352	30 648
30.0	24 246	0.80821	2.10	-4.20	0.50	23 737	24 755
35.0	19 712	0.65707	2.04	-4.08	0.50	19 310	20 114
40.0	16 117	0.53723	1.99	-3.97	0.50	15 797	16 437
45.0	13 250	0.44165	1.93	-3.86	0.50	12 994	13 506
50.0	10 950	0.36499	1.88	-3.76	0.50	10 744	11 156
55.0	9094.9	0.30316	1.83	-3.66	0.50	8928.3	9261.5
60.0	7591.1	0.25304	1.78	-3.57	0.50	7455.7	7726.5
65.0	6365.6	0.21219	1.74	-3.48	0.50	6255.0	6476.3
70.0	5362.2	0.17874	1.69	-3.39	0.50	5271.3	5453.0
75.0	4536.5	0.15122	1.65	-3.30	0.50	4461.6	4611.4
80.0	3854.1	0.12847	1.61	-3.22	0.50	3792.1	3916.2
85.0	3287.6	0.10959	1.57	-3.14	0.50	3236.0	3339.2
90.0	2815.3	0.09384	1.69	-3.06	0.55	2767.9	2862.8
95.0	2419.9	0.08066	1.80	-2.99	0.60	2376.4	2463.4
100.0	2087.7	0.069588	1.91	-2.92	0.65	2047.8	2127.5
105.0	1807.3	0.060244	2.01	-2.85	0.71	1770.9	1843.7
110.0	1569.9	0.052330	2.12	-2.78	0.76	1536.7	1603.1
115.0	1368.2	0.045605	2.22	-2.72	0.82	1337.8	1398.5
120.0	1196.1	0.039870	2.32	-2.66	0.87	1168.4	1223.8
125.0	1048.9	0.034963	2.41	-2.60	0.93	1023.6	1074.2
130.0	922.52	0.030751	2.50	-2.54	0.99	899.42	945.62
135.0	813.69	0.027123	2.60	-2.48	1.05	792.57	834.81
140.0	719.69	0.023990	2.68	-2.43	1.11	700.37	739.01
145.0	638.25	0.021275	2.77	-2.38	1.17	620.56	655.94
150.0	567.50	0.018917	2.86	-2.32	1.23	551.29	583.70

RELIABILITY DATA BASED ON AEC-Q200 COMPLIANCE		
TEST DENOMINATION	**METHOD**	$\Delta R_{25}/R_{25\ max.}$ (1)
High temperature storage	MIL-STD-202 method 108	± 1 %
Thermal cycling	JESD22 method JA-104	± 2 %
Operational life	MIL-STD-202 method 108	± 1 %
Soldering heat	MIL-STD-202 method 204	± 3 %
Moisture resistance	MIL-STD-202 method 106	± 1 %
Vibration	MIL-STD-202 method 204	± 1 %
Biased humidity (85 °C, 85 % RH)	MIL-STD-202 method 108	± 2 %
Thermal shock	MIL-STD-202 method 107	± 2 %
Mechanical shocks	MIL-STD-202-213	± 1 %

Note

- Valid for NTCLE203E3103SB0

NTC Thermistor, Epoxy Coated Mini Sensor

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | Models | Related Documents

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	2.1K to 100K	Ω
Tolerance on R_{25}-value	± 1 to ± 5	%
$B_{25/85}$-value	3511 to 4190	K
Tolerance on $B_{25/85}$-value	± 0.5 to ± 1.5	%
Operating temperature range	-55 to +150	°C
Response time (63.2 %) 25 °C to 85 °C stirred air (for info)	5	s
Dissipation factor δ in still air (for info)	1.8	mW
Maximum power dissipation at 55 °C	100	mW
Min. dielectric withstanding voltage between terminals and coated body	500	V_{AC}
Insulation resistance at 100 V_{DC}	> 10M	Ω
Weight	≈ 100	mg

FEATURES

- Advanced NTC technology
- Temperature range from -55 °C to +150 °C
- Highly resistant to thermal shocks
- Small body diameter of max. 2.5 mm
- AEC-Q200 qualified
- Fast response time
- High sensitivity
- Delivery in bulk or in tape with extra long leads (for automatic mounting)
- Mounting: radial

Pb e3 RoHS COMPLIANT

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APPLICATIONS

Temperature sensing, control and compensation.
E.g. inlet air temperature sensing thermistors or ECT in automotive applications, sensor elements in industrial and commercial applications, heating systems and industrial systems.

DESCRIPTION

These negative temperature coefficient thermistors consist of a mini-chip soldered between two tin plated 0.4 mm nickel leads, coated with ocher colored epoxy lacquer and coded with a color dot.

MOUNTING

The thermistors are suitable for all standard assembly processes like crimping, soldering, welding, and potting into epoxy or silicon resins. The parameters and materials of the assembly process should be chosen in accordance with the lead-wire and coated body and validated in the application. The mounting process should be in compliance with the following guidelines and recommendations:

- Peeling forces on the leads should be reduced to a minimum and should never exceed 3 N. A strain relief tool should be used if needed
- Avoid large temperature gradients between the welding region and the sensor

PACKAGING

- Bulk components are delivered in boxes of 500 components
- Taped components are delivered on a reel of 1500 components (according to IEC 60286-2 but with extra long leads: H0 = 32 mm)

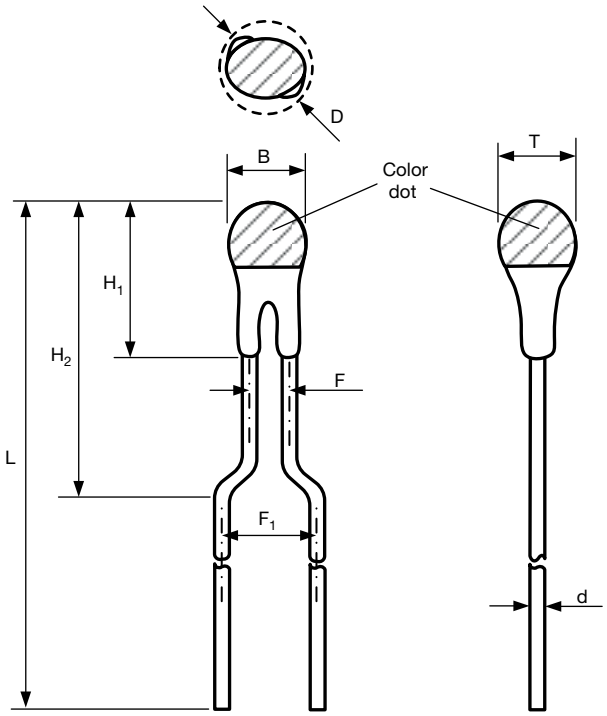
ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	COLOR DOT (see next page)	SAP MATERIAL AND ORDERING NUMBER (1)
2100	1, 2, 3, 5	3511	1	Orange	NTCLE213E3212xMyy
10 000	1, 2, 3, 5	3435	1	Red	NTCLE213E3103xLyy
10 000	1, 2, 3, 5	3984	0.5	Blue	NTCLE213E3103xHyy
12 000	1, 2, 3, 5	3740	1	Black	NTCLE213E3123xMyy
30 000	1, 2, 3, 5	3935	0.75	Green	NTCLE213E3303xHyy
100 000	1, 2, 3, 5	4190	1.5	Brown	NTCLE213E3104xXyy

Note

(1) Replace the x-digit by J for R_{25}-tolerance of 5 %, H for 3 %, G for 2 %, and F for 1 %.
Replace the y-digits by B0 for bulk delivery and by T1 for tape and reel delivery

DIMENSIONS in millimeters



PARAMETER	VALUE
B max.	2.5
T max.	2.5
F	1.1
F1	2.54
D max. (mounting diameter)	2.5
d	0.4 ± 10 %
H1 max.	5.5
H2 max.	10
L	41 ± 1

Note

- Non-dimensioned details do not affect the performance of the thermistors

NTC Thermistors, Long Insulated Leads

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | Related Documents

FEATURES

- Long and flexible leads for special mounting or assembly requirements
- Best accuracy of ± 0.4 °C at 0 °C
- Electrical features of “accuracy line” sensors
- Mounting: radial insulated leads
- AEC-Q200 qualified
- Small head diameter with fast response time of 1.2 s

Pb-free Available

RoHS COMPLIANT

QUICK REFERENCE DATA

PARAMETER	VALUE	UNIT
Resistance value at 25 °C	2765	Ω
Tolerance on R_{25}-value	± 2.93	%
$B_{25/85}$-value	3977	K
Tolerance on $B_{25/85}$-value	± 0.75	%
Operating temperature range at zero dissipation	-40 to +125	°C
Resistance value at 0 °C	9000	Ω
Tolerance on R_0-value	± 2.0	%
Maximum power dissipation at 55 °C	100	mW
Minimum dielectric withstanding voltage (RMS) between leads and coating	500	V
Dissipation factor δ (for information only)	1.35	mW/K
Response time	1.25	s
Weight	≈ 0.16	g

APPLICATIONS

- Temperature measurement, sensing and control in automotive and industrial applications as e.g. battery cells and packs

DESCRIPTION

These negative temperature coefficient thermistors consist of a mini-chip soldered between two AWG #30 PEEK insulated silver plated nickel leads and coated with ocher colored epoxy lacquer. High adhesive strength between PEEK wire and encapsulating lacquer.

PACKAGING

The thermistors are packed in cardboard boxes; the smallest packing quantity is 1000 units.

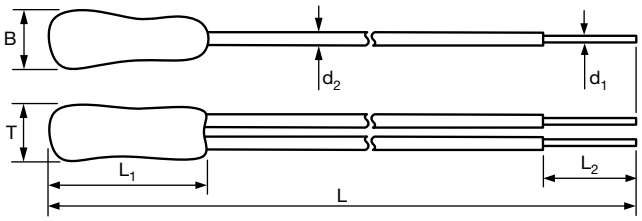
MARKING

The component is not marked.

MOUNTING

By soldering or crimping the wire end in any position. The body can be inserted in a tube, free in air, tape attached or glued.
Not intended for fluid immersed applications or continuous contact with water or conducting liquids. Can be potted in suitable resins. Consult Vishay for specific applications, mounting, alternative RT curves, or wire length.

DIMENSIONS in millimeters



T	B	L	L_1	L_2	Ø $d_{2\ MAX.}$	Ø d_1
2.0 to 2.5	2.0 to 2.5	110 ± 3	6 ± 1	5 ± 2	0.58	0.25 ± 0.025

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	SAP MATERIAL AND ORDERING NUMBER	
				RoHS COMPLIANT WITH EXEMPTION (1)	RoHS COMPLIANT
2765	2.93	3977	0.75	NTCLE301E4C90059	NTCLE301E4C90059A

Notes

Preferred versions for new designs

(1) RoHS exemption 7(c)-I: electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezo-electronic devices, or in a glass or ceramic matrix compound

NTC Thermistors, 2-Point Micro Chip Sensor Insulated Leads

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | Related Documents

FEATURES

- Flexible insulated leads for special mounting or assembly
- Miniature sized very fast reacting
- Accurate over a wide temperature range
- High stability over a long life
- Exceptional withstanding in thermal shocks
- AEC-Q200 qualified
- Fulfills the ELV 2000/53/EC

Pb-free Available

RoHS COMPLIANT

QUICK REFERENCE DATA		
PARAMETER	**VALUE**	**UNIT**
Resistance value at 25 °C	2.06K to 10K	Ω
Tolerance on R_{25}-value	± 1.92; ± 2.19	%
$B_{25/85}$-value	3511 to 3984	K
Tolerance on $B_{25/85}$	± 0.5 to ± 1	%
Temperature accuracy between 25 °C and 85 °C	± 0.5	°C
Operating temperature range	-40 to +125	°C
Maximum power dissipation at 55 °C	50	mW
Dissipation factor δ (in still air)	≈ 0.8	mW/K
Response time (in stirred air) (in oil)	≈ 3 ≈ 0.7	s
Minimum dielectric withstanding voltage between leads termination and coated body	100	V_{RMS}
Weight	≈ 0.05	g

APPLICATIONS

Temperature measurement, sensing and control in automotive and industrial applications

DESCRIPTION

These thermistors consist of a micro NTC ceramic chip soldered between two ETFE insulated AWG #32 solid silver plated nickel leads. The thermistor body is coated with a ocher colored insulating lacquer.

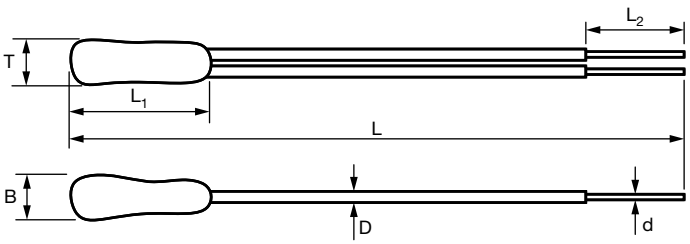
PACKAGING

The thermistors are packed in cardboard boxes; the smallest packing quantity is 1000 pieces.

MARKING

The components are not marked.

DIMENSIONS in millimeters



$T_{MAX.}$	$B_{MAX.}$	L	L_1	L_2	Ø $D_{MAX.}$	Ø d
1.6	1.6	41.0 ± 1	5.0 ± 1	5.0 ± 1	0.40	0.20 ± 0.01

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (1) (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (1) (K)	$B_{25/85}$-TOL. (± %)	SAP MATERIAL AND ORDERING NUMBER	
				RoHS COMPLIANT WITH EXEMPTION (2)	RoHS COMPLIANT
2060	1.92	3511	1.0	NTCLE305E4202SB	n/a
5000	2.19	3984	0.5	NTCLE305E4502SB	NTCLE305E4502SBA
10 000	2.19	3984	0.5	NTCLE305E4103SB	NTCLE305E4103SBA

Notes

Preferred versions for new designs

(1) Other R_{25} and B-values available on request

(2) RoHS exemption 7(c)-I: electrical and electronic components containing lead in a glass or ceramic other than dielectric ceramic in capacitors, e.g. piezo-electronic devices, or in a glass or ceramic matrix compound

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 2060 Ω

SAP PART AND ORDERING NUMBER: NTCLE305E4202SB(A)

TEMPERATURE (°C)	RESISTANCE (Ω)	R_T/R_{25}	R-TOL. (± %)	α (%/K)	T-TOL. (± °C)	$R_{MIN.}$ (Ω)	$R_{MAX.}$ (Ω)
-40.0	47 326	22.974	5.27	- 6.03	0.87	44 832	49 820
-35.0	35 203	17.089	4.95	-5.81	0.85	33 461	36 945
-30.0	26 473	12.851	4.64	-5.60	0.83	25 245	27 700
-25.0	20 115	9.7643	4.34	-5.39	0.81	19 241	20 988
-20.0	15 435	7.4925	4.06	-5.20	0.78	14 808	16 061
-15.0	11 954	5.8031	3.78	-5.02	0.75	11 502	12 407
-10.0	9341.4	4.5347	3.52	-4.85	0.73	9012.6	9670.2
-5.0	7361.4	3.5735	3.27	-4.68	0.70	7120.9	7601.8
0.0	5847.7	2.8387	3.02	-4.53	0.67	5671.0	6024.5
5.0	4680.9	2.2723	2.79	-4.38	0.64	4550.5	4811.4
10.0	3774.3	1.8322	2.56	-4.24	0.60	3677.7	3870.9
15.0	3064.4	1.4876	2.34	-4.10	0.57	2992.7	3136.2
20.0	2504.6	1.2158	2.13	-3.97	0.54	2451.3	2557.9
25.0	2060.0	1.0000	1.92	-3.85	0.50	2020.4	2099.6
30.0	1704.5	0.82744	1.86	-3.73	0.50	1672.7	1736.3
35.0	1418.6	0.68864	1.81	-3.62	0.50	1392.9	1444.3
40.0	1186.9	0.57618	1.76	-3.52	0.50	1166.1	1207.8
45.0	997.97	0.48445	1.71	-3.42	0.50	980.90	1015.0
50.0	842.90	0.40917	1.67	-3.33	0.50	828.85	856.95
55.0	714.92	0.34705	1.63	-3.25	0.50	703.29	726.55
60.0	608.74	0.29550	1.59	-3.18	0.50	599.06	618.41
65.0	520.21	0.25253	1.55	-3.11	0.50	512.13	528.30
70.0	446.08	0.21654	1.52	-3.04	0.50	439.29	452.86
75.0	383.73	0.18628	1.49	-2.98	0.50	378.01	389.45
80.0	331.09	0.16072	1.46	-2.92	0.50	326.25	335.93
85.0	286.48	0.13907	1.43	-2.87	0.50	282.37	290.59
90.0	248.55	0.12065	1.57	-2.81	0.56	244.64	252.45
95.0	216.18	0.10494	1.70	-2.77	0.62	212.50	219.87
100.0	188.49	0.091501	1.83	-2.72	0.67	185.04	191.95
105.0	164.73	0.079964	1.96	-2.67	0.73	161.50	167.95
110.0	144.27	0.070036	2.08	-2.63	0.79	141.27	147.28
115.0	126.63	0.061470	2.20	-2.59	0.85	123.84	129.42
120.0	111.36	0.054061	2.32	-2.55	0.91	108.78	113.95
125.0	98.133	0.047637	2.43	-2.51	0.97	95.746	100.52

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 5 kΩ							
SAP PART AND ORDERING NUMBER: NTCLE305E4502SB(A)							
TEMPERATURE (°C)	RESISTANCE (Ω)	R_T/R_{25}	R-TOL. (± %)	α (%/K)	T-TOL. (± °C)	$R_{MIN.}$ (Ω)	$R_{MAX.}$ (Ω)
-40	167 137	33.427	4.10	-6.63	0.62	160 290	173 984
-35	120 661	24.132	3.91	-6.41	0.61	115 939	125 383
-30	88 066	17.613	3.74	-6.19	0.60	84 775	91 358
-25	64 950	12.990	3.57	-5.99	0.60	62 632	67 268
-20	48 381	9.6761	3.41	-5.79	0.59	46 732	50 029
-15	36 382	7.2765	3.25	-5.61	0.58	35 199	37 565
-10	27 609	5.5218	3.10	-5.43	0.57	26 753	28 465
-5	21 134	4.2268	2.96	-5.26	0.56	20 509	21 759
0	16 312	3.2624	2.82	-5.10	0.55	15 852	16 772
5	12 691	2.5381	2.68	-4.94	0.54	12 350	13 031
10	9948.4	1.9897	2.55	-4.80	0.53	9694.3	10 203
15	7855.6	1.5711	2.43	-4.65	0.52	7664.7	8046.5
20	6246.4	1.2493	2.31	-4.52	0.51	6102.1	6390.6
25	5000.0	1.0000	2.19	-4.39	0.50	4890.3	5109.7
30	4028.0	0.80560	2.13	-4.26	0.50	3942.2	4113.8
35	3264.9	0.65297	2.07	-4.14	0.50	3197.3	3332.5
40	2661.9	0.53239	2.01	-4.03	0.50	2608.4	2715.5
45	2182.6	0.43653	1.96	-3.92	0.50	2139.9	2225.4
50	1799.4	0.35987	1.90	-3.81	0.50	1765.1	1833.6
55	1491.1	0.29823	1.85	-3.71	0.50	1463.5	1518.8
60	1241.9	0.24838	1.80	-3.61	0.50	1219.5	1264.3
65	1039.3	0.20787	1.76	-3.51	0.50	1021.1	1057.6
70	873.83	0.17477	1.71	-3.42	0.50	858.87	888.79
75	737.96	0.14759	1.67	-3.34	0.50	725.65	750.27
80	625.90	0.12518	1.63	-3.25	0.50	615.72	636.08
85	533.05	0.10661	1.59	-3.17	0.50	524.60	541.51
90	455.79	0.091159	1.66	-3.09	0.54	448.21	463.37
95	391.23	0.078246	1.74	-3.02	0.58	384.43	398.03
100	337.06	0.067411	1.81	-2.94	0.62	330.95	343.16
105	291.42	0.058284	1.88	-2.87	0.66	285.93	296.91
110	252.84	0.050568	1.95	-2.81	0.70	247.90	257.78
115	220.09	0.044019	2.02	-2.74	0.74	215.64	224.54
120	192.21	0.038441	2.09	-2.68	0.78	188.19	196.22
125	168.37	0.033675	2.15	-2.62	0.82	164.75	172.00

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 10 kΩ							
SAP PART AND ORDERING NUMBER: NTCLE305E4103SB(A)							
TEMPERATURE (°C)	RESISTANCE (Ω)	R/R_{25}	$\Delta R/R$ (%)	α (%/K)	$\Delta T_{MAX.}$ (± °C)	$R_{MIN.}$ (Ω)	$R_{MAX.}$ (Ω)
-40	334 274	33.427	4.10	-6.63	0.62	320 580	347 969
-35	241 323	24.132	3.91	-6.41	0.61	231 879	250 767
-30	176 133	17.613	3.74	-6.19	0.60	169 549	182 716
-25	129 900	12.990	3.57	-5.99	0.60	125 264	134 536
-20	96 761	9.6761	3.41	-5.79	0.59	93 465	100 058
-15	72 765	7.2765	3.25	-5.61	0.58	70 399	75 130
-10	55 218	5.5218	3.10	-5.43	0.57	53 506	56 931
-5	42 268	4.2268	2.96	-5.26	0.56	41 018	43 518
0	32 624	3.2624	2.82	-5.10	0.55	31 705	33 544
5	25 381	2.5381	2.68	-4.94	0.54	24 700	26 063
10	19 897	1.9897	2.55	-4.80	0.53	19 389	20 405
15	15 711	1.5711	2.43	-4.65	0.52	15 329	16 093
20	12 493	1.2493	2.31	-4.52	0.51	12 204	12 781
25	10 000	1.0000	2.19	-4.39	0.50	9780.7	10 219
30	8056.0	0.80560	2.13	-4.26	0.50	7884.3	8227.6
35	6529.7	0.65297	2.07	-4.14	0.50	6394.5	6664.9
40	5323.9	0.53239	2.01	-4.03	0.50	5216.7	5431.1
45	4365.3	0.43653	1.96	-3.92	0.50	4279.8	4450.7
50	3598.7	0.35987	1.90	-3.81	0.50	3530.2	3667.3
55	2982.3	0.29823	1.85	-3.71	0.50	2927.0	3037.6
60	2483.8	0.24838	1.80	-3.61	0.50	2439.0	2528.6
65	2078.7	0.20787	1.76	-3.51	0.50	2042.1	2115.2
70	1747.7	0.17477	1.71	-3.42	0.50	1717.7	1777.6
75	1475.9	0.14759	1.67	-3.34	0.50	1451.3	1500.5
80	1251.8	0.12518	1.63	-3.25	0.50	1231.4	1272.2
85	1066.1	0.10661	1.59	-3.17	0.50	1049.2	1083.0
90	911.59	0.091159	1.66	-3.09	0.54	896.42	926.75
95	782.46	0.078246	1.74	-3.02	0.58	768.85	796.06
100	674.11	0.067411	1.81	-2.94	0.62	661.89	686.33
105	582.84	0.058284	1.88	-2.87	0.66	571.86	593.83
110	505.68	0.050568	1.95	-2.81	0.70	495.79	515.56
115	440.19	0.044019	2.02	-2.74	0.74	431.28	449.09
120	384.41	0.038441	2.09	-2.68	0.78	376.38	392.44
125	336.75	0.033675	2.15	-2.62	0.82	329.50	344.00

NTC Thermistors, Long Insulated Leads 150 °C With Very Low Thermal Gradient

LINKS TO ADDITIONAL RESOURCES

Design Tools Related Documents

FEATURES

- Long and flexible leads for special mounting or assembly requirements
- Best accuracy of ± 0.5 °C between 25 °C and 85 °C and ± 1.0 °C between -55 °C and 150 °C
- Electrical features of “accuracy line” sensors
- Mounting: radial insulated leads, low heat-conducting FeNi wires
- AEC-Q200 qualified
- Fast response time of 0.3 s with small 1.6 mm head Ø

Pb-free

e4

RoHS COMPLIANT

QUICK REFERENCE DATA

PARAMETER	VALUE	UNIT
Resistance value at 25 °C	10K	Ω
Tolerance on R_{25}-value	± 2.19	%
Temperature accuracy between 25 °C and 85 °C -55 °C and 150 °C	 ± 0.5 ± 1.0	°C
$B_{25/85}$-value	3984	K
Tolerance on $B_{25/85}$-value	± 0.5	%
Operating temperature range at zero dissipation	-55 to +150	°C
Resistance value at 85 °C	1066.1	Ω
Maximum power dissipation at 55 °C	50	mW
Min. dielectric withstanding voltage (RMS) between leads and coating	100	V
Dissipation factor δ in still air (for information only)	0.8	mW/K
Response time (in oil)	0.3	s
Weight	≈ 0.05	g

APPLICATIONS

Temperature measurement, sensing and control in automotive and industrial applications as e.g. battery cells and packs.

DESCRIPTION

These negative temperature coefficient thermistors consist of a mini-chip soldered between two AWG #32 PEEK insulated silver plated nickel / iron leads and coated with ocher colored epoxy lacquer. High adhesive strength between PEEK wire and encapsulating lacquer.

PACKAGING

The thermistors are packed in cardboard boxes; the smallest packing quantity is 1000 units.

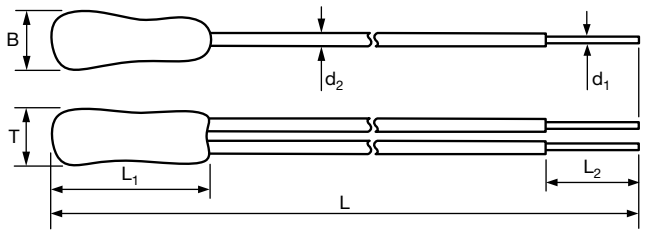
MARKING

The component is not marked.

MOUNTING

By soldering or crimping the wire end in any position. The body can be inserted in a tube, free in air, tape attached or glued.

DIMENSIONS in millimeters



T	B	L	L_1	L_2	Ø $d_{2\ MAX.}$	Ø d_1
1.6 max.	1.6 max.	75 ± 3	6 ± 1	5 ± 2	0.4	0.2 ± 0.02

ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	T-TOL. (± °C)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	SAP MATERIAL AND ORDERING NUMBER RoHS COMPLIANT
10 000	0.5	3984	0.5	NTCLE317E4103SBA

NTC Thermistors, Insulated Leads for 185 °C Applications

LINKS TO ADDITIONAL RESOURCES

3D Models | Design Tools | Related Documents

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	2.1K to 30K	Ω
Tolerance on R_{25}-value	1, 2, 3, 5	%
$B_{25/85}$-value	3435 to 3984	K
Tolerance on $B_{25/85}$-value	± 0.5 to ± 1	%
Operating temperature range	-55 to +185	°C
Response time (63.2 %) in stirred air 25 °C to 85 °C (for information only)	6	s
Dissipation factor δ in still air (for information only)	1.0	mW/K
Maximum power dissipation at 55 °C	100	mW
Minimum dielectric withstanding voltage (RMS) between terminals and coated body	1000	V_{AC}
Minimum insulation resistance between terminals and coated body at 500 V_{DC}	100M	Ω
Weight	30	mg

FEATURES

RoHS COMPLIANT

- Advanced NTC ceramic technology
- Wide temperature range from -55 °C to +185 °C
- Cost efficient thermistor design
- Small body diameter of maximum 2.4 mm
- Fast response time and high sensitivity
- Improved noxious gas and acid resistance
- Insulated Ag-plated NiFe alloy leads
- Mounting: radial
- AEC-Q200 qualified (rev. D)

APPLICATIONS

NTCLE350 can be processed by potting or molding into sensors for electric traction motors, for example in the sensing and protection of high current connectors.

NTCLE350 is suitable for EGR applications (exhaust gas recirculation) for steady state temperatures going up to 185 °C.

This series is also intended for oil temperatures sensors (OTS), in for example transmission systems and liquid cooled starter/generator systems.

The AEC-Q200 qualification (between -55 °C and 185 °C) enables this series to be used for classical motor thermal sensing applications (engine coolant, fuel sensor, TMAP for manifold air pressure) as well as in HVAC applications.

DESCRIPTION

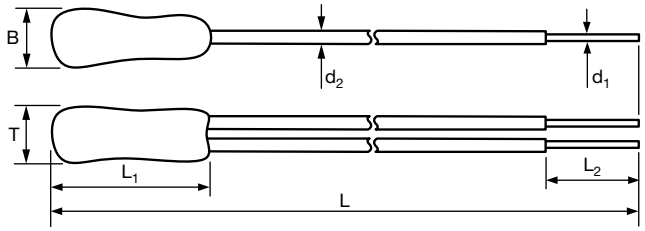
These negative temperature coefficient thermistors consist of a mini-chip soldered between two AWG #32 PEEK insulated silver plated NiFe alloy leads and coated with black colored epoxy lacquer. High adhesive strength between PEEK wire and encapsulating lacquer.

ELECTRICAL DATA AND ORDERING INFORMATION				
R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	SAP MATERIAL AND ORDERING NUMBER [1] RoHS COMPLIANT
2100	1, 2, 3, 5	3511	1	NTCLE350E4212xMB0
5000	1, 2, 3, 5	3435	1	NTCLE350E4502xLB0
10 000	1, 2, 3, 5	3984	0.5	NTCLE350E4103xHB0
10 000	1, 2, 3, 5	3435	1	NTCLE350E4103xLB0
30 000	1, 2, 3, 5	3935	1	NTCLE350E4303xHB0

Note

[1] Replace the x-digit by J for R_{25}-tolerance of 5 %, H for 3 %, G for 2 %, and F for 1 %

DIMENSIONS in millimeters



T	B	L	L_1	L_2	Ø $d_{2\ MAX.}$	Ø d_1
2.4 max.	2.4 max.	40 ± 1	6 ± 1	5 ± 1	0.4	0.2 ± 0.02

MOUNTING

The thermistors are suitable for all standard assembly processes like crimping, brazing, and welding (laser, ultrasonic, or resistance). The parameters of the assembly process should be chosen in accordance with the lead-wire material (silver plated Ni-Fe alloy) and validated in application.

Different conductor, insulation material, and dimensions are available on request.

The mounting process should be in compliance with the following guidelines and recommendations:

- Peeling forces on the leads should be reduced to a minimum and should never exceed 3 N
- Avoid large temperature gradients between the welding region and the sensor
- After complete assembly it is recommended to fix the leads in the welding region with a strain relief

If using a ceramic adhesive / potting or filling material avoid phosphate-based binders. Always follow the supplier's curing specifications fully including bringing the part up to operating temperature for a short time to ensure good moisture resistance and electrical performance of the total sensor.

ENVIRONMENTAL CONDITIONS

The thermistor should not be placed in a reducing atmosphere or be subjected to corrosive substances (e.g. phosphates) which could affect the functionality or the lifetime of the thermistor. Always maintain a sufficient partial oxygen pressure to avoid abnormal electrical drift and / or a reduced "life time".

The thermistor design can withstand conditions with low concentrations of H_2S, NO_2, Cl_2, and SO_2 according to DIN EN 60068-2-60, test Ke, method 4. Additionally it can withstand FOS90 testing according to ASTM B 809-95 (1000 hours / 90 °C / 76 % to 95 % RH / sulfur flowers) and 12 hours immersion (at 50 °C) in low concentrations of HCl, H_2SO_4, and acetic acid without functional or visual damage.

The thermistor was qualified according to AEC-Q200 rev. D with top temperature of 185 °C to assure best performance in today's most challenging environments.

SMD 0402, Glass Protected NTC Thermistors

FEATURES

- TCR ranging from -6.5 %/K at -40 °C to -2 %/K at 150 °C
- Tolerance on R_{25} down to 1 %
- Suitable for wave or reflow soldering
- NiSn terminations
- Fully glass coated and protected
- cULus recognized, file E148885 (UL category XGPU2 / XGPU8)
- AEC-Q200 qualified

RoHS COMPLIANT
HALOGEN FREE

LINKS TO ADDITIONAL RESOURCES

3D Models Design Tools

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	4.7K to 470K	Ω
Tolerance on R_{25}-value	± 1; ± 2; ± 3; ± 5	%
$B_{25/85}$-value	3490 to 4075	K
Tolerance on $B_{25/85}$-value	± 3	%
Maximum dissipation at 25 °C	70	mW
Thermal time constant τ	≈ 5	s
Dissipation factor D	≈ 2.0	mW/K
Operating temperature range at zero power	-40 to +150	°C
Weight	≈ 1.2	mg

APPLICATIONS

- Temperature sensing, protection and compensation in automotive, industrial, telecom and consumer applications. Examples are:
  - Battery chargers
  - Power supplies
  - Office equipment
  - LCD compensation
  - In-car entertainment

DESCRIPTION

Size 0402 (M1005) glass protected SMD chip thermistor with negative temperature coefficient (TCR) and matte tin (Sn) plated terminations. The device has no marking.

PACKAGING

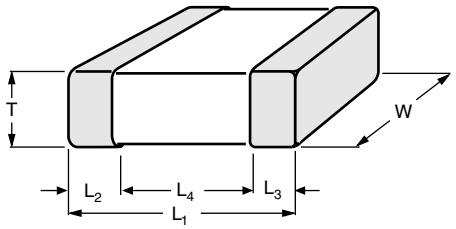
Available in 8 mm punched paper tape on reel package of 10 000 units.

ELECTRICAL DATA AND ORDERING INFORMATION				
R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	SAP MATERIAL AND ORDERING NUMBER ... (1)
4700	3, 5	3595	3	NTCS0402E3472*MT
10 000	1, 2, 3, 5	3490	3	NTCS0402E3103*L1T (2)
10 000	3, 5	3950	3	NTCS0402E3103*HT
15 000	3, 5	3965	3	NTCS0402E3153*HT
22 000	3, 5	3590	3	NTCS0402E3223*MT
33 000	3, 5	3670	3	NTCS0402E3333*MT
47 000	1, 2, 3, 5	4075	3	NTCS0402E3473*XT
68 000	3, 5	3910	3	NTCS0402E3683*HT
100 000	1, 2, 3, 5	3950	3	NTCS0402E3104*HT
470 000	3, 5	3807	3	NTCS0402E3474*HT (3)

Notes

(1) Replace * in SAP by J for ± 5 %, H for ± 3 %, G for ± 2 %, F for ± 1 % tolerance on R_{25}
(2) The digit 1 at the end of this part number NTCS0402E3103*L1T differentiates it from the legacy P/N
(3) This P/N is not UL recognized

DIMENSIONS in millimeters



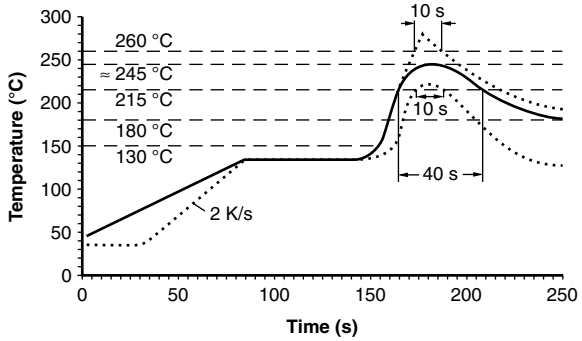
L_1	W	T	L_2 AND L_3 MIN.	L_4 MIN.
1.0 ± 0.15	0.5 ± 0.15	0.5 ± 0.15	0.1	0.3

SOLDERING CONDITIONS

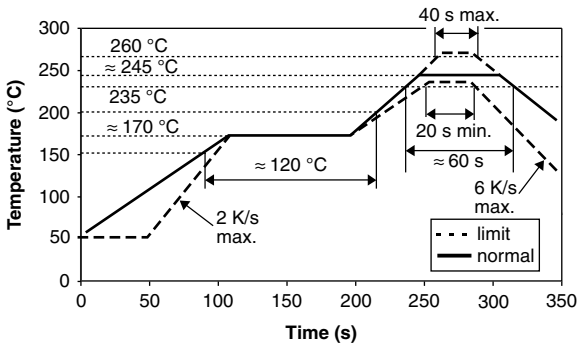
Soldering, handling, and mounting conditions are detailed in the instructions document:

Typical examples of a soldering processes that will provide reliable joints without damage, are shown below.

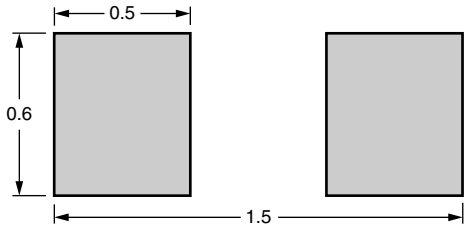
Reflow Soldering



Lead (Pb)-free Reflow Soldering Profile



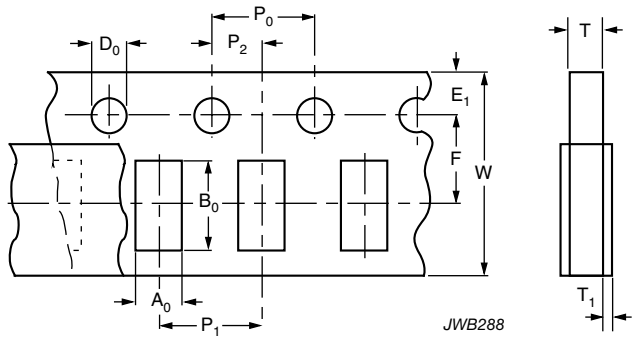
Recommended solder land pattern dimensions (mm)



PACKAGING

TAPE SPECIFICATIONS

All tape specifications are in accordance with IEC 60286-3. Basic dimensions are given below. Carrier tape material is paper.



DIMENSIONS OF PAPER TAPE in millimeters	
PARAMETER	DIMENSION
A_0 (1)	0.65 ± 0.1
B_0 (1)	1.15 ± 0.1
W	8.0 ± 0.2
E_1	1.75 ± 0.1
F	3.5 ± 0.05
D_0	1.55 ± 0.05
P_0 (2)	4.0 ± 0.1
P_1	4.0 ± 0.1
P_2	2.0 ± 0.05
T tape thickness max.	0.8
T_1 cover tape thickness max.	0.1

Notes

(1) Measured 0.3 mm above base pocket

(2) P_0 pitch cumulative error over any 10 pitches ± 0.2 mm

SMD 0603, Glass Protected NTC Thermistors

FEATURES

- TCR ranging from -7 %/K at -40 °C to -2 %/K at 150 °C
- Tolerance on R_{25} down to 1 %, and on $B_{25/85}$ down to 1 %
- Suitable for wave or reflow soldering
- NiSn terminations
- Fully glass coated and protected
- cULus recognized, file E148885 (UL category XGPU2 / XGPU8)
- AEC-Q200 qualified

AUTOMOTIVE GRADE

RoHS COMPLIANT

HALOGEN FREE

LINKS TO ADDITIONAL RESOURCES

3D Models Design Tools

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	1K to 100K	Ω
Tolerance on R_{25}-value	± 1; ± 2; ± 3; ± 5	%
$B_{25/85}$-value	3170 to 4100	K
Tolerance on $B_{25/85}$-value	± 1	%
Maximum dissipation at 25 °C	125	mW
Thermal time constant τ	≈ 8	s
Dissipation factor D	3.0	mW/K
Operating temperature range at zero power	-40 to +150	°C
Weight	≈ 0.006	g

APPLICATIONS

- Temperature sensing, protection and compensation in automotive, industrial, telecom and consumer applications. Examples are:
  - Battery chargers
  - Power supplies
  - Office equipment
  - LCD compensation
  - In-car entertainment

DESCRIPTION

Size 0603 (M1608) glass protected SMD chip thermistor with negative temperature coefficient (TCR) and matte tin (Sn) plated terminations. The device has no marking.

PACKAGING

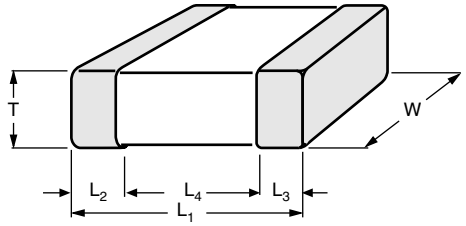
Available in 8 mm punched paper tape on reel package of 4000 units.

ELECTRICAL DATA AND ORDERING INFORMATION					
R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	UL RECOG. cULus	SAP MATERIAL AND ORDERING NUMBER (1)
1000	3, 5	3170	1		NTCS0603E3102*LT
1500	3, 5	3280	1		NTCS0603E3152*LT
2000	1, 2, 3, 5	3420	1	✓	NTCS0603E3202*LT
2200	1, 2, 3, 5	3520	1	✓	NTCS0603E3222*MT
2700	1, 2, 3, 5	3600	1	✓	NTCS0603E3272*MT
4700	1, 2, 3, 5	3830	1	✓	NTCS0603E3472*HT
5000	1, 2, 3, 5	3480	1		NTCS0603E3502*LT
10 000	1, 2, 3, 5	3435	1	✓	NTCS0603E3103*LT
10 000	1, 2, 3, 5	3610	1	✓	NTCS0603E3103*MT
10 000	1, 2, 3, 5	3960	1	✓	NTCS0603E3103*HT
15 000	1, 2, 3, 5	3600	1		NTCS0603E3153*MT
22 000	1, 2, 3, 5	3730	1	✓	NTCS0603E3223*MT
33 000	1, 2, 3, 5	3860	1	✓	NTCS0603E3333*HT
47 000	1, 2, 3, 5	3960	1	✓	NTCS0603E3473*HT
68 000	1, 2, 3, 5	3985	1	✓	NTCS0603E3683*HT
100 000	1, 2, 3, 5	4100	1	✓	NTCS0603E3104*XT

Note

(1) Replace * in SAP material number by J for ± 5 %, H for ± 3 %, G for ± 2 %, F for ± 1 % tolerance on R_{25}

DIMENSIONS in millimeters



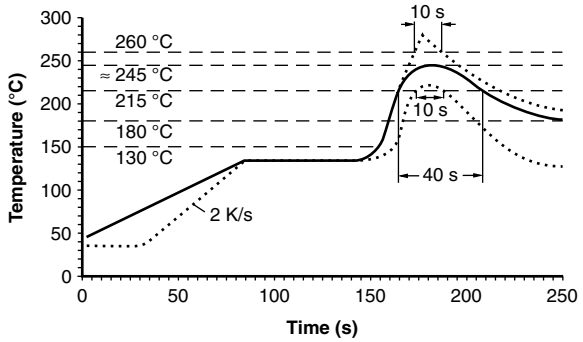
L_1	W	T	L_2 AND L_3 MIN.	L_4 MIN.
1.6 ± 0.15	0.8 ± 0.15	0.8 ± 0.15	0.2	0.4

SOLDERING CONDITIONS

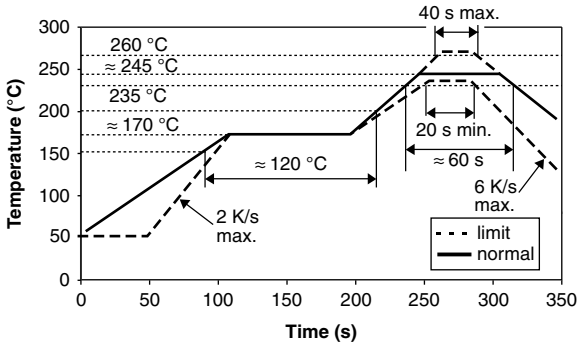
Soldering, handling, and mounting conditions are detailed in the instructions document

Typical examples of a soldering processes that will provide reliable joints without damage, are shown below.

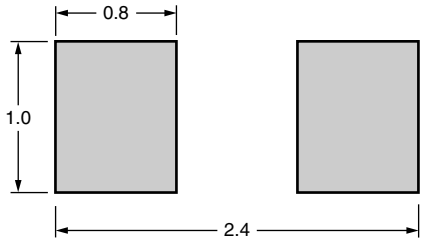
Reflow Soldering



Lead (Pb)-free Reflow Soldering Profile



Recommended solder land pattern dimensions (mm)

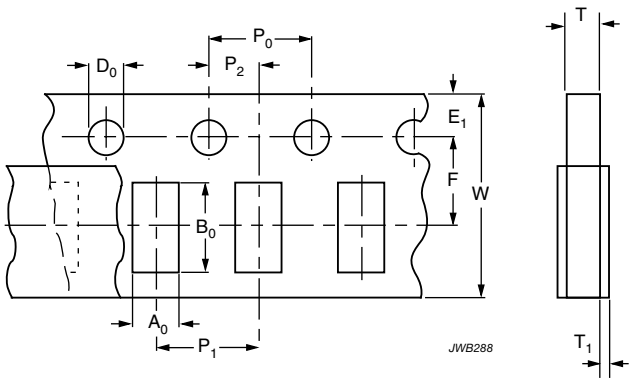


PACKAGING

TAPE SPECIFICATIONS

All tape specifications are in accordance with IEC 60286-3. Basic dimensions are given below. Carrier tape material is paper.

PAPER TAPE



DIMENSIONS OF PAPER TAPE in millimeters	
PARAMETER	DIMENSION
A_0 (1)	1.15 ± 0.1
B_0 (1)	1.9 ± 0.1
W	8.0 ± 0.2
E_1	1.75 ± 0.1
F	3.5 ± 0.05
D_0	1.55 ± 0.05
P_0 (2)	4.0 ± 0.1
P_1	4.0 ± 0.1
P_2	2.0 ± 0.05
T tape thickness max.	1.1
T_1 cover tape thickness max.	0.1

Notes

(1) Measured 0.3 mm above base pocket

(2) P_0 pitch cumulative error over any 10 pitches ± 0.2 mm

SMD 0805, Glass Protected NTC Thermistors

FEATURES

- TCR ranging from -6 %/K at -40 °C to -2 %/K at 150 °C
- Tolerance on R_{25} down to 1 %, and on $B_{25/85}$ down to 1 %
- Suitable for wave or reflow soldering
- NiSn terminations
- Fully glass coated and protected
- cULus recognized, file E148885 (UL category XGPU2 / XGPU8)
- AEC-Q200 qualified

AUTOMOTIVE GRADE

Pb-free

e3

RoHS COMPLIANT

HALOGEN FREE

LINKS TO ADDITIONAL RESOURCES

3D Models

Design Tools

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	1K to 680K	Ω
Tolerance on R_{25}-value	± 1; ± 2; ± 3; ± 5	%
$B_{25/85}$-value	3370 to 4125	K
Tolerance on $B_{25/85}$-value	± 1; ± 3	%
Maximum dissipation at 25 °C	210	mW
Thermal time constant τ	≈ 10	s
Dissipation factor D	3.5	mW/K
Operating temperature range at zero power	-40 to +150	°C
Weight	≈ 0.008	g

APPLICATIONS

- Temperature sensing, protection and compensation in automotive, industrial, telecom and consumer applications. Examples are:
  - Battery chargers
  - Power supplies
  - Office equipment
  - LCD compensation
  - In-car entertainment

DESCRIPTION

Size 0805 (M2012) glass protected SMD chip thermistor with negative temperature coefficient (TCR) and matte tin (Sn) plated terminations. The device has no marking.

PACKAGING

Available in 8 mm punched paper tape on reel package of 4000 units.

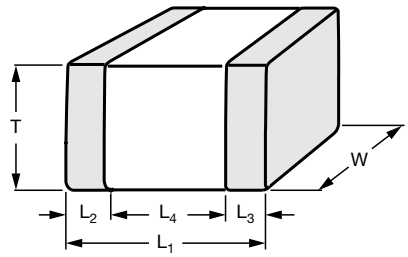
ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)	R_{25}-TOL. (± %)	$B_{25/85}$ (K)	$B_{25/85}$-TOL. (± %)	UL RECOG.	SAP MATERIAL AND ORDERING NUMBER (1)
1000	3, 5	3370	1		NTCS0805E3102*LT
1500	3, 5	3420	1		NTCS0805E3152*LT
2200	1, 2, 3, 5	3600	1	✓	NTCS0805E3222*MT
4700	1, 2, 3, 5	3500	1		NTCS0805E3472*MT
5000	1, 2, 3, 5	3480	1		NTCS0805E3502*LT
10 000	1, 2, 3, 5	3430	3	✓	NTCS0805E3103*LT
10 000	1, 2, 3, 5	3570	3	✓	NTCS0805E3103*MT
10 000	1, 2, 3, 5	3940	1	✓	NTCS0805E3103*HT
15 000	1, 2, 3, 5	3700	1	✓	NTCS0805E3153*MT
22 000	1, 2, 3, 5	3800	1	✓	NTCS0805E3223*HT
33 000	1, 2, 3, 5	3920	1	✓	NTCS0805E3333*HT
47 000	1, 2, 3, 5	3960	1	✓	NTCS0805E3473*HT
68 000	1, 2, 3, 5	4100	1	✓	NTCS0805E3683*XT
100 000	1, 2, 3, 5	3590	1	✓	NTCS0805E3104*MT
100 000	1, 2, 3, 5	4100	1	✓	NTCS0805E3104*XT
330 000	1, 2, 3, 5	3930	1	✓	NTCS0805E3334*HT
470 000	1, 2, 3, 5	4025	1	✓	NTCS0805E3474*XT
680 000	1, 2, 3, 5	4125	1	✓	NTCS0805E3684*XT

Note

(1) Replace * in SAP material number by J for ± 5 %, H for ± 3 %, G for ± 2 %, F for ± 1 % tolerance on R_{25}

DIMENSIONS



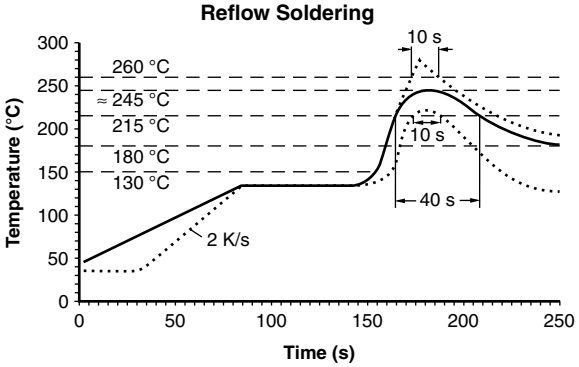
L_1	W	T	L_2 AND L_3 MIN.	L_4 MIN.
2.0 ± 0.2	1.25 ± 0.15	0.8 ± 0.15	0.2	0.55

SOLDERING CONDITIONS

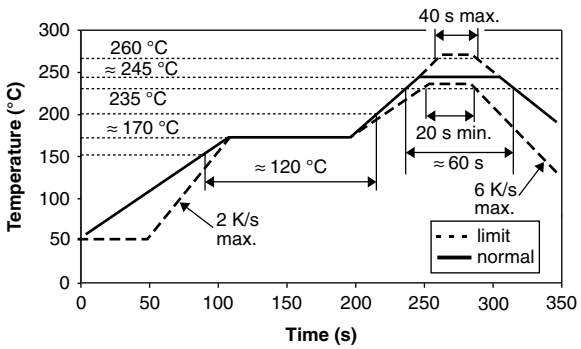
Soldering, handling, and mounting conditions are detailed in the instructions document

Typical examples of a soldering processes that will provide reliable joints without damage, are shown below.

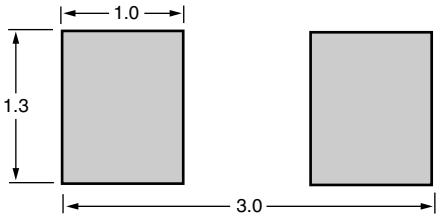
Reflow Soldering



Lead (Pb)-free Reflow Soldering Profile



Dimensions of the solder lands

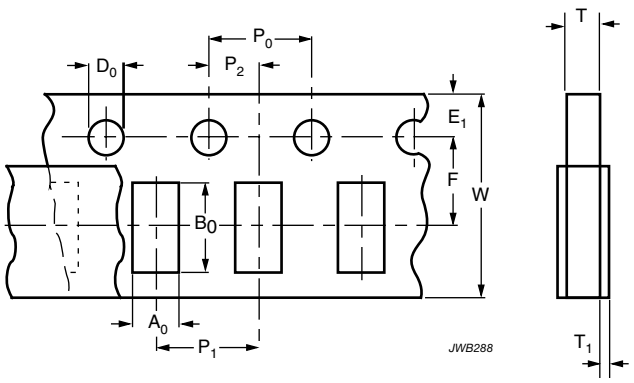


PACKAGING

TAPE SPECIFICATIONS

All tape specifications are in accordance with IEC 60286-3. Basic dimensions are given below. Carrier tape material is paper.

PAPER TAPE



DIMENSIONS OF PAPER TAPE in millimeters	
PARAMETER	**DIMENSION**
A_0 (1)	1.7 ± 0.2
B_0 (1)	2.35 ± 0.1
W	8.0 ± 0.2
E_1	1.75 ± 0.1
F	3.5 ± 0.05
D_0	1.55 ± 0.05
P_0 (2)	4.0 ± 0.1
P_1	4.0 ± 0.1
P_2	2.0 ± 0.05
T tape thickness max.	1.1
T_1 cover tape thickness max.	0.1

Notes

(1) Measured 0.3 mm above base pocket

(2) P_0 pitch cumulative error over any 10 pitches ± 1.0 mm

PTC Thermistors, Mini Radial Leaded for Over-Temperature Protection

FEATURES

- Well-defined protection temperature levels
- Fast response time
- Accurate resistance for ease of circuit design
- Excellent long term behavior ($\Delta T \leq 1$ °C after 1000 h at T_n + 15 °C)
- Wide range of protection temperatures (80 °C to 150 °C)
- Small size and rugged
- Coated leaded (bare pellets available)
- AEC-Q200 qualified

RoHS COMPLIANT

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance at 25 °C (R_{25})	20 to 120	Ω
Nominal working temperature T_n	80 to 150	°C
Maximum voltage	30	V
Operating temperature range (1)	-40 to +165	°C
Dissipation factor	5	mW/K
Thermal time constant (still air)	6	s
Weight	≈ 0.12	g

Note

(1) Max operating temperature range is T_n +15 °C, indicated value is for T_n = 150 °C

APPLICATIONS

Over-temperature protection and control in:

- Industrial electronics, motor drives, and lighting drivers
- Power supplies, converters, and heat-sink
- Motor protection

DESCRIPTION

These PTC sensing thermistors consist of a medium resistivity doped barium titanate ceramic with copper clad steel wires lead (Pb)-free soldered to the Ag metalized pellet. A high temperature silicone coating covers the sensing body and has a temperature marking character.

PACKAGING

PTC thermistors are available in 500 pieces bulk packed or 2000 pieces tape on reel.

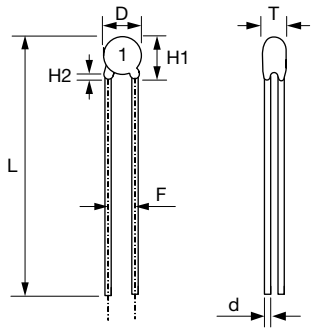
NOMINAL WORKING TEMPERATURES AND ORDERING INFORMATION			
NOMINAL WORKING TEMPERATURE	VISHAY SAP ORDERING NUMBER		
T_n (°C)	BULK	TAPE AND REEL	MARKING CODE
80	PTCSL03T081DB1E	PTCSL03T081DT1E	8
90	PTCSL03T091DB1E	PTCSL03T091DT1E	9
100	PTCSL03T101DB1E	PTCSL03T101DT1E	0
110	PTCSL03T111DB1E	PTCSL03T111DT1E	1
120	PTCSL03T121DB1E	PTCSL03T121DT1E	2
130	PTCSL03T131DB1E	PTCSL03T131DT1E	3
140	PTCSL03T141DB1E	PTCSL03T141DT1E	4
150	PTCSL03T151DB1E	PTCSL03T151DT1E	5

Note

- 2E pitch version in bulk or tape and reel available on request

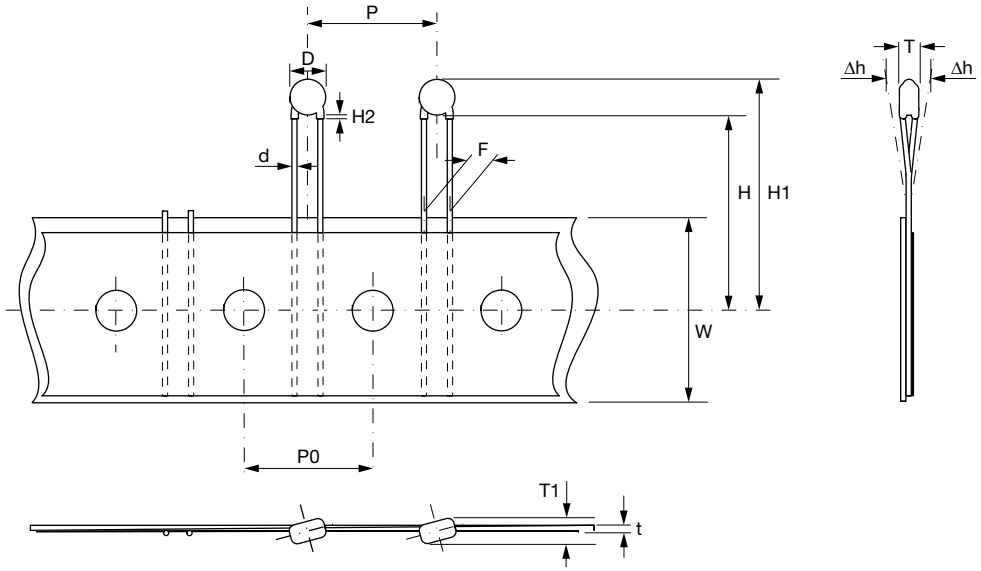
ELECTRICAL CHARACTERISTICS		
PARAMETER	**VALUES**	**UNIT**
Resistance at 25 °C	20 to 120	Ω
Maximum resistance between -20 °C and (T_n - 20) °C	250	Ω
Maximum resistance at -40 °C	300	Ω
Maximum resistance at (T_n - 5) °C	550	Ω
Minimum resistance at (T_n + 5) °C	1330	Ω
Minimum resistance at (T_n + 15) °C	4000	Ω
Maximum voltage	30	V (AC or DC)

DIMENSIONS in millimeters



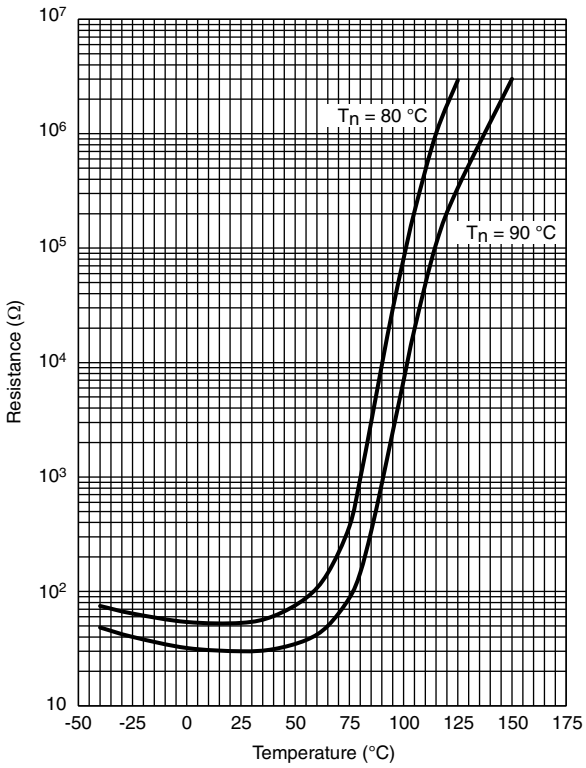
COMPONENT DIMENSIONS in millimeters	
D	3.3 ± 0.4
H1	4.7 ± 1.5
H2	1.5 ± 1.0
d	0.5 ± 0.05
L	30 ± 3
F	2.5 + 1.0 / -0.5
T	2.1 ± 0.3

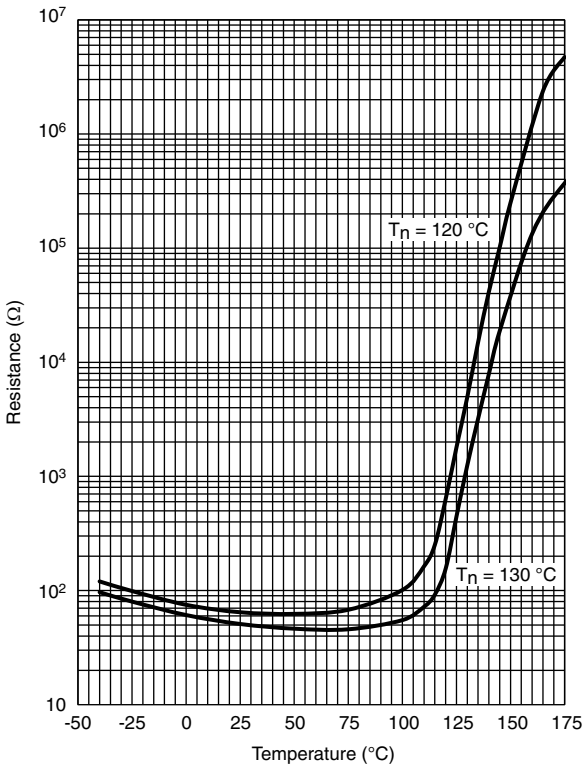
TAPING DATA DIMENSIONS in millimeters (based on IEC 60286-2)		
D	Body diameter	3.3 ± 0.4
d	Lead diameter	0.5 ± 0.05
F	Lead to lead center distance	2.5 + 0.5 / - 0.2
H	Component seating plane to tape-center	18.0 + 2.0
H1	Component top to tape-center	25 max.
Δh	Component alignment	0 ± 2
P	Component pitch	12.7
T	Total thickness	2.1 ± 0.3
T1	Total thickness in line of tape	3.5 max.
t	Total tape thickness	0.9 max.

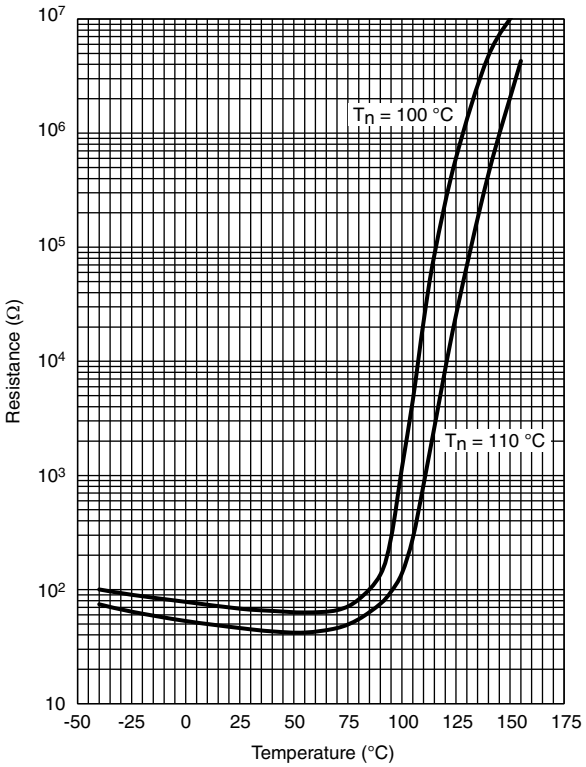


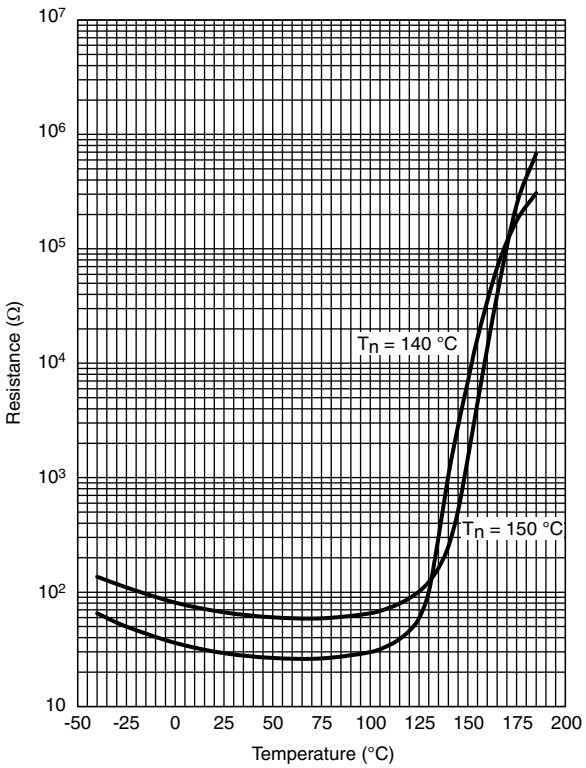
RESISTANCE VS. TEMPERATURE

Typical (≤ 5 V_{DC})









Temperature Dependent Platinum Thin Film Chip Resistor (RTD)

FEATURES

- Standardized characteristics according to IEC 60751
- AEC-Q200 qualified
- Short reaction times down to $t_{0.9} \leq 2$ s (in air)
- Outstanding stability of temperature characteristic
- Superior temperature cycling robustness

Pb-free

e3

RoHS COMPLIANT

HALOGEN FREE

DESIGN SUPPORT TOOLS AVAILABLE

3D Models | Design Tools | SPICE Models

APPLICATIONS

Temperature measurement and control in

- Automotive electronics
- Aviation electronics
- Industrial electronics

PTS AT SMD flat chip temperature dependent resistors are the perfect choice for temperature control of electronics operating under varying environmental conditions. The highly controlled platinum thin film manufacturing process guarantees an outstanding stability of temperature characteristics which ensures reliable operation even under harsh conditions. Typical applications include automotive, aviation and industrial electronics.

TECHNICAL SPECIFICATIONS

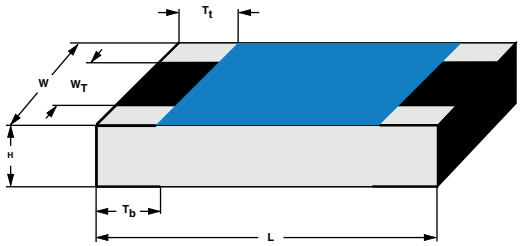
DESCRIPTION		PTS0603M	PTS0805M	PTS1206M
Resistance values R_0 at 0 °C		100 Ω	100 Ω, 500 Ω	100 Ω, 500 Ω, 1000 Ω
Temperature coefficient (0 °C to +100 °C), IEC60751		+3850 ppm/K		
Tolerance classes		F0.3, F0.6		
Temperature range		-55 °C to +175 °C		
Long term stability $\lvert\Delta R_0/R_0\rvert$; R_0 change after 1000 h at +155 °C		≤ 0.1 %		
Insulation resistance		> 10 MΩ		
Measurement current $I_{meas.}$ (DC) (1)	100 Ω	0.1 mA to 0.50 mA	0.1 mA to 1.0 mA	0.1 mA to 1.0 mA
	500 Ω	-	0.1 mA to 0.40 mA	0.1 mA to 0.40 mA
	1000 Ω	-	-	0.1 mA to 0.25 mA
Self-heating at 0 °C (2)	Calm air (v = 0.0 m/s)	≤ 0.9 K/mW	≤ 0.8 K/mW	≤ 0.7 K/mW
Thermal response time (2)	Flowing water (v = 0.4 m/s)	$t_{0.5} \leq 0.1$ s	$t_{0.5} \leq 0.2$ s	$t_{0.5} \leq 0.3$ s
		$t_{0.9} \leq 0.2$ s	$t_{0.9} \leq 0.3$ s	$t_{0.9} \leq 0.4$ s
	Flowing air (v = 3.0 m/s)	$t_{0.5} \leq 1.0$ s	$t_{0.5} \leq 1.5$ s	$t_{0.5} \leq 2.0$ s
		$t_{0.9} \leq 2.0$ s	$t_{0.9} \leq 3.0$ s	$t_{0.9} \leq 5.0$ s
Failure rate: $FIT_{observed}$		≤ 0.5 x 10^{-9}/h		

Notes

(1) Indicated measurement currents can be applied continuously with self-heating effect of less then 0.1 °C

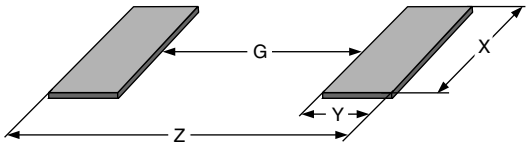
(2) Valid for sensor element only, in low dissipative mode. Response time and self-heating are influenced by mounting materials as substrate, solder lands, tracks and solders used

DIMENSIONS in millimeters



DIMENSIONS AND MASS							
TYPE	H	L	W	W_T	T_t	T_b	MASS (mg)
PTS 0603	0.45 + 0.1/- 0.05	1.55 +0.05 / -0.1	0.85 ± 0.1	> 75 % of W	0.3 + 0.15/- 0.2	0.3 + 0.15/- 0.2	1.9
PTS 0805	0.45 + 0.1 / - 0.05	2.0 ± 0.1	1.25 ± 0.15	> 75 % of W	0.4 ± 0.2	0.4 ± 0.2	4.6
PTS 1206	0.55 ± 0.1	3.1 + 0.1 / - 0.2	1.6 ± 0.15	> 75 % of W	0.5 ± 0.25	0.5 ± 0.25	9.2

SOLDER PAD DIMENSIONS in millimeters



RECOMMENDED SOLDERPAD DIMENSIONS								
TYPE	WAVE SOLDERING				REFLOW SOLDERING			
	G	Y	X	Z	G	Y	X	Z
PTS 0603	0.55	1.1	1.1	2.75	0.65	0.7	0.95	2.05
PTS 0805	0.8	1.25	1.50	3.2	0.9	0.9	1.4	2.7
PTS 1206	1.4	1.5	1.9	4.4	1.5	1.15	1.75	3.8

DESCRIPTION

A homogeneous film of platinum is deposited on a high grade (Al_2O_3) ceramic substrate and conditioned to achieve the correct temperature coefficient and stability. The sensor-elements are covered by a protective coating designed for electrical, mechanical and climatic protection. The terminations receive a final pure matte tin on nickel plating, the immunity against tin whisker growth has been proven under extensive testing.

QUALITY

The result of the determined production is verified by an extensive testing procedure and optical inspection performed on 100 % of the individual sensors. Only accepted products are laid directly into the paper tape in accordance with IEC 60286-3.

STORAGE

Solderability is specified for 2 years after production or re-qualification. The permitted storage time is 20 years.

ASSEMBLY

The Pt-sensors are suitable for processing on automatic SMD assembly systems. They are suitable for automatic soldering using wave, reflow or vapour phase as shown in IEC61760-1. The encapsulation is resistant to all cleaning solvents commonly used in the electronics industry, including alcohols, esters and aqueous solutions. The suitability of conformal coatings, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system. The use of potting resins in close contact with the protective coating or terminations is not recommended.

For frequent high temperature usage, thermal compatible substrates and solder alloys should be selected to minimize any thermal mismatch.

All products comply with the CEFIC-EECA-EICTA list of legal restrictions on hazardous substances.

This includes full compatibility with the following directives:

- 2000/53/EC End of Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the use of Hazardous Substances Directive (RoHS)
- 2002/96/EC Waste Electrical and Electronic Equipment Directive (WEEE)

APPROVALS

The Pt-sensors are tested in accordance with

- IEC 60751
- IEC 60068 series

The PTS AT are AEC-Q200 qualified.

PART NUMBER AND PRODUCT DESCRIPTION (1)

PART NUMBER (2): PTS0805M1B500RP100

P	T	S	0	8	0	5	M	1	B	5	0	0	R	P	1	0	0

TYPE	SIZE CODE	VERSION	TOLERANCE CLASS	RESISTANCE VALUE	PACKAGING (3)	SPECIAL
3 digits	4 digits	1 digit	2 digits	4 digits	2 digits	2 digits
PTS = platinum temperature sensor SMD	**0603** **0805** **1206**	**M** = AT (automotive)	**1B** = class F0.3 **2B** = class F0.6	**100R** = 100 Ω **500R** = 500 Ω **1K00** = 1000 Ω	**PU** **P1** **P5**	**00** = standard

PRODUCT DESCRIPTION (4): PTS 0805-B AT P1 500R

PTS	0805	-B	AT	P1	500R
TYPE	SIZE CODE	TOLERANCE CLASS	VERSION	PACKAGING (3)	RESISTANCE VALUE
PTS = platinum temperature sensor SMD	**0603** **0805** **1206**	**B** = class F0.3 **2B** = class F0.6	**AT** = automotive	**PU** **P1** **P5**	**100R** = 100 Ω **500R** = 500 Ω **1K** = 1000 Ω

Notes

(1) Products can be ordered using either the PART NUMBER or the PRODUCT DESCRIPTION

(2) The part number is shown to facilitate the introduction of a unified part numbering system

(3) Please refer to table PACKAGING

(4) We recommend that the Production Description is used to minimize the possibility of errors in order handling

PACKAGING

TYPE	CODE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	BOX/REEL	BOX/REEL DIAMETER
PTS 0603 PTS 0805 PTS 1206	PU	100	Paper tape acc. IEC 60286-3	8 mm	4 mm	Plastic box	114 mm
	P1	1000				Reel	180 mm/7"
	P5	5000					

TEST AND REQUIREMENTS - PERFORMANCE

TEST	CONDITIONS	REQUIREMENTS $\lvert\Delta R_0/R_0\rvert \leq \pm$	TYPICAL PERFORMANCE	
			$\lvert\Delta R_0/R_0\rvert \leq \pm$	$\Delta T \leq \pm$
High temperature exposure (storage)	AEC-Q200, 1000 h at 155 °C	0.1 %	0.015 %	0.04 °C
High temperature exposure (storage)	1000 h at 175 °C	0.2 %	0.018 %	0.05 °C
Temperature cycling	AEC-Q200, 1000 cycles -55 °C to +155 °C	0.5 %	0.04 %	0.10 °C
Biased humidity	1000 h, 1 mA biased at 85 °C / 85 % rh	0.5 %	0.015 %	0.04 °C
Operational life	1000 h, 1 mA biased at 125 °C	0.2 %	0.01 %	0.03 °C
Vibration	MIL-STD 202, method 204	0.1 %	0.02 %	0.05 °C
Mechanical shock	MIL-STD 202, method 213	0.1 %	0.02 %	0.05 °C
Resistance to soldering heat	Solder bath dipping 10 s at 260°C	0.25 %	0.05 %	0.13 °C
ESD	AEC-Q200-002, HBM (CD) 1.0 kV (0603), 1.5 kV (0805), 2.0 kV (1206)	0.2 %	0.01 %	0.03 °C
Board flex	AEC-Q200-005, 2 mm during 60 s	0.2 %	0.015 %	0.04 °C
Terminal strength	AEC-Q200-006, shear test 10 N / 17.7 N during 60 s	0.25 %	0.018 %	0.05 °C

FUNCTIONAL PERFORMANCE

The temperature resistance relationships of the PTS series follow different equations:

For the temperature range of -55 °C up to 0 °C:

$$R_T = R_0 \times (1 + A \times T + B \times T^2 + C \times (T - 100\ °C) \times T^3)$$

And for the temperature range of 0 °C up to +175 °C:

$$R_T = R_0 \times (1 + A \times T + B \times T^2)$$

R_T: Resistance as a function of temperature
R_0: Nominal resistance value at 0 °C
T: Temperature in °C

According to IEC 60751 the values of the coefficients are:

$A = 3.9083 \times 10^{-3}\ °C^{-1}$
$B = -5.775 \times 10^{-7}\ °C^{-2}$
$C = -4.183 \times 10^{-12}\ °C^{-4}$

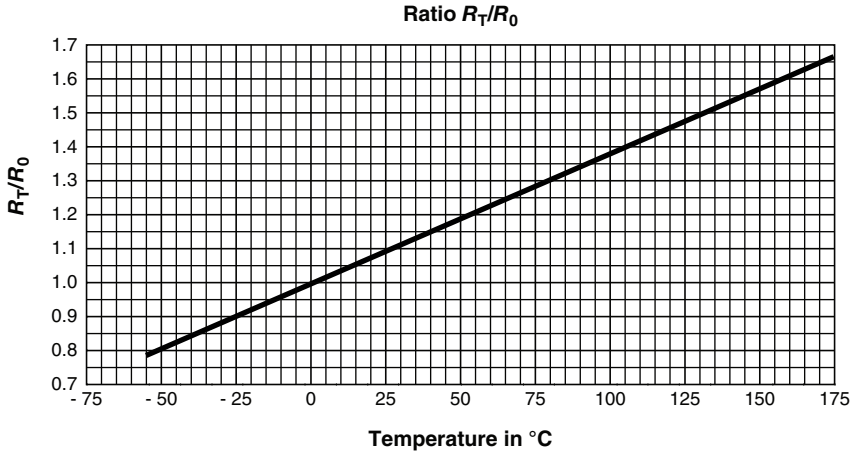
The tolerances values of the PTS AT series are classified by the following equations as specified by IEC 60751:

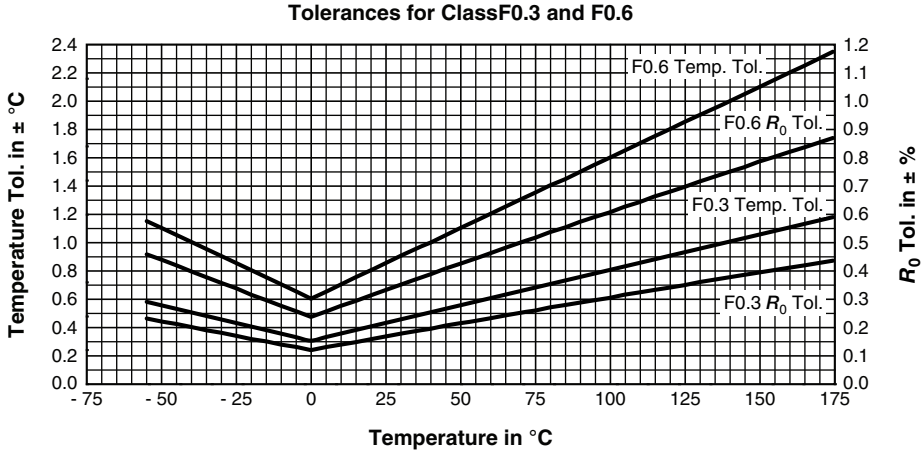
Class F0.3: $\Delta T_{F0.3} = \pm (0.3 + 0.005 \times |T|)$

Class F0.6: $\Delta T_{F0.6} = \pm (0.6 + 0.010 \times |T|)$

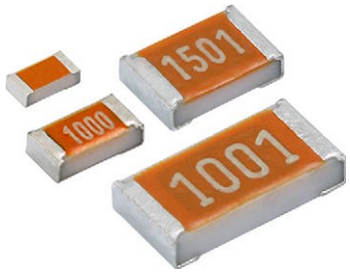
NOMINAL RESISTANCE VALUES AND TEMPERATURE TOLERANCE

TEMPERATURE in °C	NOMINAL RESISTANCE in Ω			TOLERANCE in K	
	R_0 = 100 Ω	R_0 = 500 Ω	R_0 = 1000 Ω	CLASS F0.3	CLASS F0.6
-55	78.319	391.59	783.19	± 0.58	± 1.15
-50	80.306	401.53	803.06	± 0.55	± 1.10
-25	90.192	450.96	901.92	± 0.43	± 0.85
0	**100.00**	**500.00**	**1000.00**	**± 0.30**	**± 0.60**
25	109.73	548.67	1097.35	± 0.43	± 0.85
50	119.40	596.99	1193.97	± 0.55	± 1.10
75	128.99	644.94	1289.87	± 0.68	± 1.35
100	138.51	692.53	1385.06	± 0.80	± 1.60
125	147.95	739.76	1479.51	± 0.93	± 1.85
150	157.33	786.63	1573.25	± 1.05	± 2.10
175	166.63	833.13	1666.27	± 1.18	± 2.35





SMD PTC - Nickel Thin Film Linear Thermistors



FEATURES

- Alumina substrate base with nickel based PTC thin film element
- 0402, 0603, 0805, and 1206 sizes available
- Available in tape and reel packaging
- Standard R_{25} tolerances: ± 0.5 %, ± 1 %, ± 5 %
- Operation range -55 °C to +150 °C
- High stability over the entire temperature range
- cULus recognized, file E148885 (UL category XGPU2 / XGPU8)
- AEC-Q200 qualified (grade 1), except TFPT0402

Pb Available

e3

RoHS* Available

HALOGEN FREE

ADDITIONAL RESOURCES

Design Tools

Note

* This datasheet provides information about parts that are RoHS-compliant and / or parts that are non RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS-compliant. Please see the information / tables in this datasheet for details

APPLICATIONS

Temperature compensation and sensing in

- Automotive
- Motor drives
- Lighting LED drivers
- Test and measuring equipment
- Air-flow sensor

QUICK REFERENCE DATA					
PARAMETER	**VALUE**				**UNIT**
DESCRIPTION	**TFPT0402**	**TFPT0603**	**TFPT0805**	**TFPT1206**	
Resistance value at 25 °C (2)	5	100 to 1K	100 to 5K	100 to 10K	Ω
Tolerance on R_{25}-value (2)	± 25	± 0.5; ± 1; ± 5			%
TCR at 25 °C	4110				ppm/K
Tolerance on TCR at 25 °C (1)	± 400				
Operating temperature range: at rated power at zero dissipation (4)	 -55 to +70 -55 to +150				°C
Dissipation factor δ (for information only) (5)	0.8	1.8	2.3	4	mW/K
Maximum rated power at 70 °C (P_{70}) (5)	100 (6)	75	100	125	mW
Maximum working voltage RCWV (3)	1.2	30	40	50	V
Climatic category (LCT/UCT/days)	55/150/56				-
Weight	0.65	2	5.5	10	mg
Failure rate $FIT_{observed}$	≤ 0.1 x 10^{-9}/h				

Notes

(1) Contact Vishay if closer TCR lot tolerance is desired
(2) Other R_{25}-values and tolerances are available upon request
(3) Rated continuous working voltage is maximum working voltage or $\sqrt{P_{70} \times R}$ whichever is less
(4) Zero power or zero dissipation is considered as measuring power max. 1 % of rated power P_{70}
(5) Please refer to APPLICATION INFORMATION
(6) Power levels are depending on way of mounting and substrates used. Higher power up to 200 mW at 25 °C (P_{25}) can be tolerated on uniform layer TFPT0402 5R

APPLICATION INFORMATION

When the resistor dissipates power, a temperature rise above the ambient temperature occurs, dependent on the thermal resistance of the assembled resistor together with the printed circuit board. The rated dissipation applies only if the permitted film temperature of 150 °C is not exceeded.

The TFPT0402 uniform layer linear thermistor with low resistance value can be used as an air-flow sensor in a controlled power mode where nickel film temperature changes can be related to air-flow speed.

STANDARD RESISTANCE VALUES at 25 °C in Ω

100	180	330	560	1.0K	1.8K	3.3K	5.0K	8.2K
120	220	390	680	1.2K	2.2K	3.9K	5.6K	10.0K
150	270	470	820	1.5K	2.7K	4.7K	6.8K	

Note

- Rated continuous working voltage is maximum working voltage or $\sqrt{P_{70} \times R}$ whichever is less

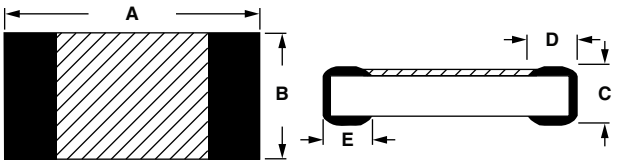
GLOBAL PART NUMBER INFORMATION

Global Part Numbering: TFPT1206L1002FM (preferred part number format)

T	F	P	T	1	2	0	6	L	1	0	0	2	F	M

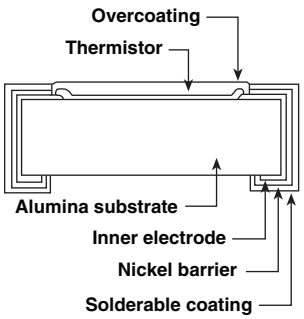
GLOBAL MODEL	CHARACTERISTIC	RESISTANCE VALUE	TOLERANCE CODE	PACKAGING
TFPT0402 **TFPT0603** **TFPT0805** **TFPT1206**	**L** = linear **U** = uniform linear (0402)	**1002** = 10K **0050** = 5R (0402)	**D** = ± 0.5 % **F** = ± 1 % **J** = ± 5 % **V** = ± 25 % (0402)	**L** = lead (Pb)-free, T/R (10 000 pcs) 0402 **M** = lead (Pb)-free, T/R (5000 pcs) **V** = lead (Pb)-free, T/R (1000 pcs) **Z** = tin / lead, T/R (5000 pcs) **Y** = tin / lead, T/R (1000 pcs)

DIMENSIONS in millimeters



PART NUMBER	A	B	C	D	E
TFPT 0402	1.00 ± 0.05	0.50 ± 0.05	0.35 ± 0.07	0.20 ± 0.10	0.20 ± 0.10
TFPT 0603	1.55 ± 0.10	0.80 ± 0.10	0.45 ± 0.10	0.30 ± 0.20	0.30 ± 0.20
TFPT 0805	2.00 ± 0.15	1.25 ± 0.15	0.45 ± 0.10	0.40 ± 0.20	0.40 ± 0.20
TFPT 1206	3.05 ± 0.15	1.50 ± 0.15	0.55 ± 0.10	0.50 ± 0.25	0.50 ± 0.25

CONSTRUCTION



TESTS AND REQUIREMENTS (except TFPT0402)

TEST	CONDITIONS [1]	REQUIREMENTS MAX. $\lvert\Delta R_{25}/R_{25}\rvert$
High temperature exposure (storage)	AEC-Q200, 1000 h at 150 °C	0.25 %
Temperature cycling	AEC-Q200, 1000 cycles -55 °C / +125 °C	0.25 %
Biased humidity	1000 h, 1 mA biased at 85 °C / 85 % RH	0.25 %
	1000 h, 1 mA biased at 40 °C / 95 % RH	0.25 %
Operational life	1000 h, P_{70} max biased at 85 °C	0.25 %
Mechanical shock and vibration	MIL-STD 202, method 213 - 204	0.50 %
Resistance to soldering heat	MIL-STD 202, method 210, solder bath dipping 10 s at 260°C	0.25 %
ESD [2]	AEC-Q200-002, HBM (CD) 0.5 kV (0603), 1.0 kV (0805), 1.0 kV (1206)	0.25 %
Board flex	AEC-Q200-005, 2 mm during 60 s	0.25 %
Terminal strength	AEC-Q200-006, shear test 17.7 N during 60 s	0.25 %

Notes

(1) Environmental performance specifications use test procedures as outlined in MIL-R23648D, MIL-STD 202 and AEC-Q200

(2) TFPTs are ESD sensitive

AGENCY APPROVALS (except TFPT0402)

- cUL certificate
- ULus certificate

AVERAGE RATIO R/R_{25} TFPT ALL SIZES AND VALUES											
TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}	TEMP.	R/R_{25}
		-20	0.825	20	0.980	60	1.150	100	1.337	140	1.541
		-19	0.828	21	0.984	61	1.155	101	1.342	141	1.547
		-18	0.832	22	0.988	62	1.159	102	1.347	142	1.552
		-17	0.836	23	0.992	63	1.164	103	1.352	143	1.557
		-16	0.839	24	0.996	64	1.168	104	1.357	144	1.563
-55	0.702	-15	0.843	**25**	**1.000**	65	1.173	105	1.362	145	1.568
-54	0.705	-14	0.847	26	1.004	66	1.177	106	1.367	146	1.574
-53	0.708	-13	0.851	27	1.008	67	1.182	107	1.372	147	1.579
-52	0.712	-12	0.854	28	1.012	68	1.186	108	1.377	148	1.584
-51	0.715	-11	0.858	29	1.017	69	1.191	109	1.382	149	1.590
-50	0.719	-10	0.862	30	1.021	70	1.196	110	1.387	150	1.595
-49	0.722	-9	0.866	31	1.025	71	1.200	111	1.392		
-48	0.725	-8	0.869	32	1.029	72	1.205	112	1.397		
-47	0.729	-7	0.873	33	1.033	73	1.209	113	1.402		
-46	0.732	-6	0.877	34	1.037	74	1.214	114	1.407		
-45	0.736	-5	0.881	35	1.042	75	1.219	115	1.412		
-44	0.739	-4	0.885	36	1.046	76	1.223	116	1.417		
-43	0.743	-3	0.889	37	1.050	77	1.228	117	1.422		
-42	0.746	-2	0.892	38	1.054	78	1.232	118	1.427		
-41	0.749	-1	0.896	39	1.059	79	1.237	119	1.432		
-40	0.753	0	0.900	40	1.063	80	1.242	120	1.437		
-39	0.756	1	0.904	41	1.067	81	1.246	121	1.442		
-38	0.760	2	0.908	42	1.071	82	1.251	122	1.448		
-37	0.763	3	0.912	43	1.076	83	1.256	123	1.453		
-36	0.767	4	0.916	44	1.080	84	1.261	124	1.458		
-35	0.771	5	0.920	45	1.084	85	1.265	125	1.463		
-34	0.774	6	0.924	46	1.089	86	1.270	126	1.468		
-33	0.778	7	0.927	47	1.093	87	1.275	127	1.473		
-32	0.781	8	0.931	48	1.097	88	1.280	128	1.478		
-31	0.785	9	0.935	49	1.102	89	1.284	129	1.484		
-30	0.788	10	0.939	50	1.106	90	1.289	130	1.489		
-29	0.792	11	0.943	51	1.110	91	1.294	131	1.494		
-28	0.796	12	0.947	52	1.115	92	1.299	132	1.499		
-27	0.799	13	0.951	53	1.119	93	1.303	133	1.505		
-26	0.803	14	0.955	54	1.124	94	1.308	134	1.510		
-25	0.806	15	0.959	55	1.128	95	1.313	135	1.515		
-24	0.810	16	0.963	56	1.133	96	1.318	136	1.520		
-23	0.814	17	0.967	57	1.137	97	1.323	137	1.526		
-22	0.817	18	0.971	58	1.141	98	1.328	138	1.531		
-21	0.821	19	0.975	59	1.146	99	1.333	139	1.536		

RATIO FORMULA

$R_T = R_{25}$ x (9.0014 x 10^{-1} + 3.87235 x 10^{-3} (°C)$^{-1}$ x T + 4.86825 x 10^{-6} (°C)$^{-2}$ x T^2 + 1.37559 x 10^{-9} (°C)$^{-3}$ x T^3)
$T_{(°C)}$ = 28.54 x $(R_T/R_{25})^3$ - 158.5 x $(R_T/R_{25})^2$ + 474.8 x (R_T/R_{25}) - 319.85)

RATIO TOLERANCES		
LOW TEMP.	HIGH TEMP.	TOL.
-55 °C	+150 °C	± 4 %
-40 °C	+125 °C	± 3 %
-20 °C	+85 °C	± 2 %
0 °C	+55 °C	± 1 %
+12 °C	+40 °C	± 0.5 %

RATIO TOLERANCE EXAMPLES:

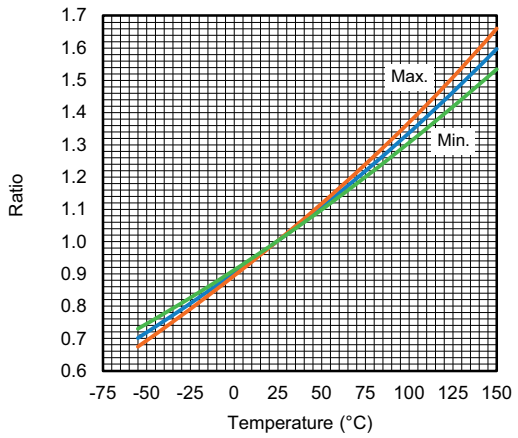
At 40 °C, ratio = 1.063 ± 0.5 % (0.005)
so, ratio = 1.058 to 1.068

At 125 °C, ratio = 1.460 ± 3 % (0.044)
so, ratio = 1.416 to 1.504

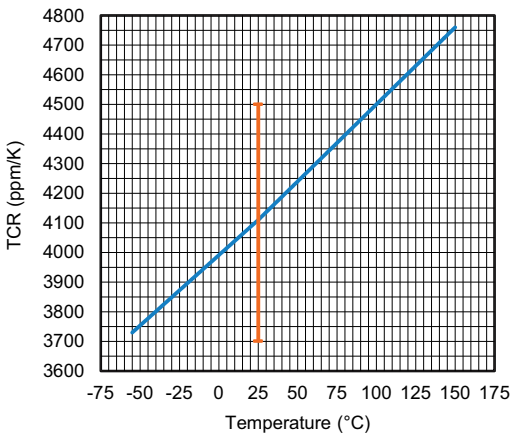
At intermediate temperatures, the ratios can be gradually adapted, for example at 105 °C the ratio tolerance will be ± 2.5 %.

For total resistance tolerance, the specific R_{25} tolerance needs to be multiplied with the ratio tolerance, for example a 100R 1 % at 25 °C will have a maximum resistance at 125 °C of 100R x 1.463 x 1.03 x 1.01 = 152.2 Ω.

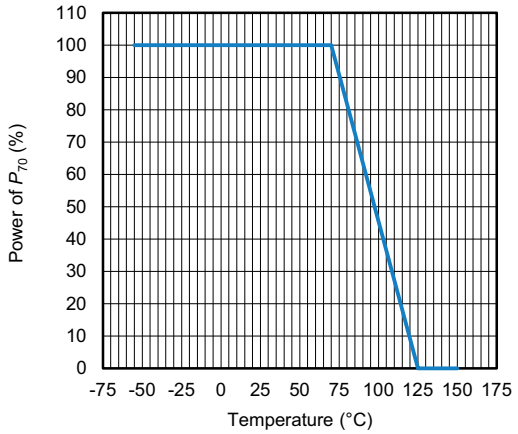
RATIO R_T/R_{25}



TCR TYPICAL VALUE



POWER DERATING



Note

- Zero power is considered as measuring power max. 1 % of rated power P_{70}

145 V PTC Thermistors for Overload Protection

FEATURES

- Wide range of trip and non-trip currents: From 47 mA up to 1 A for the non-trip current
- Small ratio between trip and non-trip currents (I_t/I_{nt} = 1.5 at 25 °C)
- High maximum inrush current (up to 13 A)
- Leaded parts withstand mechanical stresses and vibration
- UL file E148885 according to XGPU standard UL1434

RoHS COMPLIANT

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Maximum voltage (RMS or DC)	145	V
Maximum holding current (I_{hd})	0.047 to 1	A
Resistance at 25 °C (R_{25})	1.3 to 240	Ω
Tolerance on R_{25} value	20	%
Maximum overload current I_{ol}	0.2 to 13	A
Switching temperature	135 to 140	°C
Operating temperature range at max. voltage	0 to 70	°C
Storage temperature	-40 to +175	°C

QUALITY

UL approved PTCs are guaranteed to withstand severe test programs and have factory audited follow-up programs. Major UL qualification tests are long-life (6000 cycles) electrical cycle tests at trip-current, long-life stability storage tests (3000 h at 250 °C), damp heat and water immersion tests and over-voltage tests up to 200 % of rated voltage.

UL approved PTCs are guaranteed to withstand severe test programs

- Long-life cycle tests (over 5000 trip cycles)
- Long-life storage tests (3000 h at 250 °C)
- Electrical cycle tests at low ambient temperatures (-40 °C or 0 °C)
- Damp-heat and water immersion tests
- Overvoltage tests at up to 200 % of rated voltage

APPLICATIONS

Overload (current, voltage, temperature) protection in:

- Telecommunications
- Industrial electronics
- Consumer electronics
- Electronic data processing

DESCRIPTION

These directly heated ceramic-based thermistors have a positive temperature coefficient and are primarily intended for overload protection. They consist of a ceramic pellet soldered between two tinned CCS wires and coated with a UL 94 V-0 high temperature hard silicone lacquer.

MOUNTING

PTC thermistors can be mounted by wave, reflow, or hand-soldering. Current levels have been determined according IEC 60738 conditions. Different ways of mounting or connecting the thermistors can influence their thermal and electrical behavior. Standard operation is in still air, any potting or encapsulation of PTC thermistors is not recommended and will change its operating characteristics.

Typical Soldering
235 °C; duration: 5 s (Lead (Pb)-bearing)
245 °C, duration: 5 s (Lead (Pb)-free)

Resistance to Soldering Heat
260 °C, duration: 10 s max.

MARKING

Only the grey lacquered thermistors with a diameter of 8.5 mm to 20.5 mm are marked with BC, R_{25} value (example 1R9) on one side and I_{nt}, $V_{max.}$ on the other side.

ELECTRICAL DATA AND ORDERING INFORMATION

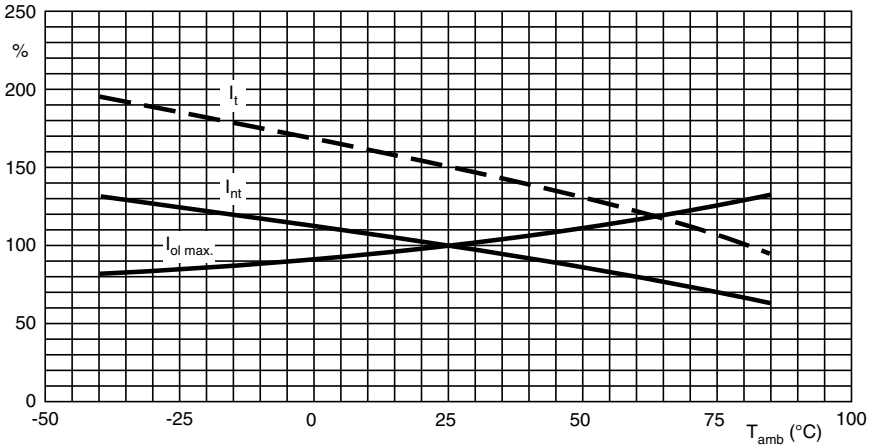
I_{nt} MAX. at 25 °C (mA) (1)	I_t MIN. at 25 °C (mA) (1)	R_{25} ± 20 % (Ω)	I_{ol} MAX. at 25 °C (mA) (2)	I_{res} MAX. at $V_{max.}$ and 25 °C (mA) (1)	DISSIP. FACTOR (mW/K) (1)	Ø D MAX. (mm)	ORDERING PART NUMBERS	
							BULK	TAPE ON REEL
47	70	240	200	9	7.3	5	PTCCL05H470FBE	PTCCL05H470FTE
65	100	115	300	11	7.3	5	PTCCL05H650FBE	PTCCL05H650FTE
93	140	55	450	13	7.3	5	PTCCL05H930FBE	PTCCL05H930FTE
110	165	40	500	13	7.3	5	PTCCL05H111FBE	PTCCL05H111FTE
130	195	28	600	13	7.3	5	PTCCL05H131FBE	PTCCL05H131FTE
170	255	19	1000	15	8.3	7	PTCCL07H171FBE	PTCCL07H171FTE
210	315	12	1400	15	8.3	7	PTCCL07H211FBE	PTCCL07H211FTE
250	375	9.4	2000	16.5	9	8.5	PTCCL09H251FBE	PTCCL09H251FTE
270	405	8	2200	16.5	9	8.5	PTCCL09H271FBE	PTCCL09H271FTE
320	480	6.7	3000	19	10.5	10.5	PTCCL11H321FBE	PTCCL11H321FTE
360	540	5.3	3500	19	10.5	10.5	PTCCL11H361FBE	PTCCL11H361FTE
410	615	4.6	4500	22.5	11.7	12.5	PTCCL13H411FBE	PTCCL13H411FTE
450	675	3.8	5000	22.5	11.7	12.5	PTCCL13H451FBE	PTCCL13H451FTE
600	900	2.9	7200	28.5	15.5	16.5	PTCCL17H601FBE	-
710	1065	2.1	8500	28.5	15.5	16.5	PTCCL17H711FBE	-
880	1320	1.7	11 000	37.5	19.8	20.5	PTCCL21H881FBE	-
1000	1500	1.3	13 000	37.5	19.8	20.5	PTCCL21H102FBE	-

Notes

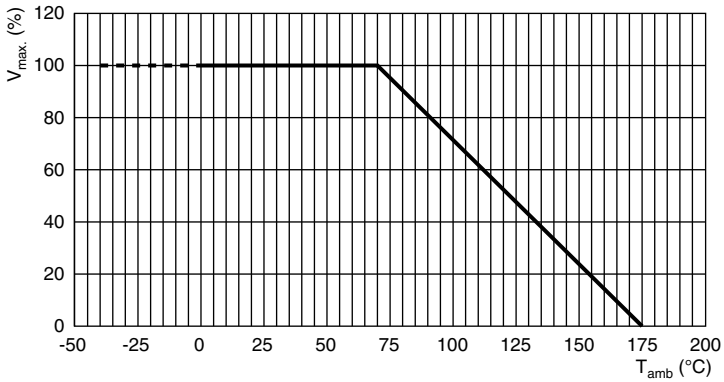
(1) The indicated current levels are guaranteed according IEC 60738 mounting conditions. For different mounting conditions the indicated current levels can change and should be evaluated in the application.

(2) $I_{ol\ max.}$ is the maximum overload current that may flow through the PTC when it passes from the low ohmic to the high ohmic state. UL approval: $I_{ol\ max.}$ x 0.85

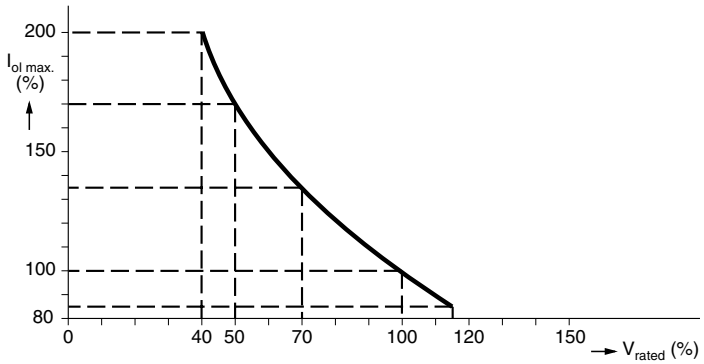
CURRENT DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



VOLTAGE DERATING AS A FUNCTION OF AMBIENT TEMPERATURE



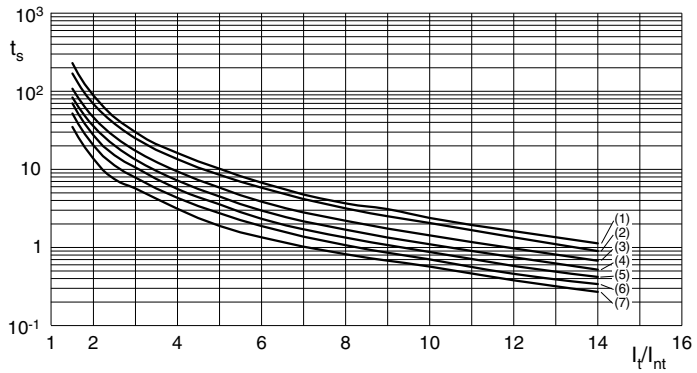
MAXIMUM OVERLOAD CURRENT $I_{ol\ max.}$ DERATING AS A FUNCTION OF VOLTAGE



$I_{ol\ max.}$ as stated in the electrical data and ordering information tables, is the maximum overload current that may flow through the PTC when passing from the low ohmic to high ohmic state at rated voltage.

When other voltages are present after tripping, the $I_{ol\ max.}$ value can be derived from the above $I_{max.}$ as a function of voltage graph. Voltages below V_{rated} will allow higher overload currents to pass the PTC.

TYPICAL TRIP-TIME AS A FUNCTION OF TRIP CURRENT RATIO



Curve 1: Ø $D_{max.}$ = 20.5 mm
Curve 2: Ø $D_{max.}$ = 16.5 mm
Curve 3: Ø $D_{max.}$ = 12.5 mm
Curve 4: Ø $D_{max.}$ = 10.5 mm
Curve 5: Ø $D_{max.}$ = 8.5 mm
Curve 6: Ø $D_{max.}$ = 7.0 mm
Curve 7: Ø $D_{max.}$ = 5.0 mm
Measured in accordance with *"IEC 60738"*.

Trip-Time or Switching Time (t_s)

To check the trip-time for a specific PTC, refer to the Electrical Data and Ordering Information tables for the value I_{nt}. Divide the overload or trip current by this I_{nt} and you realize the factor I_t/I_{nt}. This rule is valid for any ambient temperature between 0 °C and 70 °C. Adapt the correct non-trip current with the appropriate curve in the Current Deviation as a Function of the Ambient Temperature graph. The relationship between the I_t/I_{nt} factor and the switching time is a function of the PTC diameter; see the above graphs.

Example

What will be the trip-time at I_{ol} = 0.8 A and T_{amb} = 0 °C of a thermistor type PTCCL07H211FBE; 12 Ω; Ø $D_{max.}$ = 7.0 mm:

I_{nt} from the table: 210 mA at 25 °C
I_{nt}: 210 x 1.12 = 235 mA (at 0 °C).

Overload current = 0.8 A; factor I_t/I_{nt}: 0.8/0.235 = 3.40. In the typical trip-time as a function of trip current ratio graph, at the 7.0 mm line and I_t/I_{nt} = 3.40, the typical trip-time is 6.0 s.

COMPONENTS PACKING INFORMATION			
SAP ORDERING PART NUMBER		SPQ	PACKING OUTLINE
PTCCL05H....BE		500	Bulk
PTCCL05H....TE		1500	Tape and reel
PTCCL07H....BE	PTCCL09H....BE	250	Bulk
PTCCL07H....TE	PTCCL09H....TE	1500	Tape and reel
PTCCL11H....BE	PTCCL13H....BE	200	Bulk
PTCCL11H....TE		1500	Tape and reel
PTCCL13H....TE		750	Tape and reel
PTCCL17H....BE		100	Bulk
PTCCL21H....BE		100	Bulk

PTC THERMISTORS IN BULK

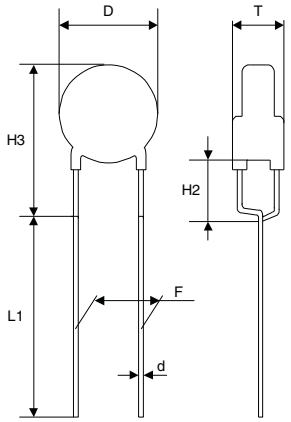


Fig. 1

DIMENSIONS OF BULK TYPE PTCs (in mm)	
D	See table
d	0.6 ± 0.05
T	5.0 max.
H2	4.0 ± 1.0
H3	D + 5 max.
L1	20 min.
F	5.0

PTC THERMISTORS ON TAPE AND REEL

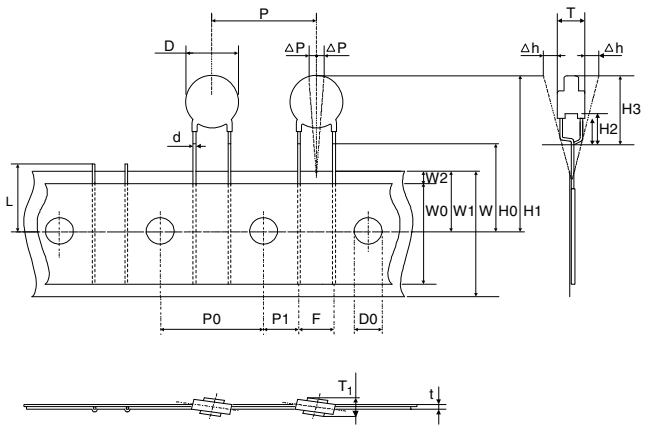
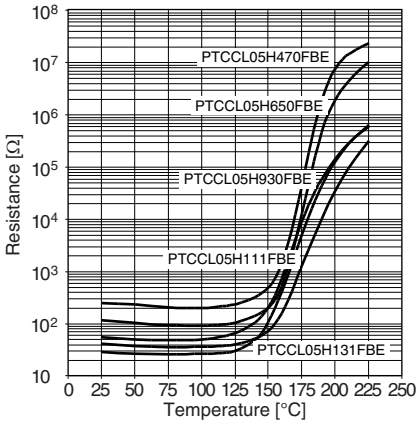


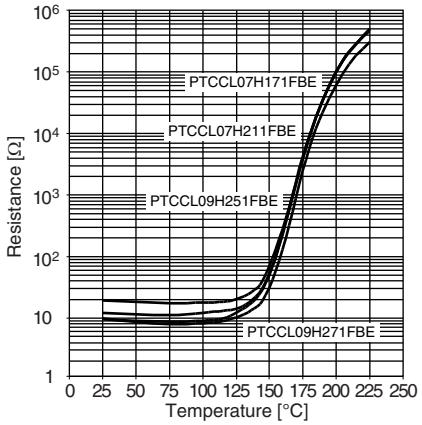
Fig. 2

TAPE AND REEL ACCORDING TO IEC 60286-2 (in mm)			
SYMBOL	PARAMETER	DIMENSIONS	TOLERANCE
D	Body diameter	See table	max.
d	Lead diameter	0.6	± 0.05
P	Pitch of components Diameter < 12 mm Diameter ≥ 12 mm	 12.7 25.4	 ± 1.0 ± 2.0
P_0	Feedhole pitch	12.7	± 0.3
F	Leadcenter to leadcenter distance (between component and tape)	5.0	+ 0.5 / - 0.2
H0	Lead wire clinch height	16.0	± 0.5
H2	Component bottom to seating plane	4.0	± 1.0
H3	Component top to seating plane	D + 5	max.
H4	Seating plane difference (left-right lead)	2	± 0.2
T	Total thinkness	5.0	max.

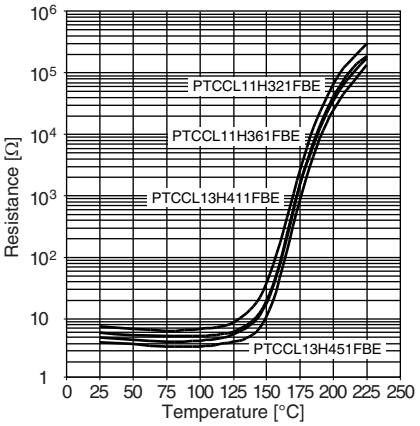
TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



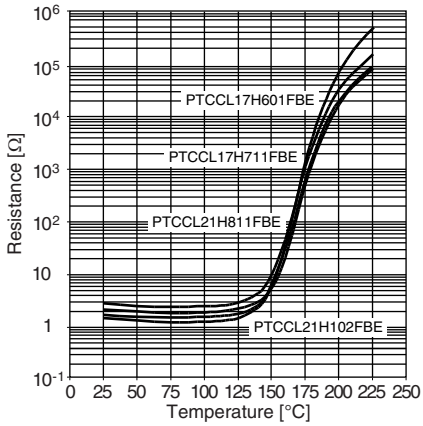
TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



265 V PTC Thermistors for Overload Protection

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Maximum voltage (RMS or DC)	265	V
Maximum holding current (I_{hd})	0.011 to 0.8	A
Resistance at 25 °C (R_{25})	2.1 to 3000	Ω
Tolerance on R_{25} value	20	%
Maximum overload current I_{ol}	0.8 to 5.5	A
Switching temperature	135 to 145	°C
Operating temperature range at max. voltage	0 to 70	°C
Storage temperature	-40 to +175	°C

QUALITY

UL approved PTCs are guaranteed to withstand severe test programs and have factory audited follow-up programs. Major UL qualification tests are long-life (6000 cycles) electrical cycle tests at trip-current, long-life stability storage tests (3000 h at 250 °C), damp heat and water immersion tests and over-voltage tests up to 200 % of rated voltage.

UL approved PTCs are guaranteed to withstand severe test programs

- Long-life cycle tests (over 5000 trip cycles)
- Long-life storage tests (3000 h at 250 °C)
- Electrical cycle tests at low ambient temperatures (-40 °C or 0 °C)
- Damp-heat and water immersion tests
- Overvoltage tests at up to 200 % of rated voltage

FEATURES

- Wide range of trip and non-trip currents: From 11 mA up to 800 mA
- Small ratio between trip and non-trip currents (I_t/I_{hd} = 1.5 at 25 °C)
- High maximum inrush current (up to 5.5 A)
- Leaded parts withstand mechanical stresses and vibration
- UL file E148885 according to XGPU standard UL1434

RoHS COMPLIANT

APPLICATIONS

Overload (current, voltage, temperature) protection in:

- Industrial electronics
- Consumer electronics
- Electronic data processing

DESCRIPTION

These directly heated ceramic-based thermistors have a positive temperature coefficient and are primarily intended for overload protection. They consist of a ceramic pellet soldered between two tinned CCS wires and coated with a UL 94 V-0 high temperature hard silicone lacquer.

MOUNTING

PTC thermistors can be mounted by wave, reflow, or hand-soldering. Current levels have been determined according IEC 60738 conditions. Different ways of mounting or connecting the thermistors can influence their thermal and electrical behavior. Standard operation is in still air, any potting or encapsulation of PTC thermistors is not recommended and will change its operating characteristics.

Typical Soldering
235 °C; duration: 5 s (Lead (Pb)-bearing)
245 °C, duration: 5 s (Lead (Pb)-free)

Resistance to Soldering Heat
260 °C, duration: 10 s max.

MARKING

Only the gray lacquered thermistors with a diameter of 8.5 mm to 20.5 mm are marked with BC, R_{25} value (example 1R9) on one side and I_{hd}, $V_{max.}$ on the other side.

ELECTRICAL DATA AND ORDERING INFORMATION

I_{nt} MAX. at 25 °C (mA) (1)	I_t MIN. at 25 °C (mA) (1)	R_{25} ± 20 % (Ω)	I_{ol} MAX. at 25 °C (mA) (2)	I_{res} MAX. at $V_{max.}$ and 25 °C (mA) (1)	DISSIP. FACTOR (mW/K) (1)	Ø D MAX. (mm)	ORDERING PART NUMBERS	
							BULK	TAPE ON REEL
11	17	3000	80	6.5	7.3	5	PTCCL05H110HBE	PTCCL05H110HTE
15	23	1900	110	6.5	7.3	5	PTCCL05H150HBE	PTCCL05H150HTE
19	29	1200	140	6.5	7.3	5	PTCCL05H190HBE	PTCCL05H190HTE
28	42	500	200	6.8	7.3	5	PTCCL05H280HBE	PTCCL05H280HTE
39	59	260	300	6.8	7.3	5	PTCCL05H390HBE	PTCCL05H390HTE
63	95	120	450	7	7.3	5	PTCCL05H630HBE	PTCCL05H630HTE
76	115	85	550	7	7.3	5	PTCCL05H760HBE	PTCCL05H760HTE
95	143	56	600	7	7.3	5	PTCCL05H950HBE	PTCCL05H950HTE
110	165	48	650	7.5	8.3	7	PTCCL07H111HBE	PTCCL07H111HTE
140	210	29	800	8	8.3	7	PTCCL07H141HBE	PTCCL07H141HTE
170	255	22	900	9	9	8.5	PTCCL09H171HBE	PTCCL09H171HTE
190	285	18	1000	9.5	9	8.5	PTCCL09H191HBE	PTCCL09H191HTE
210	315	17	1300	10	10.5	10.5	PTCCL11H211HBE	PTCCL11H211HTE
250	375	12	1500	11	10.5	10.5	PTCCL11H251HBE	PTCCL11H251HTE
280	420	11	1800	12	11.7	12.5	PTCCL13H281HBE	PTCCL13H281HTE
320	480	8.4	2200	13	11.7	12.5	PTCCL13H321HBE	PTCCL13H321HTE
400	600	6.6	3000	15	15.5	16.5	PTCCL17H401HBE	-
490	735	4.4	3500	16	15.5	16.5	PTCCL17H491HBE	-
590	855	4	4500	19.5	19.8	20.5	PTCCL21H591HBE	-
700	1050	2.8	5500	21	19.8	20.5	PTCCL21H701HBE	-
800	1200	2.1	5500	22.5	19.8	20.5	PTCCL21H801HBE (3)	-

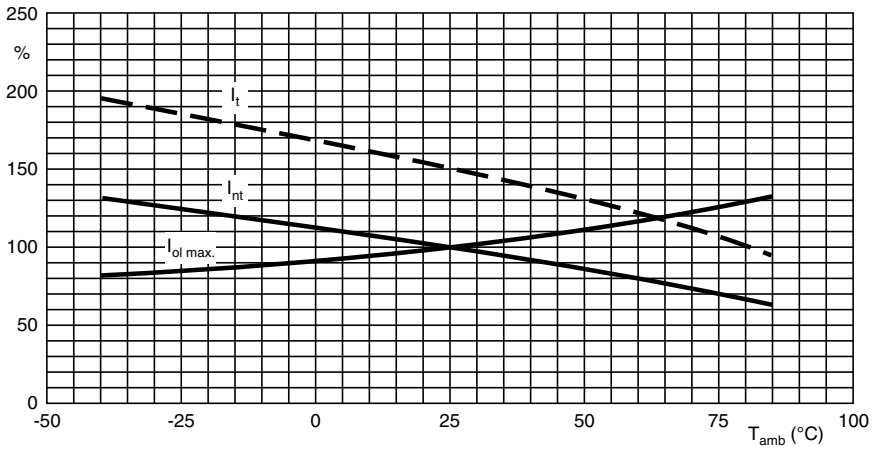
Notes

(1) The indicated current levels are guaranteed according IEC 60738 mounting conditions. For different mounting conditions the indicated current levels can change and should be evaluated in the application.

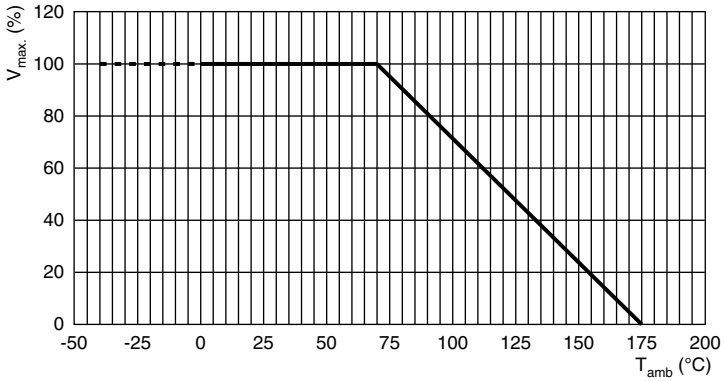
(2) $I_{ol\ max.}$ is the maximum overload current that may flow through the PTC when it passes from the low ohmic to the high ohmic state. UL approval: $I_{ol\ max.}$ x 0.85

(3) Not UL approved

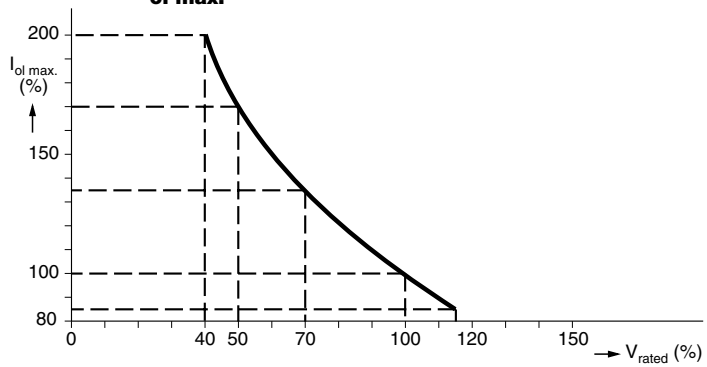
CURRENT DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



VOLTAGE DERATING AS A FUNCTION OF AMBIENT TEMPERATURE



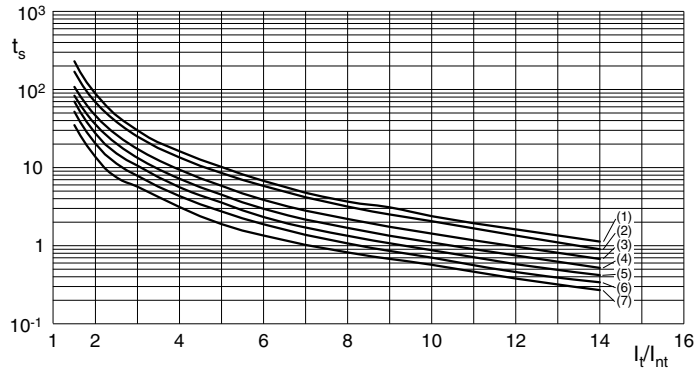
MAXIMUM OVERLOAD CURRENT $I_{ol\ max.}$ DERATING AS A FUNCTION OF VOLTAGE



$I_{ol\ max.}$ as stated in the electrical data and ordering information tables, is the maximum overload current that may flow through the PTC when passing from the low ohmic to high ohmic state at rated voltage.

When other voltages are present after tripping, the $I_{ol\ max.}$ value can be derived from the above $I_{max.}$ as a function of voltage graph. Voltages below V_{rated} will allow higher overload currents to pass the PTC.

TYPICAL TRIP-TIME AS A FUNCTION OF TRIP CURRENT RATIO



Curve 1: Ø $D_{max.}$ = 20.5 mm
Curve 2: Ø $D_{max.}$ = 16.5 mm
Curve 3: Ø $D_{max.}$ = 12.5 mm
Curve 4: Ø $D_{max.}$ = 10.5 mm
Curve 5: Ø $D_{max.}$ = 8.5 mm
Curve 6: Ø $D_{max.}$ = 7.0 mm
Curve 7: Ø $D_{max.}$ = 5.0 mm

Measured in accordance with *"IEC 60738"*.

Trip-Time or Switching Time (t_s)

To check the trip-time for a specific PTC, refer to the Electrical Data and Ordering Information tables for the value I_{nt}. Divide the overload or trip current by this I_{nt} and you realize the factor I_t/I_{nt}. This rule is valid for any ambient temperature between 0 °C and 70 °C. Adapt the correct non-trip current with the appropriate curve in the Current Deviation as a Function of the Ambient Temperature graph. The relationship between the It/Int factor and the switching time is a function of the PTC diameter; see the above graphs.

Example

What will be the trip-time at I_{ol} = 0.8 A and T_{amb} = 50 °C of a thermistor type PTCCL09H171HBE; 22 Ω; Ø $D_{max.}$ = 8.5 mm:

I_{nt} from the table: 170 mA at 25 °C
I_{nt}: 170 x 0.87 = 148 mA (at 50 °C)

Overload current = 0.8 A; factor I_t/I_{nt}: 0.8/0.148 = 5.40. In the Typical trip-time as a function of trip current ratio graph, at the 8.5 mm line and I_t/I_{nt} = 5.40, the typical trip-time is 3.0 s.

COMPONENTS PACKING INFORMATION			
SAP ORDERING PART NUMBER		SPQ	PACKING OUTLINE
PTCCL05H....BE		500	Bulk
PTCCL05H....TE		1500	Tape and reel
PTCCL07H....BE	PTCCL09H....BE	250	Bulk
PTCCL07H....TE	PTCCL09H....TE	1500	Tape and reel
PTCCL11H....BE	PTCCL13H....BE	200	Bulk
PTCCL11H....TE		1500	Tape and reel
PTCCL13H....TE		750	Tape and reel
PTCCL17H....BE		100	Bulk
PTCCL21H....BE		50	Bulk

PTC THERMISTORS IN BULK

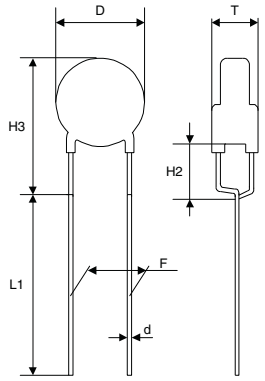


Fig. 1

DIMENSIONS OF BULK TYPE PTCs (in mm)	
D	See table
d	0.6 ± 0.05
T	5.5 max.
H2	4.0 ± 1.0
H3	D + 5 max.
L1	20 min.
F	5.0

PTC THERMISTORS ON TAPE AND REEL

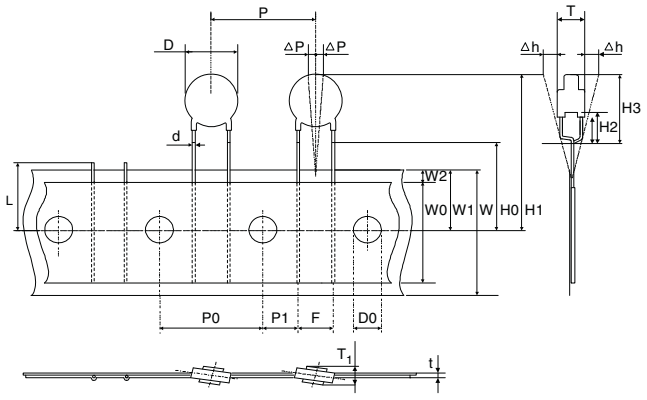
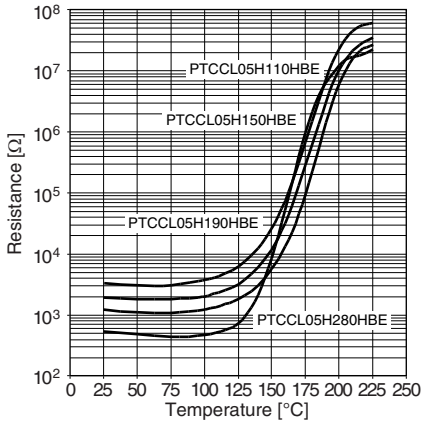


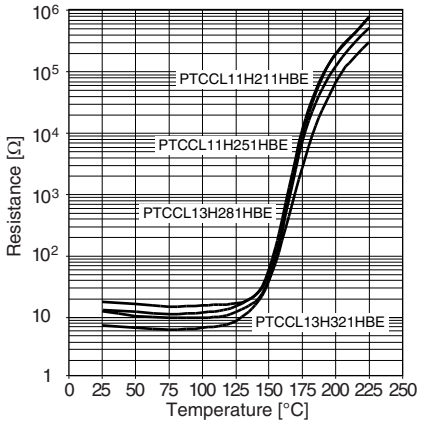
Fig. 2

TAPE AND REEL ACCORDING TO IEC 60286-2 (in mm)			
SYMBOL	PARAMETER	DIMENSIONS	TOLERANCE
D	Body diameter	See table	max.
d	Lead diameter	0.6	± 0.05
P	Pitch of components Diameter < 12 mm Diameter ≥ 12 mm	 12.7 25.4	 ± 1.0 ± 2.0
P_0	Feedhole pitch	12.7	± 0.3
F	Leadcenter to leadcenter distance (between component and tape)	5.0	+ 0.5 / - 0.2
H0	Lead wire clinch height	16.0	± 0.5
H2	Component bottom to seating plane	4.0	± 1.0
H3	Component top to seating plane	D + 5	max.
H4	Seating plane difference (left-right lead)	0	± 0.2
T	Total thinkness	5.5	max.

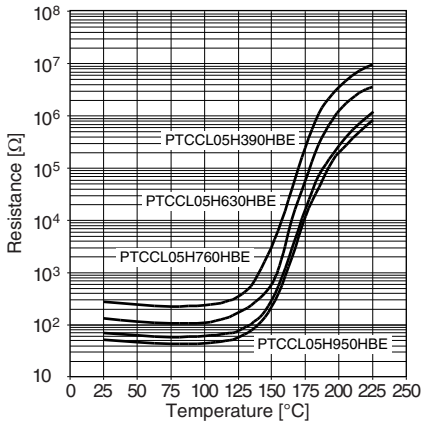
TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



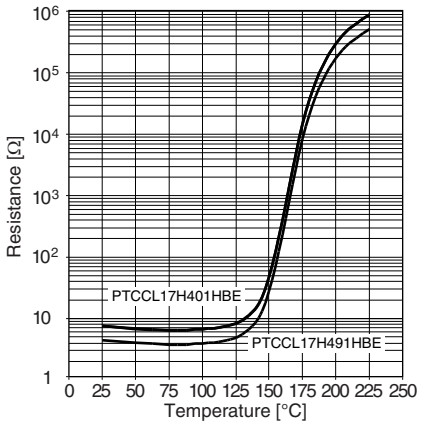
TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



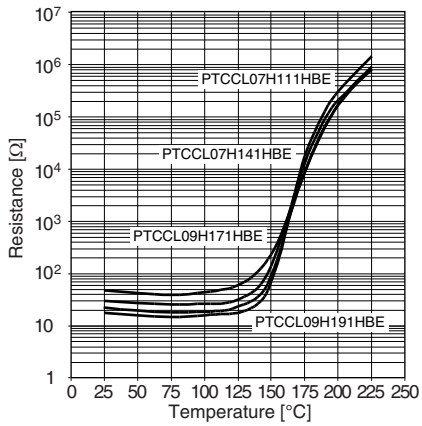
TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



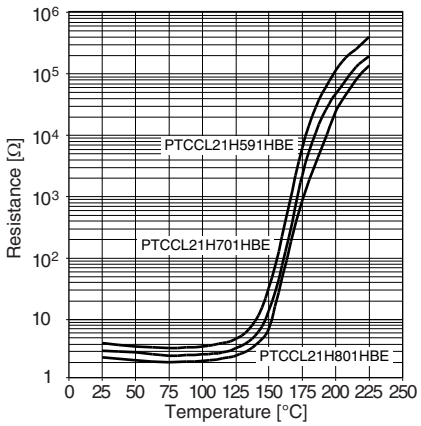
TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



30 V to 60 V PTC Thermistors for Overload Protection

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Maximum voltage (DC or AC)	30 to 60	V
Maximum holding current (I_{hd})	0.094 to 2	A
Resistance at 25 °C (R_{25})	0.3 to 50	Ω
Tolerance on R_{25} value	20	%
Maximum overload current I_{ol}	0.8 to 23	A
Switching temperature	135 to 145	°C
Operating temperature range at max. voltage	-40 to +85	°C
Storage temperature	-40 to +150	°C

QUALITY

UL approved PTCs are guaranteed to withstand severe test programs and have factory audited follow-up programs. Major UL qualification tests are long-life (6000 cycles) electrical cycle tests at trip-current, long-life stability storage tests (3000 h at 250 °C), damp heat and water immersion tests and over-voltage tests up to 200 % of rated voltage.

UL approved PTCs are guaranteed to withstand severe test programs

- Long-life cycle tests (over 5000 trip cycles)
- Long-life storage tests (3000 h at 250 °C)
- Electrical cycle tests at low ambient temperatures (-40 °C or 0 °C)
- Damp-heat and water immersion tests
- Overvoltage tests at up to 200 % of rated voltage

FEATURES

- Wide range of trip and non-trip currents: From 94 mA up to 2 A for the trip current
- Small ratio between trip and non-trip currents (I_t/I_{hd} = 1.5 at 25 °C)
- High maximum overload current (up to 23 A)
- Leaded parts withstand mechanical stresses and vibration
- UL file E148885 according to XGPU standard UL1434

RoHS COMPLIANT

APPLICATIONS

Overload (current, voltage, temperature) protection in:

- Industrial electronics
- Consumer electronics
- Electronic data processing

DESCRIPTION

These directly heated ceramic-based thermistors have a positive temperature coefficient and are primarily intended for overload protection. They consist of a ceramic pellet soldered between two tinned CCS wires and coated with a UL 94 V-0 high temperature hard silicone lacquer.

Bare metalized pellets are available on request.

MOUNTING

PTC thermistors can be mounted by wave, reflow, or hand-soldering. Current levels have been determined according IEC 60738 conditions. Different ways of mounting or connecting the thermistors can influence their thermal and electrical behavior. Standard operation is in air, any potting or encapsulation of PTC thermistors is not recommended and will change its operating characteristics.

Typical Soldering
235 °C; duration: 5 s (lead (Pb)-bearing)
245 °C, duration: 5 s (lead (Pb)-free)

Resistance to Soldering Heat
260 °C, duration: 10 s max.

MARKING

Only the gray lacquered thermistors with a diameter of 8.5 mm to 20.5 mm are marked with BC, R_{25} value (example 1R9) on one side and I_{hd}, $V_{max.}$ on the other side.

ELECTRICAL DATA AND ORDERING INFORMATION

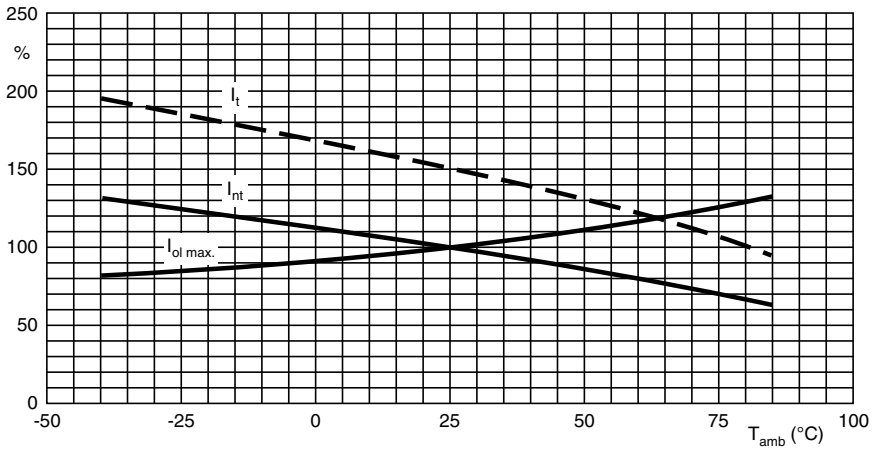
I_{nt} MAX. at 25 °C (mA) (1)	I_t MIN. at 25 °C (mA) (1)	R_{25} ± 20 % (Ω)	V MAX. (V)	I_{ol} MAX. at 25 °C (mA) (2)	I_{res} MAX. at $V_{max.}$ and 25 °C (mA) (1)	DISSIP. FACTOR (mW/K) (1)	Ø D MAX. (mm)	ORDERING PART NUMBERS	
								BULK	TAPE ON REEL
94	145	50	60	800	22	6.9	5	PTCCL05H940EBE	PTCCL05H940ETE
130	195	25	60	1200	25	6.9	5	PTCCL05H131EBE	PTCCL05H131ETE
180	270	13	30	1700	45	6.9	5	PTCCL05H181DBE	PTCCL05H181DTE
270	405	6	30	2500	60	6.9	5	PTCCL05H271DBE	PTCCL05H271DTE
320	480	5	30	3500	62	7.8	7	PTCCL07H321DBE	PTCCL07H321DTE
410	615	3	30	4500	65	7.8	7	PTCCL07H411DBE	PTCCL07H411DTE
470	705	2.5	30	5000	70	8.8	8.5	PTCCL09H471DBE	PTCCL09H471DTE
540	810	1.9	30	6000	75	8.8	8.5	PTCCL09H541DBE	PTCCL09H541DTE
610	915	1.7	30	7000	80	9.9	10.5	PTCCL11H611DBE	PTCCL11H611DTE
700	1050	1.3	30	8000	90	9.9	10.5	PTCCL11H701DBE	PTCCL11H701DTE
830	1245	1.1	30	10 000	100	11.5	12.5	PTCCL13H831DBE	PTCCL13H831DTE
920	1380	0.9	30	11 000	105	11.5	12.5	PTCCL13H921DBE	PTCCL13H921DTE
1170	1755	0.7	30	13 500	140	14.5	16.5	PTCCL17H112DBE	-
1390	2085	0.5	30	16 000	170	14.5	16.5	PTCCL17H132DBE	-
1770	2655	0.4	30	20 000	200	18.7	20.5	PTCCL21H172DBE	-
2050	3075	0.3	30	23 000	220	18.7	20.5	PTCCL21H202DBE	-

Notes

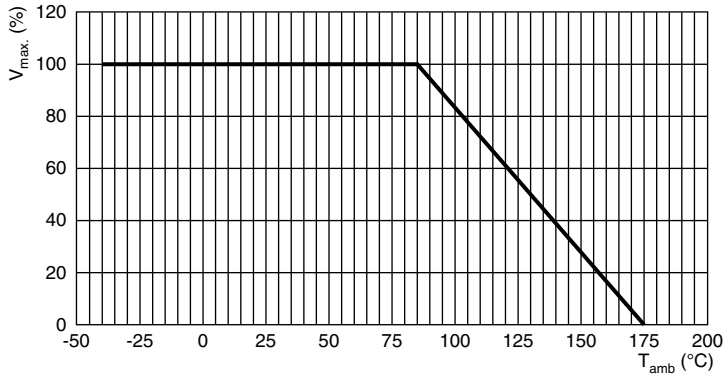
(1) The indicated current levels are guaranteed according IEC 60738 mounting conditions. For different mounting conditions the indicated current levels can change and should be evaluated in the application.

(2) $I_{ol\ max.}$ is the maximum overload current that may flow through the PTC when it passes from the low ohmic to the high ohmic state. UL approval: $I_{ol\ max.}$ x 0.85

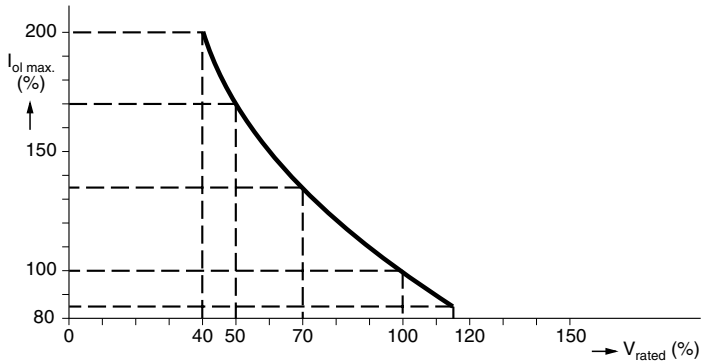
CURRENT DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



VOLTAGE DERATING AS A FUNCTION OF AMBIENT TEMPERATURE



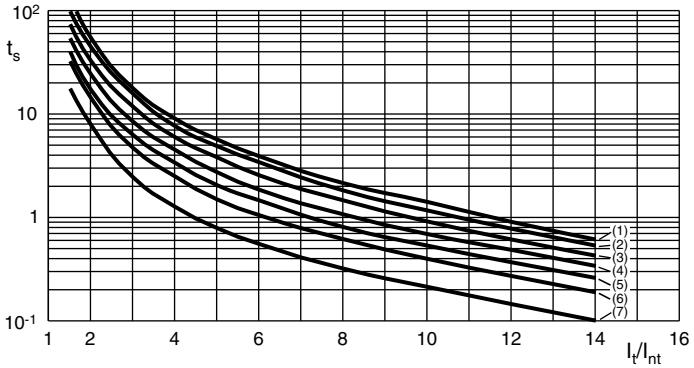
MAXIMUM OVERLOAD CURRENT $I_{ol\ max.}$ DERATING AS A FUNCTION OF VOLTAGE



$I_{max.}$ as stated in the electrical data and ordering information tables, is the maximum overload current that may flow through the PTC when passing from the low ohmic to high ohmic state at rated voltage.

When other PTC voltages are present after tripping, the $I_{max.}$ value can be derived from the above $I_{max.}$ as a function of voltage graph. Voltages below V_{rated} will allow higher overload currents to pass the PTC.

TYPICAL TRIP-TIME AS A FUNCTION OF TRIP CURRENT RATIO



Curve 1: Ø $D_{max.}$ = 20.5 mm
Curve 2: Ø $D_{max.}$ = 16.5 mm
Curve 3: Ø $D_{max.}$ = 12.5 mm
Curve 4: Ø $D_{max.}$ = 10.5 mm
Curve 5: Ø $D_{max.}$ = 8.5 mm
Curve 6: Ø $D_{max.}$ = 7.0 mm
Curve 7: Ø $D_{max.}$ = 5.0 mm

Measured in accordance with *"IEC 60738"*.

Trip-Time or Switching Time (t_s)

To check the trip-time for a specific PTC, refer to the Electrical Data and Ordering Information tables for the value Int. Divide the overload or trip current by this I_{nt} and you realize the factor I_t/I_{nt}. This rule is valid for any ambient temperature between 0 °C and 85 °C. Adapt the correct non-trip current with the appropriate curve in the Current Deviation as a Function of the Ambient Temperature graph. The relationship between the I_t/I_{nt} factor and the switching time is a function of the PTC diameter; see the above graphs.

Example

What will be the trip-time at I_{ol} = 3 A and T_{amb} = 0 °C of a thermistor type PTCCL09H471DBE; 2.5 Ω; Ø $D_{max.}$ = 8.5 mm:

I_{nt} from the table: 470 mA at 25 °C
I_{nt}: 470 x 1.12 = 526 mA (at 0 °C)

Overload current = 3 A; factor I_t/I_{nt}: $^3/_{0.526}$ = 5.70. In the Typical trip-time as a function of trip current ratio graph, at the 8.5 mm line and I_t/I_{nt} = 5.70, the typical trip-time is 1.7 s.

COMPONENTS PACKING INFORMATION			
SAP ORDERING PART NUMBER		SPQ	PACKING OUTLINE
PTCCL05H....BE		500	Bulk
PTCCL05H....TE		1500	Tape and reel
PTCCL07H....BE	PTCCL09H....BE	250	Bulk
PTCCL07H....TE	PTCCL09H....TE	1500	Tape and reel
PTCCL11H....BE	PTCCL13H....BE	250	Bulk
PTCCL11H....TE		1500	Tape and reel
PTCCL13H....TE		750	Tape and reel
PTCCL17H....BE		200	Bulk
PTCCL21H....BE		100	Bulk

PTC THERMISTORS IN BULK

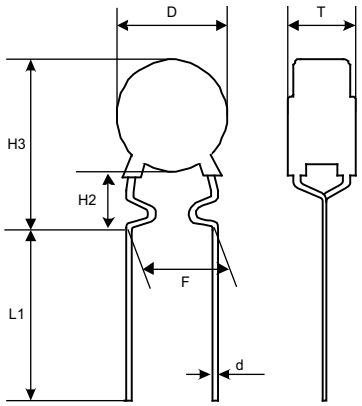


Fig. 1

DIMENSIONS OF BULK TYPE PTCs (in mm)	
D	See table
d	0.6 ± 0.05
T	4.0 max.
H2	4.0 ± 1.0
H3	D + 5 max.
L1	20 min.
F	5.0

PTC THERMISTORS ON TAPE AND REEL

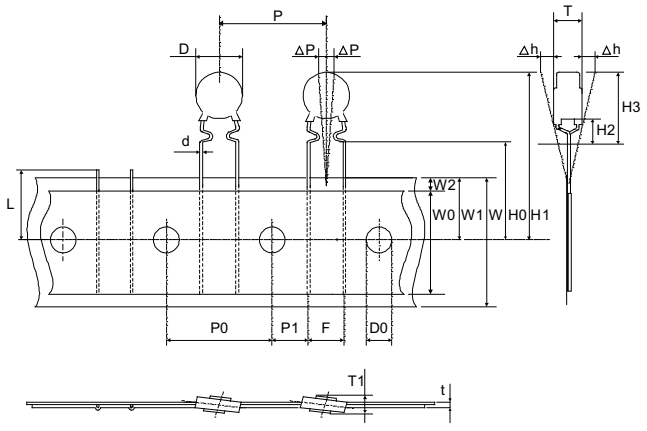
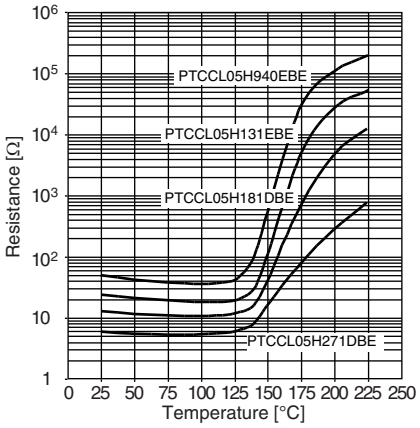


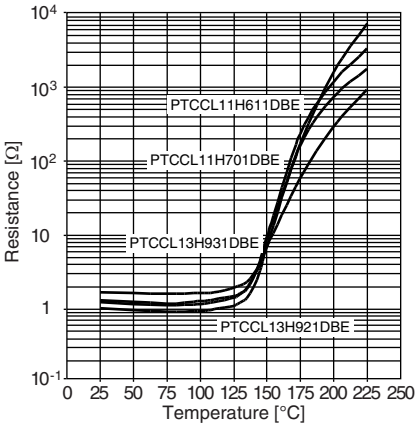
Fig. 2

TAPE AND REEL ACCORDING TO IEC 60286-2 (in mm)			
SYMBOL	PARAMETER	DIMENSIONS	TOLERANCE
D	Body diameter	See table	max.
d	Lead diameter	0.6	± 0.05
P	Pitch of components Diameter < 12 mm Diameter ≥ 12 mm	 12.7 25.4	 ± 1.0 ± 2.0
P_0	Feedhole pitch	12.720.385 mm	± 0.3
F	Leadcenter to leadcenter distance (between component and tape)	5.0	+ 0.5 / - 0.2
H0	Lead wire clinch height	16.0	± 0.5
H2	Component bottom to seating plane	4.0	± 1.0
H3	Component top to seating plane	D + 5	max.
T	Total thinkness	4.0	max.

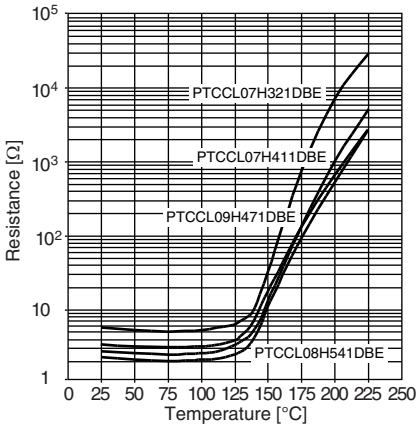
TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



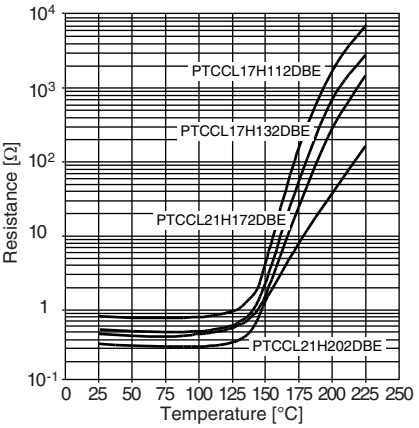
TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC



600 V / 1000 V PTC Thermistors for Overload Protection

FEATURES

- Fast response time for rapid protection
- Automatic resetting once overload is removed
- Operates on DC or AC voltage
- UL approved types available (E148885)

RoHS COMPLIANT

APPLICATIONS

Over-temperature/over-load protection for metering, low current signal protection, digital signal protection against over-voltage

DESCRIPTION

Test and measuring instruments, such as oscilloscopes and digital multimeters, can be easily damaged if excessive voltages are applied across their input terminals.

Simple and effective overload protection can be provided by connecting a high-voltage PTC thermistor in series with the instrument; see Typical Connection of the PTC Thermistor for Digital Multimeter Protection drawing. Under normal conditions, the resistance of the PTC thermistor is low, so the test voltage will be measured by the instrument. Under an overload condition, the PTC thermistor will switch to its high-resistance state, absorbing the overload current and protecting the instrument. When the overload is removed, the PTC thermistor will return to its low-resistance state, ready to resume its protective function.

QUICK REFERENCE DATA

PARAMETER	VALUE	UNIT
Maximum rated voltage	600 to 1000	V_{RMS}
Nominal holding current (Int)	10	mA
Resistance at 25 °C (R_{25})	400 to 1600	Ω
Tolerance on R_{25} value	20 to 30	%
Maximum overload current I_{ol}	0.5 to 2.0	A
Switching temperature	90 to 115	°C
Operating temperature range at rated voltage	-20 to 85	°C

ELECTRICAL DATA AND ORDERING INFROMATION

INT MAX. at 25 °C (mA)	IT MIN. at 25 °C (mA)	R_{25} (2) (Ω)	MAXIMUM VOLTAGE (1) (V)	INSULATION VOLTAGE (V)	UL APPROVAL	ORDERING PART NUMBERS
10	20	1600 ± 300	600	-	UL	PTCCL05H100SBE
10	25	1500 ± 450	1000	-	-	PTCCL07H100VBE
10	50	400 ± 100	600	> 1000	UL	PTCCL10H010SBE

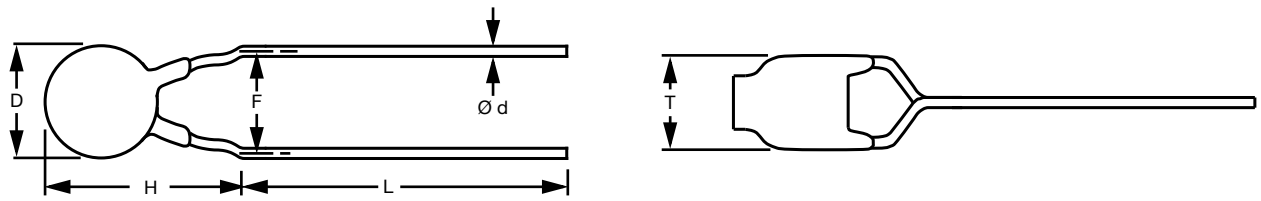
Notes

(1) These PTCs can handle maximum voltage without series resistance

(2) Other resistance values and voltage levels on request

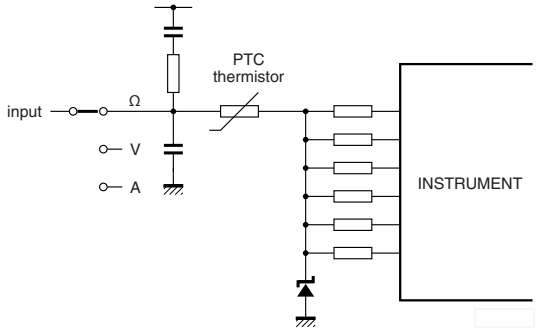
COMPONENT DIMENSIONS in millimeters

PTC THERMISTORS IN BULK

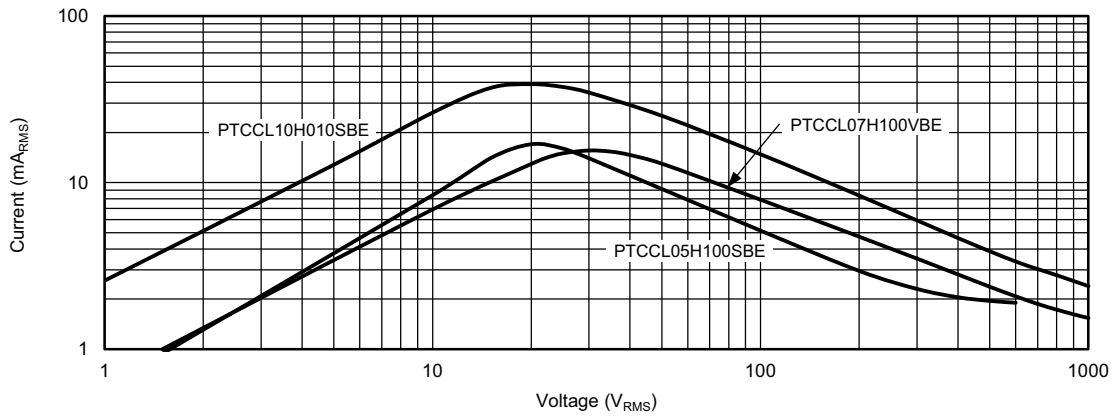


H MAX.	L	D MAX.	T MAX.	F	Ø d	MASS (g)	SPQ	PART NUMBER
10.4	20 ± 3	5	4.5	5.0	0.6	~ 0.5	500	PTCCL05H100SBE
12	20 ± 3	7	5.0	5.0	0.6	~ 0.60	250	PTCCL07H100VBE
13.5	3.1 ± 0.5	10	6.5	8.12	0.8	~ 1.8	500	PTCCL10H010SBE

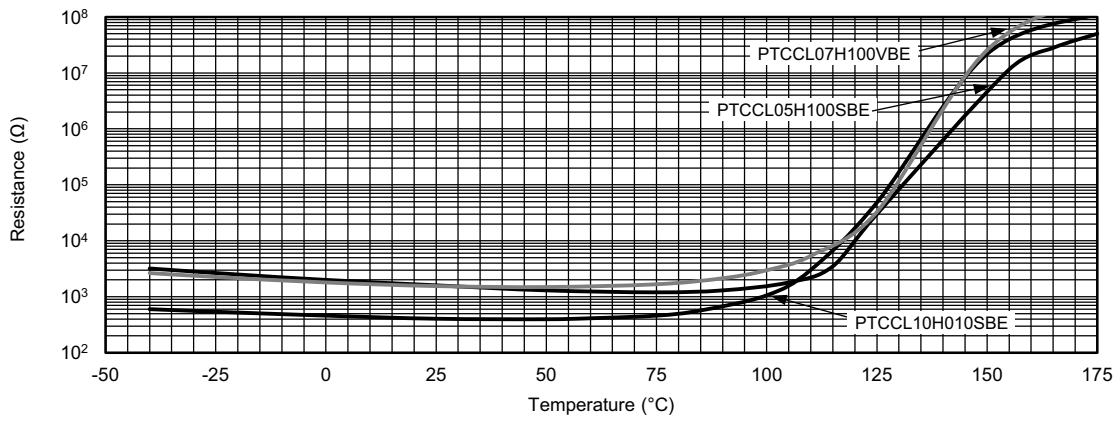
TYPICAL CONNECTION OF THE PTC THERMISTOR FOR DIGITAL MULTIMETER PROTECTION



TYPICAL CURRENT / VOLTAGE CHARACTERISTIC



TYPICAL RESISTANCE / TEMPERATURE CHARACTERISTIC (≤ 5 V$_{DC}$)



PTC Thermistors, Overload Protection for Telecommunication

FEATURES

- Wide resistance range in telecom area from 4 Ω to 70 Ω
- Fast protection against power contact faults
- Withstand high overload currents of up to 10 A
- High voltage withstanding capabilities for the larger sized thermistors (up to 600 V)
- Good tracking over a wide temperature range for all matched or binned thermistors (matching at 85 °C ≤ 2 x matching at 25 °C)
- UL1434 approved types available (XGPU2)
- All telecom PTCs are coated with a high temperature silicon lacquer (UL 94 V-0) to protect them from any harsh environments and to improve their lifetime

RoHS COMPLIANT

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Maximum voltage (RMS or DC)	220 to 600	V_{RMS}
Maximum holding current (I_{hl})	100 to 175	mA
Resistance at 25 °C (R_{25})	8 to 50	Ω
Tolerance on R_{25} value	15 to 25	%
Maximum overload current I_{ol}	0.6 to 10.0	A
Tripping time at 1 A	1 to 40	s
Operating temperature range at max. voltage	0 to 70 (95)	°C

APPLICATIONS

Over-temperature/over-load protection:

- Main distribution frame (MDF)
- Central office switching (C.O.)
- Subscriber terminal equipment (T.E.)
- Set-top box (S.B.)

MARKING

Clear marking on a gray coated body
BC and R_{25} value

ELECTRICAL DATA AND ORDERING INFORMATION

RESISTANCE		MATCHING (Ω)	$V_{max.}$ (V_{RMS})	NON-TRIP CURRENT		TRIP CURRENT		MAX. TRIP TIME at 1 A	$I_{max.}$ AT $V_{max.}$	APPLICATION AREA [2]	ORDERING PART NUMBERS
R_{25} (Ω)	TOL. (%)			I_{hl} (mA)	at T (°C)	I_t (mA)	at T (°C)	$t_{max.}$ (S)	$I_{max.}$ (A)		
25	± 20	1.0	220	70	70	200	25	2.5	4.0	C.O.	PTCTL4MR250GTE
10	± 20	1.0	230	100	70	250	25	3.0	2.0	MDF; ISDN	PTCTL3MR100GTE
25	± 15	no	245	70	70	200	25	5.0	2.6	C.O.	PTCTL4NR250GTE
16	± 20	no	245	140	55	270	25	8.0	1.6	T.E.	PTCTL6NR160GTE
10	± 20	no	245	140	55	270	25	8.0	2.0	T.E.	PTCTL6NR100GTE
25	± 20	1.0	250	70	70	175	25	1.3	3.2	MDF; C.O.	PTCTL3MR250HTE
10	± 20	no	250	100	70	450	0	40.0	10.0	T.E.	PTCTL8NR100HBE
8	± 25	0.5	285	135	95	400	25	6.0	0.6	MDF; ISDN	PTCTL4MR080JBE
16	± 25	no	300	100	70	250	25	2.0	2.6	MDF; T.E.	PTCTL3NR160KTE
10	± 20	no	350	100	70	270	25	4.0	1.0	T.E.; S.B.	PTCTL4NR100LBE
10	± 20	1.0	350	100	70	270	25	4.0	1.0	C.O.	PTCTL4MR100LTE
50	± 20	1.0	600	50	70	140	25	1.0	1.0	C.O.	PTCTL4MR500SBE
35	± 20	3.0	600	70	70	600	0	3.0	1.0	C.O.	PTCTL4MR350STE
25	± 20	0.5	600	70	70	170	25	2.5	2.0	C.O.	PTCTL4MR250STE
25	± 20	0.5	600	70	70	170	25	5.0	2.0	C.O.	PTCTL6MR250STE
10	± 20	0.5	600	175	25	400	25	7.0	1.0	C.O.	PTCTL7MR100SBE [1]
10	± 20	no	600	175	25	400	25	7.0	1.0	T.E.; S.B.	PTCTL7NR100SBE [1]

Notes

- All types pass ITU-T K20-21-45 telecommunication protection recommendation

(1) UL 1434 approved types and compatible with UL1459 and GR1089

(2) MDF: Main Distribution Frame; C.O.: Central Office Switching; T.E.: Subscriber Terminal Equipment; S.B.: Set-top Box

OVERCURRENT PROTECTION OF TELECOMMUNICATION LINES

The PTC thermistor must protect the telephone line circuit against overcurrent which may be caused by the following events:

- Surges due to lightning strikes on or near to the line plant.
- Short-term induction of alternating voltages from adjacent power lines or railway systems, usually caused when these lines or systems develop faults.
- Direct contact between telephone lines and power lines.

To provide good protection under such conditions a PTC thermistor is connected in series with each line, usually as secondary protection; see Typical Telephone Line drawing fig. 1. However, even with primary line protection (usually a gas discharge tube), the PTC thermistor must fulfil severe requirements.

Surge pulses of up to 2 kV can occur and in order to withstand short-term power induction the PTC thermistor must withstand high voltages. If the line has primary protection a 220 V to 300 V PTC thermistor is adequate. Without primary protection, however, a 600 V PTC device is necessary. Vishay BCcomponents manufacturers a range of PTC thermistors (see Electrical Data and Ordering Information Table) covering both requirements.

In the case of direct contact between the telephone line and a power line, the PTC thermistor must withstand very high inrush power at normal mains voltage. Under such conditions, overload currents of up to 10 A on a 230 V mains could occur for up to several hours. To handle this power, the resistance/temperature characteristic of the thermistor must have a very steep slope and the ceramic must be extremely homogeneous.

In case of overcurrent due to short-term induction of alternating voltages, currents of several amperes with voltages as high as 650 V_{RMS} can be present for several seconds.

For standard high voltage applications, resistance values from 25 Ω to 50 Ω are available. However, ISDN networks which carry high-frequency sound and vision, need lower line impedance.

Telecommunication designers are therefore demanding high voltage thermistors with much lower R_{25} values, which places even greater demands on the manufacture of PTC thermistors. For these applications PTC thermistors which have a R_{25} value of 10 Ω with voltages in the 300 V_{RMS} to 600 V_{RMS} range are available.

In a typical telephone line application, two PTC thermistors are used, one each for the tip and ring (or A and B) wire together with their series resistors. For good line balance it is important that the thermistor and resistor pairs are matched.

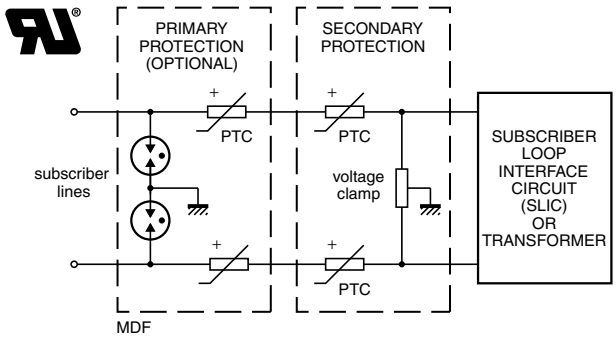
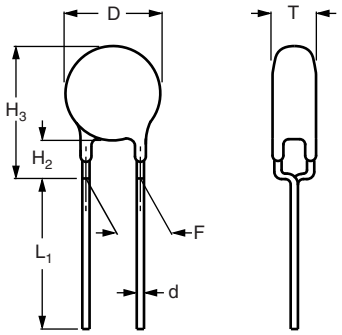


Fig. 1 - Typical telephone line showing where PTC thermistors can be used for overcurrent protection.

PTC THERMISTORS IN BULK



COMPONENT DIMENSIONS (in mm)								
D MAX.	T MAX.	H_2	L_1	H_3 MAX.	H_0	PACKAGING (1)(2)		ORDERING PART NUMBER
						TYPE	SPQ	
8.5	5.0	1.5 to 3.0	-	11.5	16	Taped on reel	1500	PTCTL4MR250GTE
7.0	4.0	2.0 ± 0.5	-	9.8	18	Taped on reel	1500	PTCTL3MR100GTE
8.3	4.0	1.5 to 3.0	-	11.0	18	Taped on reel	1500	PTCTL4NR250GTE (3)
11	4.5	4.0 ± 1.0	-	15.5	16	Taped on reel	1500	PTCTL6NR160GTE
11	4.5	4.0 ± 1.0	-	15.5	16	Taped on reel	1500	PTCTL6NR100GTE (3)
7.0	4.0	2.0 ± 0.5	-	9.8	18	Taped on reel	1500	PTCTL3MR250HTE
13.6	6.0	4.0 ± 1.0	20 ± 4.0	18.6	-	Bulk	200	PTCTL8NR100HBE (3)
8.3	5.0	1.5 ± 0.5	20 ± 3.0	10.3	-	Bulk	250	PTCTL4MR080JBE
7.0	4.0	2.5 ± 0.5	-	10.0	16	Taped on reel	1500	PTCTL3NR160KTE
8.5	4.0	2.5 ± 0.5	4.1 ± 0.5	11.5	-	Bulk	500	PTCTL4NR100LBE
8.5	4.0	2.5 ± 0.5	-	11.5	16	Taped on reel	1500	PTCTL4MR100LTE
8.5	4.0	2.5 ± 0.5	4.1 ± 0.5	11.5	-	Bulk	500	PTCTL4MR500SBE
8.0	5.0	2.5 ± 0.5	-	11.0	16	Taped on reel	1500	PTCTL4MR350STE
8.5	4.0	2.0 ± 0.5	-	11.0	16	Taped on reel	1500	PTCTL4MR250STE
10.5	5.0	2.0 ± 0.5	-	12.6	16	Taped on reel	1500	PTCTL6MR250STE
13	5.5	4.0 ± 1.0	20 min.	18.0	-	Bulk	200	PTCTL7MR100SBE
13	5.5	4.0 ± 1.0	20 min.	18.0	-	Bulk	200	PTCTL7NR100SBE

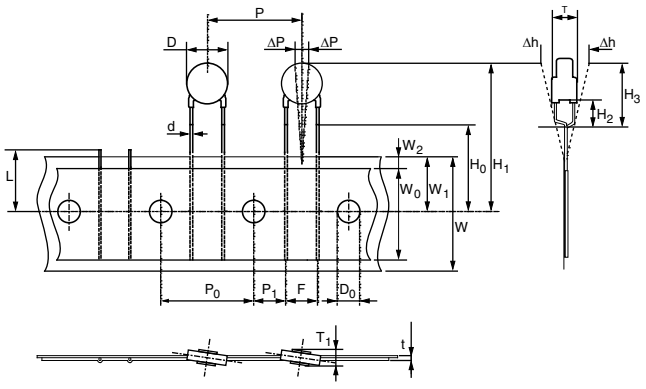
Notes

(1) Taped in accordance with IEC 60286-2

(2) Metallized ceramic pellet for clamping or substrate mounting, available on request

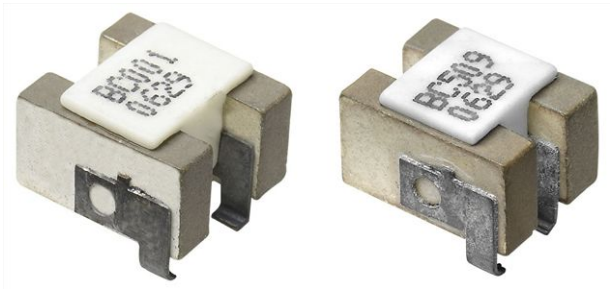
(3) Insulated version is also available

PTC THERMISTORS ON TAPE AND REEL



TAPE AND REEL ACCORDING TO IEC 60286-2 (in mm)			
SYMBOL	PARAMETER	DIMENSIONS	TOLERANCE
D	Body diameter	see table	max.
d	Lead diameter	0.6	± 0.05
P	Pitch between thermistors	12.7	± 1
P_0	Feedhole pitch	12.7	± 0.3
F	Leadcenter to leadcenter distance (between component and tape)	5	+ 0.5 / - 0.2
H0	Lead wire clinch height	see table	± 0.5
H2	Component bottom to seating plane	see table	see table
H3	Component top to seating plane	see table	max.
T	Total thinkness	see table	max.

TWIN Vertical SMD PTC Thermistors For Telecom Overload Protection



FEATURES

- Very small footprint, allowing to increase the number of lines per PCB
- Matched pairs in one component, significantly reducing the assembly time
- Narrow tracking between the 2 PTC's over a wide temperature range (matching at 85 °C: ≤ 2 x matching at 25 °C)
- Limited height and weight, used on high speed pick-and-place circuit assembly
- Flat pick-up ceramic area for easy placement
- Small ceramics for faster response time
- Thermal coupled PTC's for enhanced protection
- Small and large pitch available
- Compliant with the enhanced level requirements of ITU - K20-21-45 edition 2003
- Suitable for lead (Pb)-bearing and lead (Pb)-free reflow soldering

e3
RoHS COMPLIANT

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	10 to 50	Ω
Switching temperature	105 to 130	°C
Maximum voltage (RMS)	240	V_{RMS}
Maximum overload current	2.5 to 8.0	A
Operating temperature range at $V_{max.}$	-40 to 85	°C
Maximum trip time at 1 A	1.2 to 4.0	s
Weight	~ 1.3	g

DESCRIPTION

The component consists of two high performance PTC ceramics mounted together on an alumina spacer cover and with 4 lead (Pb)-free tin plated contacts. The terminations are joined to the Ag plated ceramics by a high melting solder.

MARKING

- All TWIN Vertical SMD PTC's are marked with the last 3-digits of the type number (BCxxx) and a date code (YYWW)

APPLICATIONS

Over-temperature/over-load protection:

- Telecom
  - Telecommunications infrastructure
  - PABX
  - Set-top Box (S.B.)

MOUNTING

A flat pick-up area of 30 mm² and low weight allows for fast placement. No excessive solder paste should be used as no solder or flux can reach the ceramic body during reflow soldering. Not suitable for bismuth containing solder.

Typical soldering

235 °C, duration: 5 s (Lead (Pb)-bearing)

245 °C, duration: 5 s (Lead (Pb)-free)

Resistance to soldering heat

260 °C, duration: 10 s max.

ELECTRICAL DATA

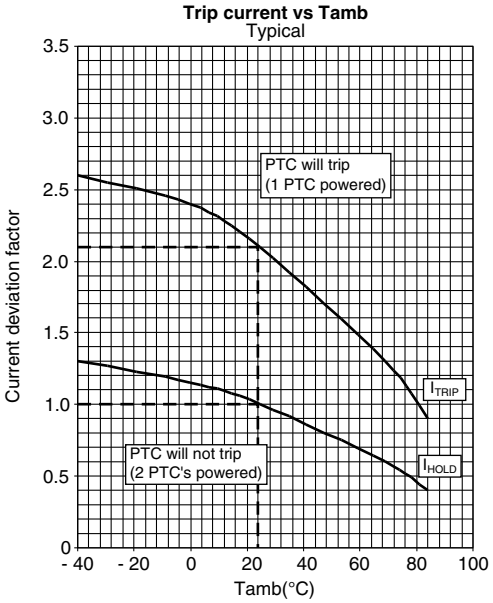
R_{25} ± 20 % (Ω)	MATCHING (Ω)	$V_{max.}$ (V_{RMS})	I_{nt} at 25 °C (mA)	I_{nt} at 70 °C (mA)	I_{nt} at 85 °C (mA)	I_t (mA)	MAX. TRIP-TIME at 1 A (s)	$I_{max.}$ at $V_{max.}$ (A)	I_{res} (2 PIECES POWERED) at $V_{max.}$ (mA)
10	0.5	240	140	85	55	300	4.0	4.0	12.0
20	0.5	240	90	60	40	200	2.0	8.0	12.0
25	0.5	240	100	60	40	200	2.0	4.0	12.0
35	1.0	240	100	60	40	200	1.5	4.0	12.0
50	1.0	240	90	50	35	190	1.2	2.5	12.0

Note

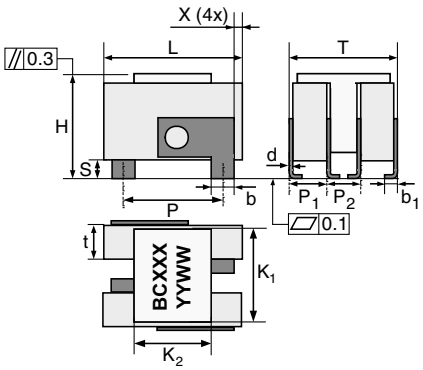
- All data is measured at 25 °C unless otherwise specified

ORDERING INFORMATION		
R_{25} ± 20 % (Ω)	SAP CODING	
	SMALL PITCH	LARGE PITCH
10	PTCTT95R100GTE	PTCTT95R100GTELAR
20	PTCTT95R200GTE	PTCTT95R200GTELAR
25	PTCTT95R250GTE	PTCTT95R250GTELAR
35	PTCTT95R350GTE	PTCTT95R350GTELAR
50	PTCTT95R500GTE	PTCTT95R500GTELAR

ELECTRICAL CHARACTERISTICS

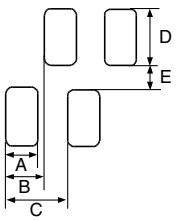


PTC OUTLINES



DIMENSIONS in millimeters		
	SMALL PITCH	LARGE PITCH
L	9.0 ± 0.1	9.0 ± 0.1
T	7.2 ± 0.25	8.4 ± 0.25
H	6.9 ± 0.25	6.9 ± 0.25
b	1.5 ± 0.1	1.5 ± 0.1
b_1	0.9 ± 0.15	0.9 ± 0.15
S	1.25 ± 0.15	1.25 ± 0.15
d	0.22 ± 0.025	0.22 ± 0.025
t	2.3 ± 0.1	2.3 ± 0.1
P	6.5 ± 0.5	6.5 ± 0.5
P_1	2.55 ± 0.15	2.55 ± 0.15
P_2	2.2 ± 0.1	3.45 ± 0.15
X	0.5 ± 0.2	0.5 ± 0.2
K_1	6.0 ± 0.5	7.2 ± 0.5
K_2	5.0 ± 0.5	5.0 ± 0.5

FOOTPRINT



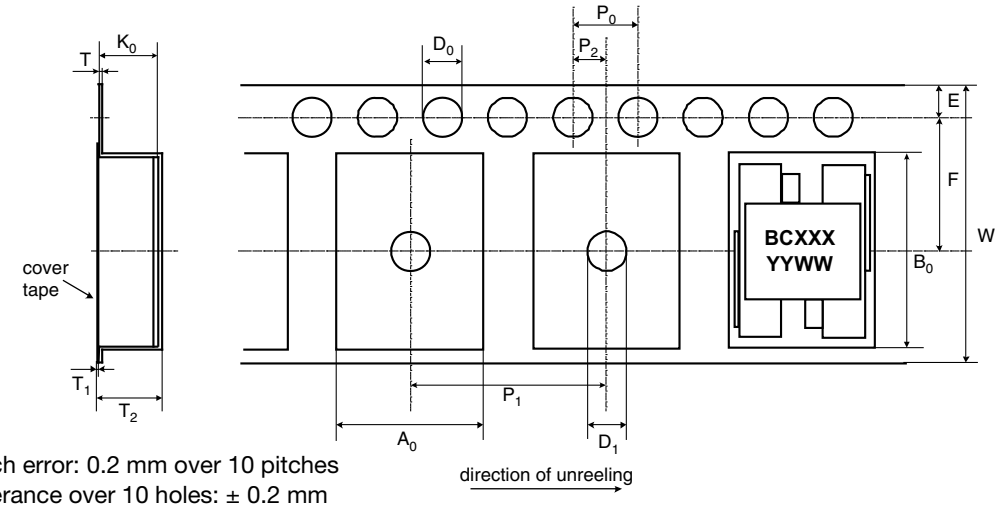
RECOMMENDED FOOTPRINT in millimeters		
	SMALL PITCH	LARGE PITCH
A	2.0	2.0
B	2.4	2.4
C	3.8	5.0
D	3.8	4.0
E	2.7	1.4

PACKAGING

Tape specifications

All tape and reel specifications are in accordance with IEC 60286-3. Carrier tape material is non-conductive polystyrene or polycarbonate.

Blister tape

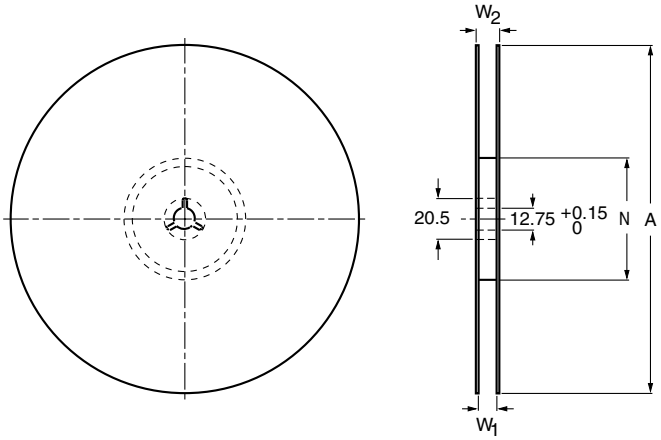


Cumulative pitch error: 0.2 mm over 10 pitches
Cumulative tolerance over 10 holes: ± 0.2 mm

DIMENSIONS OF BLISTER TAPE in millimeters					
	SMALL PITCH	LARGE PITCH		SMALL PITCH	LARGE PITCH
A_0	7.2 ± 0.1	8.4 ± 0.1	D_1	1.5 + 0.1	1.5 + 0.1
B_0	9.3 ± 0.1	9.3 ± 0.1	P_0	4.0 ± 0.1	4.0 ± 0.1
K_0	7.2 ± 0.1	7.2 ± 0.1	P_1	12.0 ± 0.1	12.0 ± 0.1
W	16.0 ± 0.3	16.0 ± 0.3	P_2	2.0 ± 0.1	2.0 ± 0.1
E	1.75 ± 0.1	1.75 ± 0.1	T	0.5 ± 0.05	0.5 ± 0.05
F	7.5 ± 0.1	7.5 ± 0.1	T_1	0.05	0.05
D_0	1.5 + 0.1	1.5 + 0.1	T_2	7.8 max.	7.8 max.

REEL SPECIFICATIONS in millimeters

Reel



REEL DIMENSIONS in millimeters					
UNITS PER REEL	TAPE WIDTH	A	N	W_1	W_2 MAX.
1000	16	380	64	16.4	20.4

Note

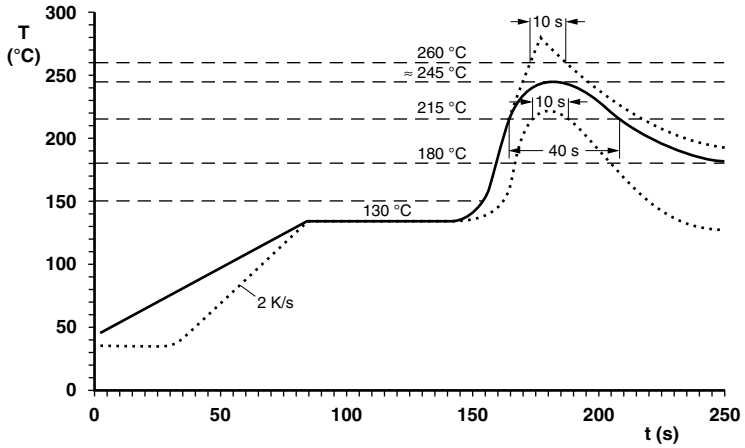
- Reels are packed in sealed plastic bags for protection against high humidity and corrosive atmospheres

SOLDERING CONDITIONS

This SMD thermistor is only suitable for reflow soldering, in accordance with JEDEC J-STD-020. Soldering processes which can be used are reflow (infrared and convection heating) and vapour phase. The maximum temperature of 260 °C during 10 s should not be exceeded and no liquid flux should be allowed to reach the ceramic body.

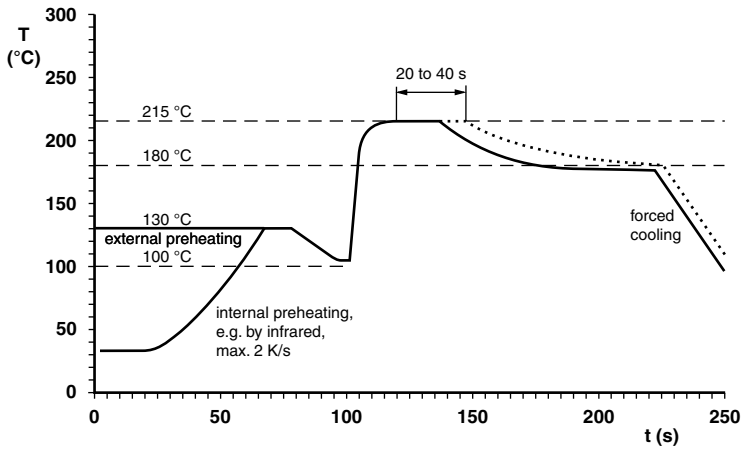
Typical examples of soldering processes that will provide reliable joints without damage, are shown below.

Reflow soldering



Typical values (solid line)
Process limits (dotted lines)

Vapour phase soldering



Typical values (solid line)
Process limits (dotted line)

HANDLING PRECAUTIONS

Because of the nature of PTC ceramic material the component should not be touched with bare hands, as the residue of perspiration can influence component behaviour at high temperatures.

Handling forces applied to the component should be limited to 5 N in any condition.

SMD PTC Thermistors For Overload Protection

FEATURES

- Compact resettable overload protection
- Low mounting height
- Suitable for reflow soldering
- Small ceramic diameter for faster response
- Low heat transfer to substrate
- Flat terminations for stable positioning and good solderability

Pb e3 RoHS COMPLIANT

QUICK REFERENCE DATA

PARAMETER	VALUE		UNIT
	STANDARD TYPES (1)	TELECOM TYPES (1)	
Resistance value at 25 °C	2 to 500	10 to 70	Ω
Tolerance on R_{25} value	± 10; ± 15; ± 20		%
Maximum overload current I_{ol} ($V_{max.}$ dependent)	2 to 10		A
Maximum holding current (I_{nt})	50 to 500 (at 25 °C)	50 to 100 (at 70 °C)	
Maximum voltage (RMS or DC)	16 to 400	220 to 600	V_{RMS}
Maximum trip time at 1 A	0.8 to 6		s
Switching temperature (T_{sw})	105 to 140		°C
Operating temperature range at max. voltage	-40 to 85		
Storage temperature	-40 to 155		
Maximum continuous power at 25 °C	2		W

Note

(1) Customized products are available on request in the indicated nominal R_{25} range. Larger 8 mm ceramics for lower resistance values or higher voltages are in use in the PTCCZ08 series.

APPLICATIONS

Over-temperature/over-load protection:

- Telecom
  - -Central Office Switching (C.O.)
  - -Subscriber Terminal Equipment (T.E.)
  - -Set-top Box
  - -Modems
- General industry and automotive
  - -Low power overload protection
  - -Inrush current limitation

DESCRIPTION

The component consists of a high performance PTC ceramic mounted in a lead frame with lead (Pb)-free tin plated contacts. The terminations are joined to the Ag plated ceramic by a high melting solder. The ceramic is covered with a protective high temperature silicone layer.

MARKING

- All SMD PTCs are marked with a 3-digit type number (XXX) and a date code (YYWW)

ELECTRICAL DATA AND ORDERING INFORMATION

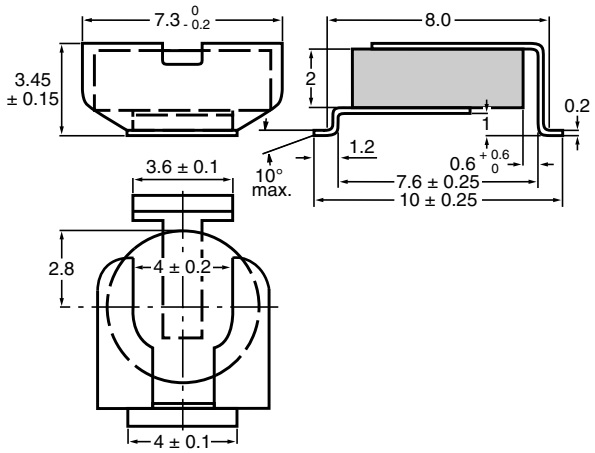
RESISTANCE		MATCHING (Ω)	$V_{max.}$ (V)	I_{nt} at		I_t at	MAX. TRIP-TIME at 1 A (s)	MAX. I_{ol} at $V_{max.}$ (A)	T_{sw}	OPERATING TEMP. RANGE AT MAX. VOLTAGE	STORAGE TEMP. RANGE	CATALOG NUMBER	
R_{25} (Ω)	TOL. (%)			25 °C (mA)	70 °C (mA)	25 °C (mA)						SAP ORDERING CODE	TYPE NR MARKING
TELECOM AND INDUSTRIAL TYPES													
10	20	-	245	165	100	270	3.0	2.0	105	0 to 70	-25 to 125	PTCTZ3NR100GTT (2)	012
10	20	0.5	245	165	100	270	3.0	2.0	105	0 to 70	-25 to 125	PTCTZ3MR100GTT (2)	016
40	25	no	265	80	50	130	0.8	2.0	105	0 to 70	-25 to 125	PTCTZ3NR400HTT	002
25	20	1	265	120	70	220	1.3	2.0	110	0 to 70	-25 to 125	PTCTZ3MR250HTT (2)	005
15 to 20	-	-	300	150	100	250	1.5	1.5	115	0 to 70	-25 to 125	PTCTZ3NR150KTT (2)	004
15 to 20	-	0.5	300	150	100	250	1.5	2.0	115	0 to 70	-25 to 125	PTCTZ3MR150KTT (2)	003
20	20	0.5	300	120	70	250	1.4	1.5	105	0 to 70	-25 to 125	PTCTZ3MR200KTT (2)	018
35	+15 / -20	1	425	110	70	175	1.0	0.7	125	-25 to 85	-40 to 155	PTCTZ3MR350MTT (2)	009
50	20	1	425	90	60	150	0.8	0.7	125	-40 to 70	-40 to 125	PTCTZ3MR500MTT	019
GENERAL INDUSTRIAL TYPES													
3.3	25	-	24	400	-	650	6.0	8.0	140	-40 to 85	-40 to 155	PTCTZ3NR339CTT	013
9.4	25	-	60	150	100	300	1.8	3.0	115	-40 to 85	-40 to 155	PTCTZ3NR949ETT	011

Note

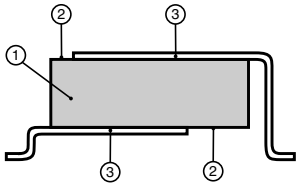
(2) These types pass ITU-K20-21-45 telecommunication protection recommendation

PTC OUTLINES

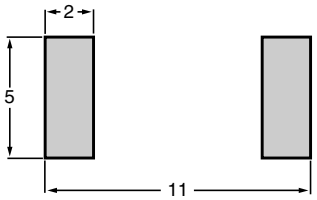
PTC SMD ceramic size: 6.5 mm



DIMENSIONS in millimeters



DIMENSIONS OF SOLDER LANDS in millimeters



PACKAGING					
TYPE	QUANTITY	CARRIER TAPE	WIDTH	PITCH	REEL DIAMETER
PTCTZ	1500	PS conductive blister tape acc. IEC60286-3	16 mm	12 mm	330 mm

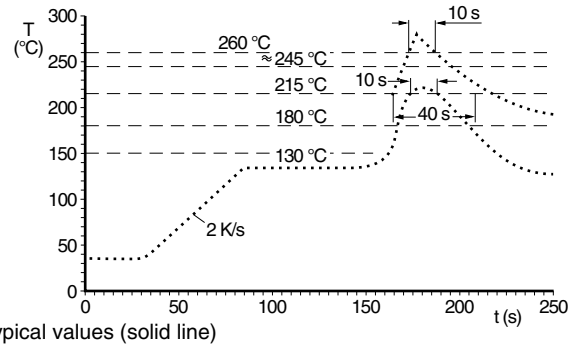
MATERIAL INFORMATION		
REF.	DESCRIPTION	MATERIAL AND REMARKS
1	Ceramic	$BaTiO_3$ doped
2	Metalization	NiCr Ag layer (vacuum deposition)
3	Lead frame	Ni plated phosphor bronze material covered by matte tin layer

SOLDERING CONDITIONS

This SMD thermistor is only suitable for reflow soldering, in accordance with JEDEC J-STD-020D. Soldering processes which can be used are reflow (infrared and convection heating) and vapor phase. The maximum temperature of 260 °C during 10 s should not be exceeded and no liquid flux should be allowed to reach the ceramic body.

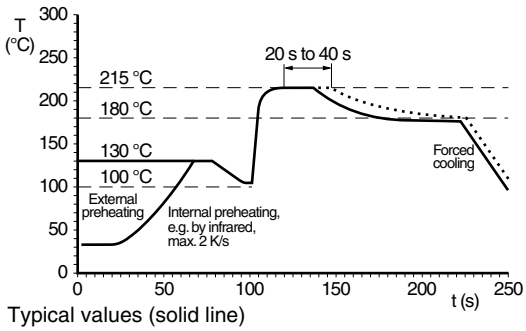
Typical examples of a soldering processes that will provide reliable joints without damage, are shown below.

Reflow soldering



Typical values (solid line)
Process limits (dotted lines)

Vapor phase soldering



Typical values (solid line)
Process limits (dotted lines)

MOUNTING CONDITIONS

A flat pick-up area of minimum 10 mm^2 and low weight allows for fast placement.

Because of the nature of PTC ceramic material the component should not be touched with bare hands, as the residue of perspiration can influence component behavior at high temperatures.

Handling forces applied to the component should be limited to 5 N in any condition.

PTC Thermistors, Time Delay for Lighting

FEATURES

- Reliable lamp starting, due to well defined inrush-current generated time delay
- Accurate resistance for ease of circuit design
- Small size and durable
- Available bulk-packed or taped-on-reel
- Long life: More than 20 000 starts for a 20 W CFL lamp

RoHS COMPLIANT

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Rated voltage (RMS)	80 to 200	V_{RMS}
Nominal switching current	150 to 500	mA
Resistance at 25 °C (R_{25})	100 to 625	Ω
Tolerance on R_{25} value	20 to 30	%
Maximum overload current I_{ol}	0.5 to 1.0	A
Tripping time	0.3 to 1	s
Operating temperature range at rated voltage	-20 to 105	°C

DESCRIPTION

Positive temperature coefficient (PTC) thermistors for overload protection have proved to be the ideal electronic ballast component for increased lamp life-time.

When the rectified mains is first applied, the PTC thermistor is cold, so its resistance is low. The lamp voltage will be below the necessary ignition value, so the current will flow through the cathodes, heating them to their emission temperature. At the same time, the PTC thermistor will heat up to its switch temperature, whereupon its resistance will rise rapidly, allowing the lamp voltage to reach its ignition value and light the lamp.

Once the lamp is lit, the cathodes are fed by a high-frequency lamp supply, to avoid flicker and improve efficiency. The PTC thermistor plays no further part until the lamp is switched off, whereupon it is ready to resume its smooth-starting function.

We supply a range of lighting PTC thermistors for this application offering a wide choice of voltage and switch times.

APPLICATIONS

Fluorescent lighting and lighting ballasts for:

- CFL 5 to 25 W range
- TL HF-ballasts

MOUNTING

The leads are suitable for soldering in any position. The lacquer may cover the leads up to 1.0 mm from the seating plane.

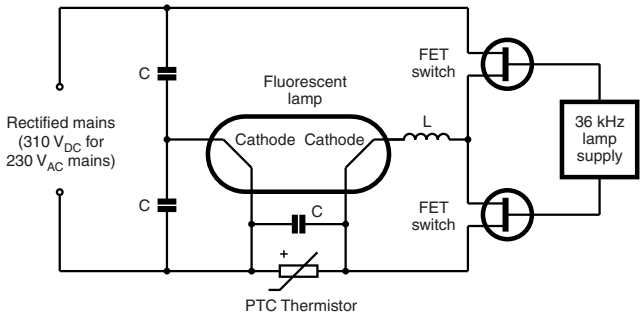
ELECTRICAL DATA AND ORDERING INFORMATION

R_{25} (Ω)		SWITCH TEMPERATURE (°C)	MAXIMUM PEAK VOLTAGE [4] (V_{peak})	TYPICAL [1] TRIP TIME at 25 °C		CATALOG NUMBER
MIN.	MAX.			t_{trip} (s)	at I_t (mA)	SAP CODING
500	750	≈ 110	700	0.4	200	PTCLL05P131TBE [2]
185	300	≈ 120	700	0.5	300	PTCLL05P211TTE [2]
75	125	≈ 80	700	0.7	300	PTCLL05P251TTE [2]
225	375	≈ 105	900	0.75	300	PTCLL07P261VTE [3]
75	125	≈ 105	1 000	0.85	500	PTCLL07P421WTE [3]

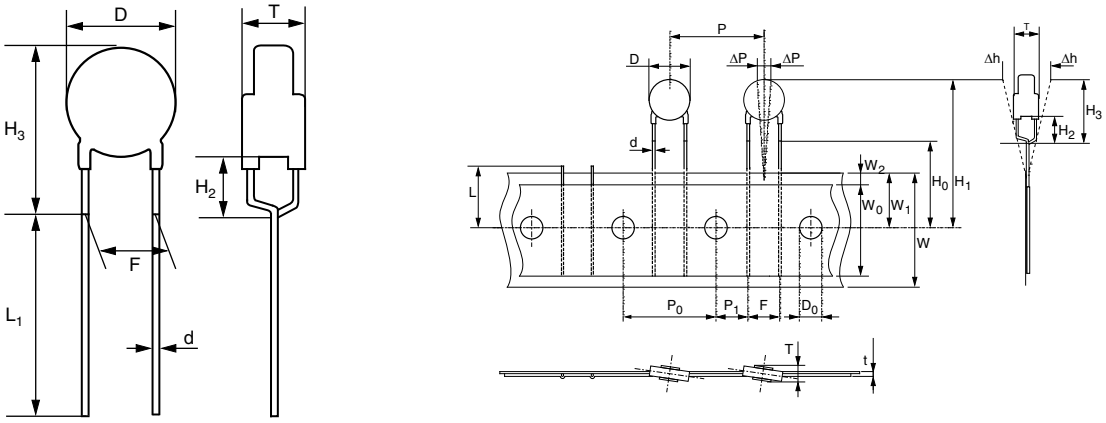
Notes

(1) Ignition time of the lamp approximately equals the tripping time.
(2) Specific for CFL lamp electronic starter.
(3) Specific for HF-TL ballast.
(4) Highest lamp ignition voltage should be smaller than the maximum allowable peak voltage.

TYPICAL ELECTRONIC BALLAST CIRCUIT



DIMENSIONS in millimeters



$D_{max.}$	$T_{max.}$	H_3	L_1	WEIGHT (g)	FIGURES	PACKAGING	SPQ	MATERIAL ORDERING NUMBER
5.4	4.5	10	3.5 ± 0.5	≈ 0.33	Fig. 1	Bulk	500	PTCLL05P131TBE
5.4	4.5	9	-	≈ 0.45	Fig. 2	On tape	1500	PTCLL05P211TTE
5.4	4.5	10	-	≈ 0.45	Fig. 2	On tape	1500	PTCLL05P251TTE
7.0	5.0	12	-	≈ 0.66	Fig. 2	On tape	1500	PTCLL07P261VTE
7.0	5.0	12	-	≈ 0.66	Fig. 2	On tape	1500	PTCLL07P421WTE

TAPE AND OTHER DEVICE DIMENSIONS in millimeters according IEC 60286 for tape on reel

SYMBOL	PARAMETER	DIMENSIONS	TOLERANCE
d	Lead diameter	0.6	± 0.05
P	Pitch between thermistors	12.7	± 1
F	Lead to lead distance guaranteed between component and tape	5	+0.5 / -0.2
H_2	Component body to seating plane	4	± 1
H_0	Lead-wire clinch height	16	± 0.5

PTC Thermistors Motor Start Packages

FEATURES

- Large diameter ceramic pellets for high starting current
- Various package sizes for optimum inrush current and switching time
- Rugged mechanical construction for reliable long life operation
- UL approved packages
- Plastic case mold UL 94 V-0 approved
- Adapted accessories for easy mounting

RoHS COMPLIANT

QUICK REFERENCE DATA		
PARAMETER	**VALUE**	**UNIT**
Resistance value at 25 °C	15 to 75	Ω
Tolerance on resistance value	± 30	%
Maximum current ratings	6 to 36	A_{RMS}
Switching temperature	110 to 120	°C
Switching times (typical)	0.25 to 1.0	s
Maximum voltage rating	410, 500	V_{RMS}
Operating temperature range	-10 to +80	°C
Storage temperature range	-25 to +105	°C

APPLICATIONS

- Single phase motor start assist in
  - Refrigerator systems
  - Air-conditioning systems
  - Heat-pumps
  - Small compressors

PTC MOTOR START SELECTION CHART								
VISHAY CERA-MITE PART NUMBER	**CASE STYLE**	**R_{DYN} (Ω) ± 20 %**	**R_{25} (Ω) ± 30 %**	**SWITCH TIME t (s) at 230 V**	**CURRENT RATING (A_{RMS})**	**MAX. VOLTAGE RATING (V_{RMS})**	**COMPRESSOR RANGE (BTU 000)**	**COMPRESSOR RANGE (HP)**
PTC305C20	C	25	35	0.25	10	410	10 to 28	0.75 to 2.0
PTC305C21	C	35	50	0.35	8	410	8 to 18	0.5 to 1.5
PTC305C22	C	50	75	0.50	6	410	5 to 12	0.25 to 1.0
PTC305C19	B	20	30	0.50	18	500	20 to 50	1.5 to 4.0
PTC305C12	B	25	40	0.60	15	500	18 to 42	1.5 to 3.5
PTC305C2	B	50	85	1.00	12	500	10 to 25	1.0 to 2.5
PTC305C9	A	10	15	0.50	36	500	28 to 68	3.0 to 7.0
PTC305C11	A	12.5	20	0.60	30	500	28 to 62	3.0 to 6.0
PTC305C1	A	25	42.5	1.00	24	500	14 to 36	1.5 to 3.5

PTC MOTOR START ACCESSORY SELECTION CHART	
ACCESSORY PART NUMBER	**DESCRIPTION**
PTCAUX36-520M	Round mounting bracket for case style C
PTCAUX36-520H	Round mounting bracket for case style A and B
PTCAUX7-36-5C	U-shaped mounting bracket for case style B
PTCAUX7-36-4C	U-shaped mounting bracket for case style A
PTCAUX50-1278	Jumper wire for case style A

ECONOMICAL SOLID STATE TORQUE ASSIST FOR HEAT PUMPS, ROOM AIR, COMMERCIAL AND RESIDENTIAL AIR CONDITIONING AND REFRIGERATION SYSTEMS

Positive Temperature Coefficient Themistors (PTC) have been used for many years in millions of HVAC applications to provide starting torque assistance to Permanent Split Capacitor (PSC) single phase compressor motors.

Sizes are available to cover the full range of 120 V/240 V PSC compressor motors.

Safety Agency Recognition

Vishay Cera-Mite motor start PTC thermistors are recognized by Underwriter Laboratories file E97640 in accordance with standard for controllers and refrigeration components UL 873 or UL 60730; and Canadian Standard C22.2 No. 24. All packages and accessories are RoHS-compliant.

RELATIVE COMPARISON OF VARIOUS MOTOR STARTING METHODS

Three methods have historically been employed to generate starting torque for PSC motors. All are well-proven technologies and may be compared relative to one another based upon categories shown below.

The importance of each category is dependent upon the motor application and industry sector.

In general, if the PTC starter produces sufficient starting torque, it is considered the simplest and most economical choice.

Table 1

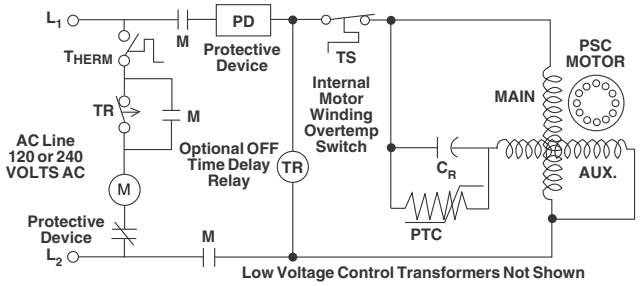
STARTING METHOD	MECHANICAL			ELECTRICAL					FINANCIAL		
	EASE OF WIRING	PANEL SPACE REQUIRED	SENSITIVE TO MOUNTING DIRECTION	ACCELERATION TORQUE PRODUCED	ACCELERATION (SWITCH) TIME	RESET TIME REQUIRED	EMI/RFI GENERATED	TECHNOLOGY	INVENTORY MIX REQUIRED	RELIABILITY	PURCHASED COST
PTC starter	Simple 2 wire	Lowest	No	Lowest	Fixed	3 min to 5 min	No	Solid State	Lowest	Highest	Lowest
Start cap with PTC acting as a current relay	Moderate 2 wire or 3 wire	Medium	Yes	Medium	Fixed	2 min to 5 min	No	Solid State	Medium	Medium	Medium
Start cap used with potential or current relay	Difficult 4 wire or 5 wire	Highest	Yes	Highest	Variable based on motor speed	None	Yes	Electro Mechanical	Highest	Lowest	Highest

SIMPLIFIED PTC STARTING DIAGRAM

Start Sequence

When starting the compressor, contactor (M) closes; the PTC, which is at low resistance, provides starting current to the motor's auxiliary winding. After time delay (t), the current passing through the PTC causes it to heat and "switch" to a very high resistance. At this point the motor is up to speed and the run capacitor (C_R) determines the current in the auxiliary winding. The PTC remains hot and at high resistance as long as voltage remains on the circuit. When contactor (M) opens, shutting off voltage to the compressor, the PTC cools to its initial low resistance and is again ready to provide torque assist on the next startup.

Fig T-2

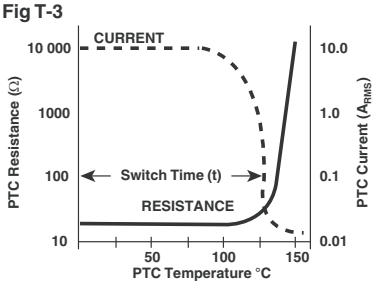


Restart

It is important to provide time between motor starts to allow the PTC to cool to near its initial temperature. This time is usually 3 min to 5 min and is determined by the thermostat (THERM) or separate time-delay relay (TR). Attempts to restart in less time may be successful depending on compressor equalization, line voltage, temperature, and other conditions. If the motor were to stall in a locked-rotor state, overload device (PD or TS) would open the line and a further time delay would occur until the motor overload is reset. Motor start PTCs are applied to compressors having means to equalize pressure during shutdown.

TYPICAL PTC CHARACTERISTICS AS A MOTOR START DEVICE

Fig T-3



START AND ACCELERATION TORQUES SINGLE PHASE PSC HIGH EFFICIENCY COMPRESSORS

The use of a PTC start assist insures sufficient acceleration torque to overcome not only breakaway friction, but also parasitic asynchronous torques associated with the 5th and 7th motor harmonics or lamination slot harmonics.

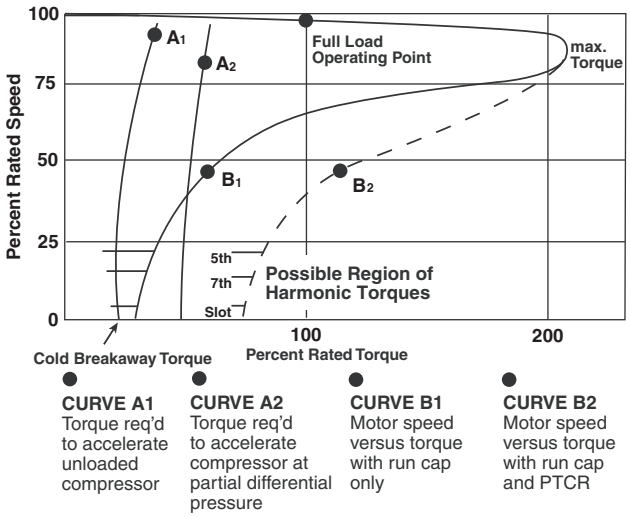
Acceleration Time Considerations

The time to accelerate a rotating machine is:

$$\text{accelerating time (s)} = \frac{\text{RPM x WK}^2\ (\text{lb ft}^2)}{\text{average torque (lb ft) x 308}}$$

(average torque = curve B - curve A)

1. If (curve B - curve A) is zero or less, the motor may stall.
2. In calculating torque available from curve B, allowance should be made for cusps in the torque curve due to harmonics. The time needed to accelerate from rest to 1/2 speed is critical, as the average torque available in this region is limited. Select a PTC with sufficient switching time (t) to accelerate the compressor.
3. Scroll and rotary compressors may have less breakaway torque than shown.
4. A compressor with no equalization may require over 100 % starting torque and time as long as several seconds. PTC starters not recommended.



CONSIDERATIONS FOR CURRENT IN PTC APPROXIMATE EQUIVALENT CIRCUIT PSC MOTOR AT ZERO SPEED

$$I_L\ (\text{run}) = \frac{\text{HP x 746}}{V_M \text{ x pf x eff}} \text{ x } I_L\ (\text{start}) \approx I_L \text{ run}$$

For running conditions:

$$\text{If } V_{aux} = V_M \text{ then } I_M \text{ and } I_{aux} = \frac{I_L}{\sqrt{2}}$$

$$\text{If } (V_{aux} \neq V_M) \text{ then } I_{aux} = \frac{I_L}{\sqrt{2}} \text{ x } \frac{V_M}{V_{aux}} \text{ and } Z_{aux} = \frac{V_M}{I_{aux}}$$

For the greatest starting torque, PTC should be chosen to make:

$V_M \text{ x } I_M = V_{aux} \text{ x } I_{aux}$. In many cases the auxiliary Volt-Amperes are limited to about 50 % of the main winding Volt-Amperes to get 50 % to 70 % rated torque.

Then at start, with PTC in series:

$$Z'_{aux} = R_{\overline{PTC}} + Z_{\overline{aux}}$$

$$I_{Rstart} \text{ through PTC} = \frac{V_M}{Z_{aux}}$$

$$I_{Cstart} \text{ through Run Cap} = \frac{V_M}{X_C}; X_C = \frac{1}{2\pi fC}\ \Omega$$

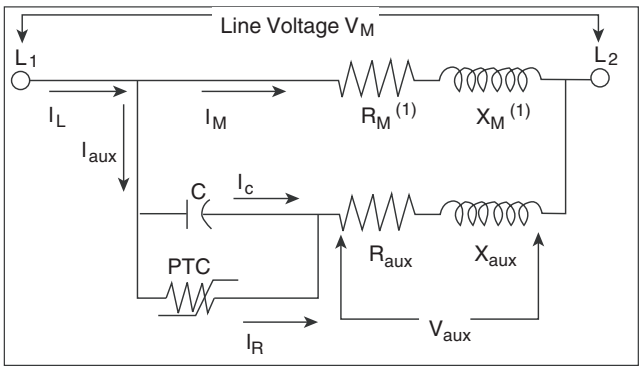
$$I_{aux\ start} = I_{\overline{R\ start}} + I_{\overline{C\ start}}$$

If Z_{aux} is low impedance, less than 10 % of R_{PTC}

then it can be ignored and I_{PTC} at start $= \frac{V_M}{R_{PTCR}}$

This closely approximates the condition for motors over 1/2 HP

Fig. T-5



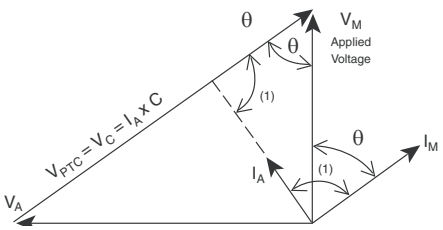
* R and X are total of stator and rotor

Fig T-6

Simplified voltage diagram of the PSC motor at operating speed.

Note

(1) I_A (auxiliary current) leads I_M (main current) by 80° to 90° when C (run capacitor) is chosen for balanced operation at 3/4 to full load. Line Power Factor = sine 2θ



EFFECT OF PTC RESISTANCE ON STARTING TORQUE OF PSC MOTORS

Table 2

MOTOR HP (TABLE 4) (NOTE 7)	LOCKED ROTOR TORQUE WITH RUN CAP ONLY % RATED TORQUE (SEE A)	STARTING TORQUE WITH RUN CAP AND PTC (% RATED TORQUE) (SEE B) RESISTANCE (R_{DYN})				
		50 Ω	25 Ω	20 Ω	12.5 Ω	10 Ω
0.5	25 % to 35 %	70 % to 100 %	80 % to 100 %	NA	NA	NA
1	25 % to 35 %	50 % to 70 %	70 % to 100 %	NA	NA	NA
2	20 % to 30 %	40 % to 60 %	60 % to 90 %	70 % to 100 %	70 % to 100 %	80 % to 100 %
3.5	20 % to 30 %	NA	40 % to 60 %	50 % to 85 %	60 % to 90 %	70 % to 100 %
5	15 % to 25 %	NA	NA	40 % to 60 %	50 % to 75 %	60 % to 90 %
6.5	15 % to 25 %	NA	NA	NA	40 % to 70 %	50 % to 80 %

A. Rated torque is the torque at full speed rated load.
It is calculated as:

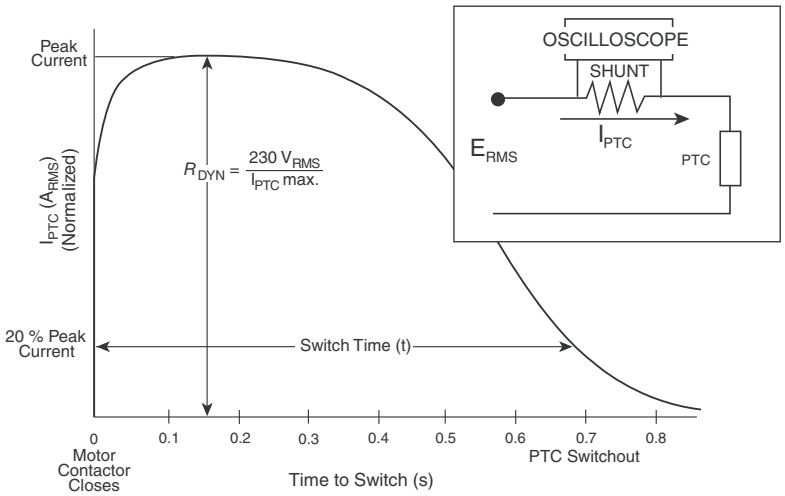
$$\text{Torque (lb - ft)} = \frac{\text{HP x 5250}}{\text{RPM}}$$

The range shown includes both normal slip and high efficiency low slip motors. Starting torque varies as: $(\text{Line Voltage})^2$

B. Figure T-4 shows effect of using PTC to increase starting torque. For reciprocating compressors, it is advised to choose a resistance value that gives at least 50 % rated torque at locked rotor. Scroll and rotary compressors may require less torque.

TYPICAL PTC CURRENT VS. TIME SHOWING DEFINITION OF RDYN AND SWITCH TIME (t)

Fig T-7



$$\text{Time (t)} \approx \text{KM (130 °C - } T_0) \frac{R_{DYN}}{V^2_{PTC}}$$

M = PTC mass (g)
T_0 = PTC temp at time 0
K = 0.75 J/g/°C

START CAPACITOR REPLACEMENT

Capacitor Starting Comparison

Some PSC motors have historically been started with a capacitor and relay. To deliver the same starting current as a start capacitor, a PTC resistance is available for approximately equal ohms. Table 3 can be used for conversion.

Even though the start current may be the same, the start torques may differ depending on the motor design.The PTC has a fixed time built in. The start capacitor will stay in the circuit until a relay switches it out. The longer time provided by the capacitor and relay may be needed on applications where equalization is not present or adequate reset time is not available.

STARTING CURRENT APPROXIMATION BASED ON

$$X_C = \frac{1}{2\pi fC}$$

Table 3

START CAPACITOR	PTC VALUE
50 µF	50 Ω
75 µF	37.5 Ω
100 µF	25 Ω
125 µF	20 Ω
200 µF	12.5 Ω
250 µF	10 Ω

PTC SELECTION

- Choosing the best PTC for an application is a simple matter. See Table 4 and Table 2. Vishay Cera-Mite PTCs are available in three case sizes (A, B, and C)
- Table 4 indicates the correct case size for the application. Table 2 shows how to choose the correct resistance value
- Using a device too small or resistance too high will give inadequate starting performance. An oversize device will not harm the motor, but may not be optimum with regards to acceleration dynamics, or power dissipation
- The PTC is generally self protecting when applied within the voltage and current ratings
- All PTC305C Series starters and accessories are RoHS compliant

Table 4

PTC MOTOR START SELECTION CHART

VISHAY CERA-MITE PART NUMBER (2)	CASE STYLE (2)	RESISTANCE (Ω) (3)		SWITCH TIME (4) (t) s AT 230 V	CURRENT RATING (5) (A_{RMS})	MAX. VOLTAGE RATING (6) (V_{RMS})	AVG. POWER DISSIPATION (7) (W)	COMPRESSOR RANGE (8)	
		R_{DYN} ± 20 %	R_{25} ± 30 %					BTU (000)	HP
PTC305C20 (1)	C	25	35	0.25	10	410	3.5	10 to 28	0.75 to 2.0
PTC305C21	C	35	50	0.35	8	410	3.5	8 to 18	0.5 to 1.5
PTC305C22 (1)	C	50	75	0.50	6	410	3.5	5 to 12	0.25 to 1.0
PTC305C19 (1)	B	20	30	0.50	18	500	7	20 to 50	1.5 to 4.0
PTC305C12 (1)	B	25	40	0.60	15	500	7	18 to 42	1.5 to 3.5
PTC305C2	B	50	85	1.00	12	500	7	10 to 25	1.0 to 2.5
PTC305C9 (1)	A	10	15	0.50	36	500	9	28 to 68	3.0 to 7.0
PTC305C11	A	12.5	20	0.60	30	500	9	28 to 62	3.0 to 6.0
PTC305C1 (1)	A	25	42.5	1.00	24	500	9	14 to 36	1.5 to 3.5
									UL File E97640

Notes

(1) Preferred values.

(2) Part number is stamped on the device for UL recognition. The customer part number can also include 1 or 3 character alpha-numeric suffix to designate specific customer marking and accessory furnished. The suffix is not marked on the part. Certified outline drawing and complete part number will be furnished on request for specific applications.(Example: PTC305C19K01.) Mounting brackets and other accessories are to be ordered separately.

(3) RDYN is nominal resistance equal to U/I when 230 V, 50 Hz/60 Hz is applied (see Fig T-7). This resistance determines current and maximum starting torque at the moment of application of voltage to the motor and can be measured with an oscilloscope.
For receiving inspection or routine trouble shooting, the DC resistance at 25 °C (R_{25}) as measured with an ohmmeter is approximately 50 % greater. For example: PTC305C20 measured with an ohmmeter would be 35 Ω ± 30 % tolerance.

(4) Resistance values are duplicated in several case sizes (i.e.: PTC305C20, C12, and C1) to provide longer switch time (t) and higher current ratings (see Fig. T-7). Larger parts may be needed for more difficult starting conditions (voltage or temperature) or may be used for accelerating fans against back pressure.

(5) Maximum current in the PTC is determined by

$$\frac{\text{Maximum Line Voltage}}{\text{Minimum } R_{DYN}}$$

Motor auxiliary winding impedance is usually small compared to PTC resistance, and does not materially affect PTC current.
Current in PTC is a percentage of the full motor inrush (locked rotor) current; usually 30 % to 50 % (see Fig T-5).

(6) In application, the maximum voltage is the voltage that appears across the run capacitor at rated speed, high line, light load. This is not the applied line voltage (see Fig T-6).
THESE DEVICES ARE INTENDED FOR APPLICATION ON 240 VOLT LINES OR SYSTEMS WITH MAXIMUM LINE VOLTAGE UP TO 265 V. The PTC305C20, 21 and 22 are also used on 120 V systems where the motor is designed to use same run capacitor and PTC as equivalent 230 V compressor.

(7) This is the power used to keep the PTC switched in a high impedance state under full load running conditions at typical ambient temperature.

(8) BTU and horsepower ranges are for reference only. PTC may be applied outside those ranges as long as maximum voltage and maximum current are not exceeded. Scroll and rotary compressors may require less starting assistance allowing use of smaller devices.

DIMENSIONS FOR PTC MOTOR START DEVICES in inches (millimeters)

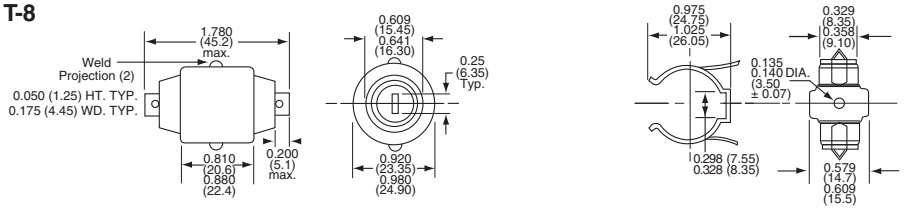
- **PACKAGED MOTOR START PTCS ARE OFFERED IN THREE DIFFERENT CASE SIZES TO ACCOMMODATE THE RANGE OF PSC COMPRESSOR MOTORS SERVED**

Case Style C

Case Style C is a 2-terminal single pellet device with current carrying capacity up to 10 A. For proper mounting a bracket has to be ordered separately.

SAP ORDERING PART NUMBER	
CASE C	MOUNTING BRACKET
PTC305C20 PTC305C21 PTC305C22	PTCAUX36-520M (Round)

Fig T-8



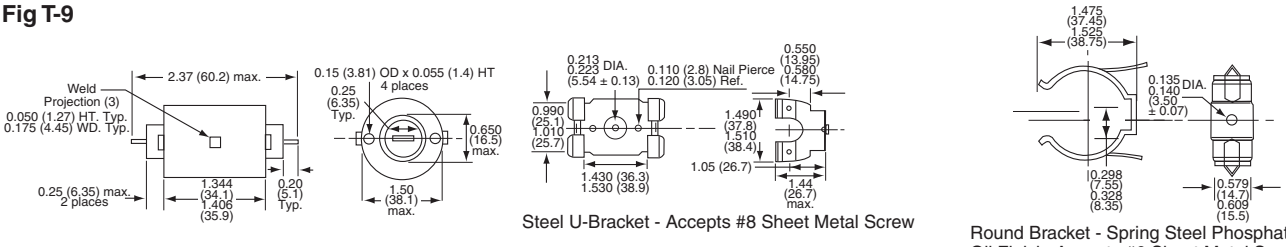
Round Bracket - Spring Steel Phosphate & Oil Finish. Accepts #6 Sheet Metal Screw

Case Style B

Case Style B is a 2-terminal single pellet unit with current carrying capacity up to 18 A. For proper mounting a U shaped or round bracket has to be ordered separately.

SAP ORDERING PART NUMBER	
CASE B	MOUNTING BRACKET
PTC305C2 PTC305C12 PTC305C19	PTCAUX7-36-5C (U-shaped) PTCAUX36-520H (Round)

Fig T-9



Steel U-Bracket - Accepts #8 Sheet Metal Screw

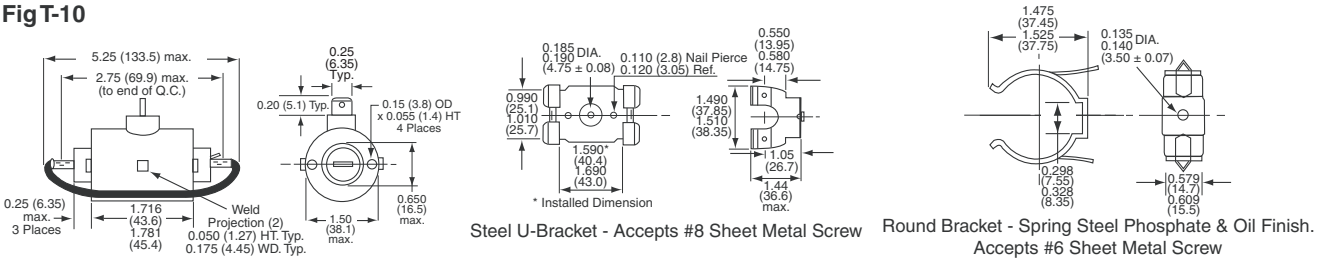
Round Bracket - Spring Steel Phosphate & Oil Finish. Accepts #6 Sheet Metal Screw

Case Style A

Case Style A is a 3-terminal device that incorporates two pellets to be connected in parallel, resulting in lower resistance values and current carrying capacity up to 36 A. For proper mounting a U shaped or round bracket has to be ordered separately. To connect the two PTC pellets in parallel, a jumper wire can be ordered separately.

SAP ORDERING PART NUMBER		
CASE A	MOUNTING BRACKET	WIRE JUMPER
PTC305C1 PTC305C9 PTC305C11	PTCAUX7-36-4C (U-shaped) PTCAUX36-520H (Round)	PTCAUX50-1278 (9.75" (248) Long 105 °C wire)

Fig T-10



Steel U-Bracket - Accepts #8 Sheet Metal Screw

Round Bracket - Spring Steel Phosphate & Oil Finish. Accepts #6 Sheet Metal Screw

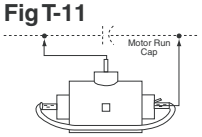
OPERATING TEMPERATURE

Under normal operation, the ceramic pellet inside the case can reach a temperature of 150 °C. The plastic case material has been recognized by UL for operation up to this temperature. The actual temperature on the outside of the case will be approximately 100 °C while the motor is running. An appropriate mounting location and 105 °C, 600 V wiring are recommended.

CONNECTION DIAGRAMS

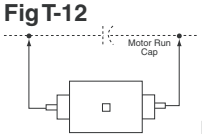
PTC Thermistors Motor Start units are connected directly across the PSC motor's "run" capacitor. Case style A is a 3-terminal device and uses an external jumper wire to connect the two internal pellets in parallel. A special "piggyback" terminal on the jumper wire provides for two connections on one side of the A-style case.

Fig T-11



A Style
3-Terminal Case

Fig T-12



B & C Style
2-Terminal Case

VISHAY CERA-MITE MOTOR START FEATURES

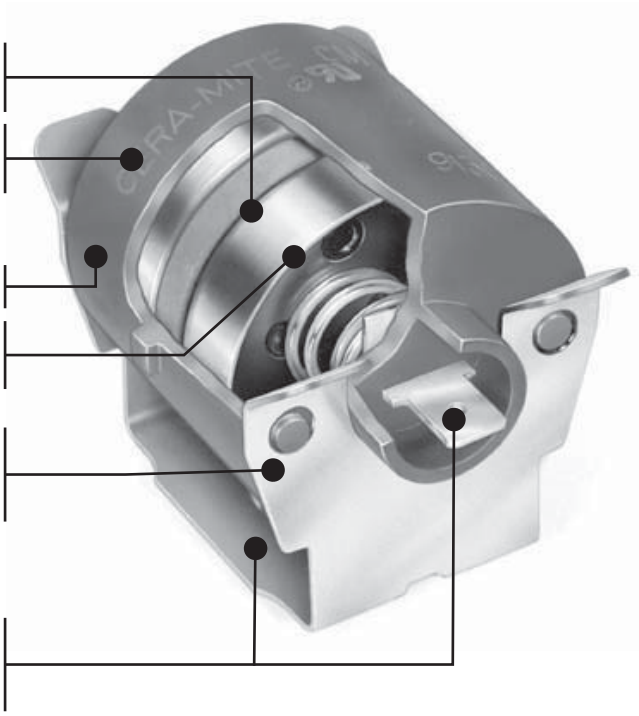
ADVANCED CERAMIC ENGINEERING FOR HVAC

Vishay Cera-Mite's capability in large diameter ceramic pellets, unique formulations tailored to motor starting, and heavy duty electrode systems, have been developed and proven with the cooperation of HVAC industry experts over a period of more than 30 years.

INHERENT PERFORMANCE

Large diameter pellets make possible low resistance start devices needed to match torque requirements of high efficiency compressor motors.

Various package sizes offer selection of timing intervals, providing optimum switching time without dependence on sensing speed, counter EMF, or current.



RUGGED MECHANICAL CONSTRUCTION

Vishay Cera-Mite PTC cases are molded from a UL 94 V-0 high temperature, engineered plastic/glass composite.

Heavy duty aluminum contact plates and stainless steel force springs are scaled to the pellet sizes and current ratings to insure no internal arcing and to enhance quick reset time.

Unbreakable metal mounting brackets, sold separately, attach securely with a single screw. The "U" - brackets developed by Vishay Cera-Mite feature lower power consumption and greater reliability by maximizing case to ground thermal impedance.

SIMPLE AND ECONOMICAL

A solid state device requiring only 2 quick connect wires and one bracket screw to install. Compared to the alternative start capacitor and relay, PTC start devices save several wires, occupy less panel space, mount more easily, and cost less.

OUTSTANDING RELIABILITY

Over a twenty year period, with an installed base of millions of Vishay Cera-Mite PTC start devices, experience has demonstrated reliability at 1.0 FIT or less. Users have benefited from very low warranty expense.

RESTART CONSIDERATIONS

A properly sized PTC will provide adequate starting current and starting time with a cool down time of 3 min to 5 min, coordinating perfectly with standard "off delay" equalization timers restart characteristics of the three case sizes are shown.

Fig T-13

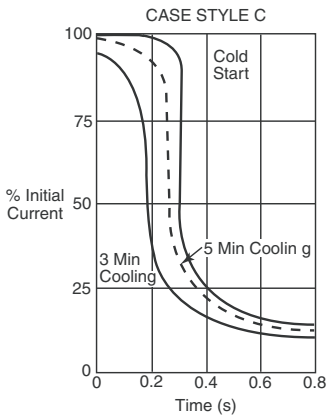


Fig T-14

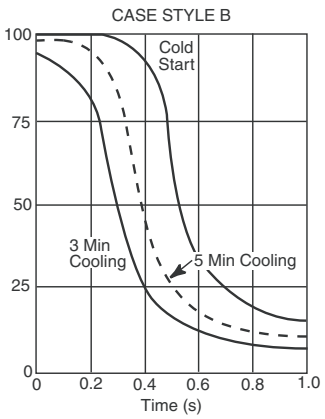
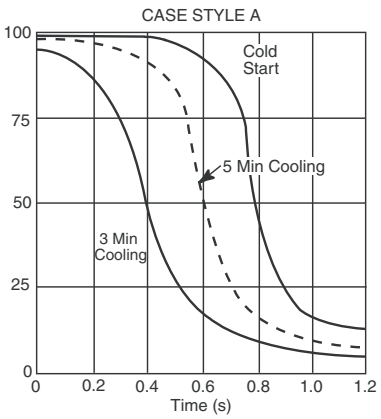


Fig T-15



PTC Thermistors Motor Start Pellets

FEATURES

- Rugged silver electrodes well suited for long life OEM pressure contact mounting
- Various pellet sizes for optimum inrush current and switching time
- Withstanding voltage is 2 times the maximum voltage rating
- UL approved pellets

RoHS COMPLIANT

QUICK REFERENCE DATA		
PARAMETER	**VALUE**	**UNIT**
Resistance value at 25 °C	3.3 to 75	Ω
Tolerance on resistance value	± 30	%
Current ratings	4 to 16	A_{RMS}
Switching times (typical)	0.25 to 1.0	s
Maximum voltage rating	160 to 450	V_{RMS}
Operating temperature range	-10 to +85	°C
Storage temperature range	-25 to +105	°C

APPLICATIONS

- Single Phase motorstart assist in
- Refrigerator systems
- Airconditioning systems
- Heat-pumps
- Small compressors
- Inrush current generation

DESCRIPTION

These directly heated thermistors have a positive temperature coefficient and are primarily intended for inrush current generation. They consist of a high grade ceramic disk with two rugged pattern silver electrodes for contact pressure mounting. These ceramic pellets can be build into proprietary motor start devices for compressor, refrigerator and HVAC OEMs.

MOUNTING

The PTC thermistor pellets are suitable for pressure contact mounting in application specific housing assemblies. Examples of such assemblies can be found in the PTC305C series. Assembly housing must be appropriate for usage up to 180 °C surface temperature of the PTC pellets.

The pellets are not solderable.

MARKING

The pellets are not marked. Marking is available on request for customized parts.

SAFETY AGENCY RECOGNITION

Vishay Cera-Mite motor start PTC pellet thermistors are recognized by Underwriter Laboratories file E148885 in accordance with Standard for Thermistor Type Devices UL 1434; and Canadian Standards C22.2 No. 0-1991.

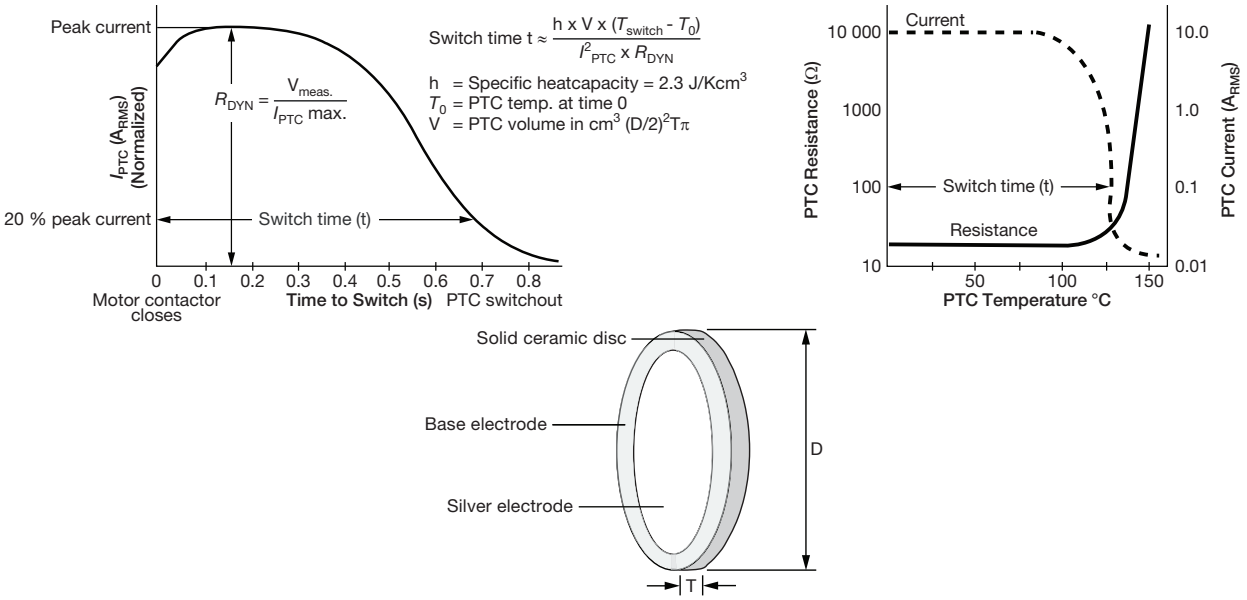
ELECTRICAL DATA AND ORDERING INFORMATION

PART NUMBER	R_{25} (1) ± 30 % (Ω)	R_{DYN} (2) (Ω)	$V_{meas.}$ R_{DYN} (V_{RMS})	MAX. VOLTAGE (3) (V_{RMS})	MAX. CURRENT (A_{RMS})	SIZE Ø x T (mm)	UL (4)	T_{SWITCH} (°C)
PTC307C1674P	5.0	4.0	120	200	10	16 + 0.2/- 0.4 x 2.5 ± 0.25	Y	105
PTC307C1700P	6.8	5.0	120	200	10		Y	105
PTC307C1711P	10	7.2	120	200	10		Y	105
PTC307C1668P	5.0	4.0	120	180	12	17.5 ± 0.3 x 2.5 ± 0.25	Y	120
PTC307C1644P	6.8	5.0	120	200	10		Y	120
PTC307C1651P	10	7.2	120	200	10		Y	120
PTC307C1720P	20	13	120	320	8		Y	120
PTC307C1411P	3.3	2.6	120	160	12	20 + 0.2/- 0.8 x 2.5 ± 0.25	Y	120
PTC307C1484P	4.7	3.5	120	180	12		Y	120
PTC307C1544P	5.6	4.1	120	180	12		Y	120
PTC307C1399P	6.8	5.0	120	200	10		Y	120
PTC307C1489P	10	7.2	120	230	9		Y	120
PTC307C1476P	12	8.5	120	250	8.5		Y	120
PTC307C1530P	15	10.5	120	300	8		Y	120
PTC307C1531P	22	15	120	400	8		Y	120
PTC307C1282P	33	22	120	355	6		Y	120
PTC307C1533P	47	30	120	400	5		Y	120
PTC307C1292P	68	42	120	430	4		Y	120
PTC307C1487P	3.9	3.0	50	175	16	20 + 0.2/- 0.8 x 3.2 ± 0.25	Y	120
PTC307C1529P	12	10.3	100	350	8		Y	120
PTC307C1545P	14	12	100	320	8		Y	120
PTC307C1640P	30	15.9	240	380	12		Y	120
PTC307C1740P	30	15.9	240	450	7		Y	120
PTC307C1024P	38	25	240	400	9	20 + 0.2/- 0.8 x 5.0 ± 0.25	Y	120
PTC307C1409P	50	35	240	400	7.5		Y	120
PTC307C1410P	75	50	240	400	5.5		Y	120

Notes

- R_{25} = zero power resistance measured at < 0.5 V_{DC}, standard tolerance ± 30 %, other tolerances and values on request
- R_{DYN} = nominal dynamic resistance during inrush, measured with $V_{meas.}$ applied, for information only
- The maximum voltage is the voltage that appears across the PTC in a motor start application. This is not the applied line voltage. Withstanding voltage of all UL approved types is minimum twice the specified maximum operating voltage.
- UL recoginition following XGPU2 category of standard UL1434, file E148885

TYPICAL PTC CURRENT VS. TIME SHOWING DEFINITION OF R_{DYN} AND SWITCH TIME (t)



PTC Thermistors, Overload Protection for Telecommunication

FEATURES

- Wide resistance range in telecom area from 4 Ω to 70 Ω
- Fast protection against power contact faults
- Withstand high overload currents of up to 10 A
- High voltage withstanding capabilities for the larger sized thermistors (up to 600 V)
- Good tracking over a wide temperature range for all matched or binned thermistors (matching at 85 °C ≤ 2 x matching at 25 °C)
- UL1434 approved types available (XGPU2)
- All telecom PTCs are coated with a high temperature silicon lacquer (UL 94 V-0) to protect them from any harsh environments and to improve their lifetime

RoHS COMPLIANT

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Maximum voltage (RMS or DC)	220 to 600	V_{RMS}
Maximum holding current (I_{hl})	100 to 175	mA
Resistance at 25 °C (R_{25})	8 to 50	Ω
Tolerance on R_{25} value	15 to 25	%
Maximum overload current I_{ol}	0.6 to 10.0	A
Tripping time at 1 A	1 to 40	s
Operating temperature range at max. voltage	0 to 70 (95)	°C

APPLICATIONS

Over-temperature/over-load protection:

- Main distribution frame (MDF)
- Central office switching (C.O.)
- Subscriber terminal equipment (T.E.)
- Set-top box (S.B.)

MARKING

Clear marking on a gray coated body
BC and R_{25} value

ELECTRICAL DATA AND ORDERING INFORMATION

RESISTANCE		MATCHING (Ω)	$V_{max.}$ (V_{RMS})	NON-TRIP CURRENT		TRIP CURRENT		MAX. TRIP TIME at 1 A	$I_{max.}$ AT $V_{max.}$	APPLICATION AREA [2]	ORDERING PART NUMBERS
R_{25} (Ω)	TOL. (%)			I_{hl} (mA)	at T (°C)	I_t (mA)	at T (°C)	$t_{max.}$ (S)	$I_{max.}$ (A)		
25	± 20	1.0	220	70	70	200	25	2.5	4.0	C.O.	PTCTL4MR250GTE
10	± 20	1.0	230	100	70	250	25	3.0	2.0	MDF; ISDN	PTCTL3MR100GTE
25	± 15	no	245	70	70	200	25	5.0	2.6	C.O.	PTCTL4NR250GTE
16	± 20	no	245	140	55	270	25	8.0	1.6	T.E.	PTCTL6NR160GTE
10	± 20	no	245	140	55	270	25	8.0	2.0	T.E.	PTCTL6NR100GTE
25	± 20	1.0	250	70	70	175	25	1.3	3.2	MDF; C.O.	PTCTL3MR250HTE
10	± 20	no	250	100	70	450	0	40.0	10.0	T.E.	PTCTL8NR100HBE
8	± 25	0.5	285	135	95	400	25	6.0	0.6	MDF; ISDN	PTCTL4MR080JBE
16	± 25	no	300	100	70	250	25	2.0	2.6	MDF; T.E.	PTCTL3NR160KTE
10	± 20	no	350	100	70	270	25	4.0	1.0	T.E.; S.B.	PTCTL4NR100LBE
10	± 20	1.0	350	100	70	270	25	4.0	1.0	C.O.	PTCTL4MR100LTE
50	± 20	1.0	600	50	70	140	25	1.0	1.0	C.O.	PTCTL4MR500SBE
35	± 20	3.0	600	70	70	600	0	3.0	1.0	C.O.	PTCTL4MR350STE
25	± 20	0.5	600	70	70	170	25	2.5	2.0	C.O.	PTCTL4MR250STE
25	± 20	0.5	600	70	70	170	25	5.0	2.0	C.O.	PTCTL6MR250STE
10	± 20	0.5	600	175	25	400	25	7.0	1.0	C.O.	PTCTL7MR100SBE [1]
10	± 20	no	600	175	25	400	25	7.0	1.0	T.E.; S.B.	PTCTL7NR100SBE [1]

Notes

- All types pass ITU-T K20-21-45 telecommunication protection recommendation

(1) UL 1434 approved types and compatible with UL1459 and GR1089

(2) MDF: Main Distribution Frame; C.O.: Central Office Switching; T.E.: Subscriber Terminal Equipment; S.B.: Set-top Box

OVERCURRENT PROTECTION OF TELECOMMUNICATION LINES

The PTC thermistor must protect the telephone line circuit against overcurrent which may be caused by the following events:

- Surges due to lightning strikes on or near to the line plant.
- Short-term induction of alternating voltages from adjacent power lines or railway systems, usually caused when these lines or systems develop faults.
- Direct contact between telephone lines and power lines.

To provide good protection under such conditions a PTC thermistor is connected in series with each line, usually as secondary protection; see Typical Telephone Line drawing fig. 1. However, even with primary line protection (usually a gas discharge tube), the PTC thermistor must fulfil severe requirements.

Surge pulses of up to 2 kV can occur and in order to withstand short-term power induction the PTC thermistor must withstand high voltages. If the line has primary protection a 220 V to 300 V PTC thermistor is adequate. Without primary protection, however, a 600 V PTC device is necessary. Vishay BCcomponents manufacturers a range of PTC thermistors (see Electrical Data and Ordering Information Table) covering both requirements.

In the case of direct contact between the telephone line and a power line, the PTC thermistor must withstand very high inrush power at normal mains voltage. Under such conditions, overload currents of up to 10 A on a 230 V mains could occur for up to several hours. To handle this power, the resistance/temperature characteristic of the thermistor must have a very steep slope and the ceramic must be extremely homogeneous.

In case of overcurrent due to short-term induction of alternating voltages, currents of several amperes with voltages as high as 650 V_{RMS} can be present for several seconds.

For standard high voltage applications, resistance values from 25 Ω to 50 Ω are available. However, ISDN networks which carry high-frequency sound and vision, need lower line impedance.

Telecommunication designers are therefore demanding high voltage thermistors with much lower R_{25} values, which places even greater demands on the manufacture of PTC thermistors. For these applications PTC thermistors which have a R_{25} value of 10 Ω with voltages in the 300 V_{RMS} to 600 V_{RMS} range are available.

In a typical telephone line application, two PTC thermistors are used, one each for the tip and ring (or A and B) wire together with their series resistors. For good line balance it is important that the thermistor and resistor pairs are matched.

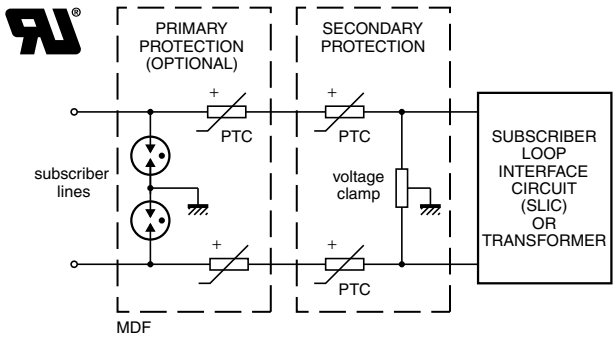
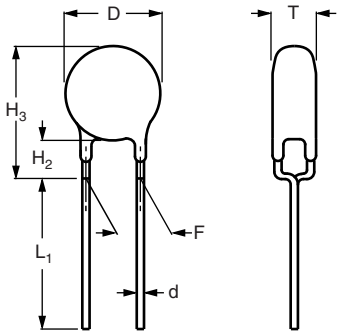


Fig. 1 - Typical telephone line showing where PTC thermistors can be used for overcurrent protection.

PTC THERMISTORS IN BULK



COMPONENT DIMENSIONS (in mm)								
D MAX.	T MAX.	H_2	L_1	H_3 MAX.	H_0	PACKAGING (1)(2)		ORDERING PART NUMBER
						TYPE	SPQ	
8.5	5.0	1.5 to 3.0	-	11.5	16	Taped on reel	1500	PTCTL4MR250GTE
7.0	4.0	2.0 ± 0.5	-	9.8	18	Taped on reel	1500	PTCTL3MR100GTE
8.3	4.0	1.5 to 3.0	-	11.0	18	Taped on reel	1500	PTCTL4NR250GTE (3)
11	4.5	4.0 ± 1.0	-	15.5	16	Taped on reel	1500	PTCTL6NR160GTE
11	4.5	4.0 ± 1.0	-	15.5	16	Taped on reel	1500	PTCTL6NR100GTE (3)
7.0	4.0	2.0 ± 0.5	-	9.8	18	Taped on reel	1500	PTCTL3MR250HTE
13.6	6.0	4.0 ± 1.0	20 ± 4.0	18.6	-	Bulk	200	PTCTL8NR100HBE (3)
8.3	5.0	1.5 ± 0.5	20 ± 3.0	10.3	-	Bulk	250	PTCTL4MR080JBE
7.0	4.0	2.5 ± 0.5	-	10.0	16	Taped on reel	1500	PTCTL3NR160KTE
8.5	4.0	2.5 ± 0.5	4.1 ± 0.5	11.5	-	Bulk	500	PTCTL4NR100LBE
8.5	4.0	2.5 ± 0.5	-	11.5	16	Taped on reel	1500	PTCTL4MR100LTE
8.5	4.0	2.5 ± 0.5	4.1 ± 0.5	11.5	-	Bulk	500	PTCTL4MR500SBE
8.0	5.0	2.5 ± 0.5	-	11.0	16	Taped on reel	1500	PTCTL4MR350STE
8.5	4.0	2.0 ± 0.5	-	11.0	16	Taped on reel	1500	PTCTL4MR250STE
10.5	5.0	2.0 ± 0.5	-	12.6	16	Taped on reel	1500	PTCTL6MR250STE
13	5.5	4.0 ± 1.0	20 min.	18.0	-	Bulk	200	PTCTL7MR100SBE
13	5.5	4.0 ± 1.0	20 min.	18.0	-	Bulk	200	PTCTL7NR100SBE

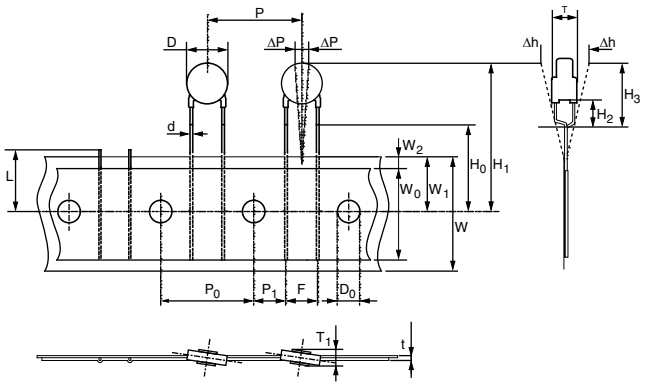
Notes

(1) Taped in accordance with IEC 60286-2

(2) Metallized ceramic pellet for clamping or substrate mounting, available on request

(3) Insulated version is also available

PTC THERMISTORS ON TAPE AND REEL



TAPE AND REEL ACCORDING TO IEC 60286-2 (in mm)			
SYMBOL	PARAMETER	DIMENSIONS	TOLERANCE
D	Body diameter	see table	max.
d	Lead diameter	0.6	± 0.05
P	Pitch between thermistors	12.7	± 1
P_0	Feedhole pitch	12.7	± 0.3
F	Leadcenter to leadcenter distance (between component and tape)	5	+ 0.5 / - 0.2
H0	Lead wire clinch height	see table	± 0.5
H2	Component bottom to seating plane	see table	see table
H3	Component top to seating plane	see table	max.
T	Total thinkness	see table	max.

По вопросам продаж и поддержки обращайтесь:

Алматы (7273)495-231
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Иваново (4932)77-34-06
Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Липецк (4742)52-20-81
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сургут (3462)77-98-35
Тверь (4822)63-31-35
Томск (3822)98-41-53
Тула (4872)74-02-29
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Челябинск (351)202-03-61
Череповец (8202)49-02-64
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