



NTC Thermistors, Radial Leaded, Standard Precision



FEATURES

- Accuracy over a wide temperature range
- High stability over a long life
- Excellent price/performance ratio
- UL recognized, file E148885
- Material categorization:
For definitions of compliance please see www.vishay.com/doc?99912

RoHS
COMPLIANT

APPLICATIONS

- Temperature measurement, sensing and control, temperature compensation in industrial and consumer electronics

DESCRIPTION

These thermistors have a negative temperature coefficient. The device consists of a chip with two solid copper tin plated leads. It is grey lacquered and color coded, but not insulated.

PACKAGING

The thermistors are packed in bulk or tape on reel; see code numbers and relevant packaging quantities.

DESIGN-IN SUPPORT

For complete Curve Computation, visit:
www.vishay.com/resistors-non-linear/curve-computation-list/

MARKING

The thermistors are marked with colored bands; see dimensions drawing and "Electrical data and ordering information".

MOUNTING

By soldering in any position.
Not intended for potted applications.

QUICK REFERENCE DATA		
PARAMETER	VALUE	UNIT
Resistance value at 25 °C	3.3 to 470K	Ω
Tolerance on R_{25} -value	± 2; ± 3; ± 5	%
$B_{25/85}$ -value	2880 to 4570	K
Tolerance on $B_{25/85}$ -value	± 0.5 to ± 3	%
Operating temperature range: At zero power dissipation; continuously At zero power dissipation; for short periods	- 40 to + 125 ≤ 150	°C
Response time (in oil)	≈ 1.2	s
Thermal time constant τ (for information only)	15	s
Dissipation factor δ (for information only)	7 8.5 (for R_{25} -value ≤ 680 Ω)	mW/K
Maximum power dissipation at 55 °C	500	mW
Climatic category (LCT/UCT/days)	40/125/56	-
Weight	≈ 0.3	g

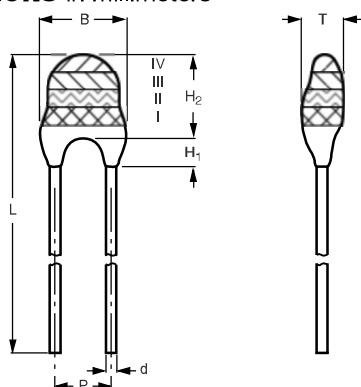
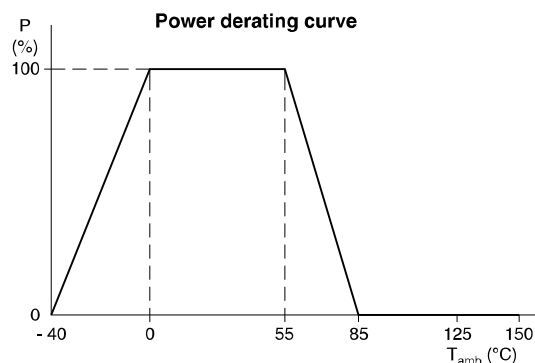
ELECTRICAL DATA AND ORDERING INFORMATION								
R_{25} (Ω)	$B_{25/85}$ -VALUE (K)	(± %)	UL APPROVED (Y/N)	SAP MATERIAL NUMBER NTCLE100E3...B0/T1/T2 ⁽²⁾	OLD 12NC CODE 2381 640 3/4/6... ⁽¹⁾	COLOR CODE ⁽³⁾		
						I	II	III
3.3	2880	3	N	338*B0	*338	Orange	Orange	Gold
4.7	2880	3	N	478*B0	*478	Yellow	Violet	Gold
6.8	2880	3	N	688*B0	*688	Blue	Grey	Gold
10	2990	3	N	109*B0	*109	Brown	Black	Black
15	3041	3	N	159*B0	*159	Brown	Green	Black
22	3136	3	N	229*B0	*229	Red	Red	Black
33	3390	3	Y	339*B0	*339	Orange	Orange	Black
47	3390	3	Y	479*B0	*479	Yellow	Violet	Black
68	3390	3	Y	689*B0	*689	Blue	Grey	Black
100	3560	1.5	Y	101*B0	*101	Brown	Black	Brown
150	3560	1.5	Y	151*B0	*151	Brown	Green	Brown
220	3560	1.5	Y	221*B0	*221	Red	Red	Brown
330	3560	1.5	Y	331*B0	*331	Orange	Orange	Brown

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						I	II	III
470	3560	1.5	Y	471*B0	*471	Yellow	Violet	Brown
680	3560	1.5	Y	681*B0	*681	Blue	Grey	Brown
1000	3528	0.5	Y	102*B0	*102	Brown	Black	Red
1500	3528	0.5	Y	152*B0	*152	Brown	Green	Red
2000	3528	0.5	Y	202*B0	*202	Red	Black	Red
2200	3977	0.75	Y	222*B0	*222	Red	Red	Red
2700	3977	0.75	Y	272*B0	*272	Red	violet	Red
3300	3977	0.75	Y	332*B0	*332	Orange	Orange	Red
4700	3977	0.75	Y	472*B0	*472	Yellow	Violet	Red
5000	3977	0.75	Y	502*B0	*502	Green	Black	Red
6800	3977	0.75	Y	682*B0	*682	Blue	Grey	Red
10 000	3977	0.75	Y	103*B0	*103	Brown	Black	Orange
12 000	3740	2	Y	123*B0	*123	Brown	Red	Orange
15 000	3740	2	Y	153*B0	*153	Brown	Green	Orange
22 000	3740	2	Y	223*B0	*223	Red	Red	Orange
33 000	4090	1.5	Y	333*B0	*333	Orange	Orange	Orange
47 000	4090	1.5	Y	473*B0	*473	Yellow	Violet	Orange
50 000	4190	1.5	Y	503*B0	*503	Green	Black	Orange
68 000	4190	1.5	Y	683*B0	*683	Blue	Grey	Orange
100 000	4190	1.5	Y	104*B0	*104	Brown	Black	Yellow
150 000	4370	2.5	Y	154*B0	*154	Brown	Green	Yellow
220 000	4370	2.5	Y	224*B0	*224	Red	Red	Yellow
330 000	4570	1.5	N	334*B0	*334	Orange	Orange	Yellow
470 000	4570	1.5	N	474*B0	*474	Yellow	Violet	Yellow

Notes

- (1) Replace * in 12NC by 3 for 5 %, 6 for 3 %, 4 for 2 %
(2) Replace * in SAP by J for 5 %, H for 3 %, G for 2 %
(3) For $R_{25} \pm 2$ % band IV is red, ± 3 % band IV is orange, ± 5 % band IV is gold

DIMENSIONS in millimeters

DERATING AND TEMPERATURE TOLERANCES

Note

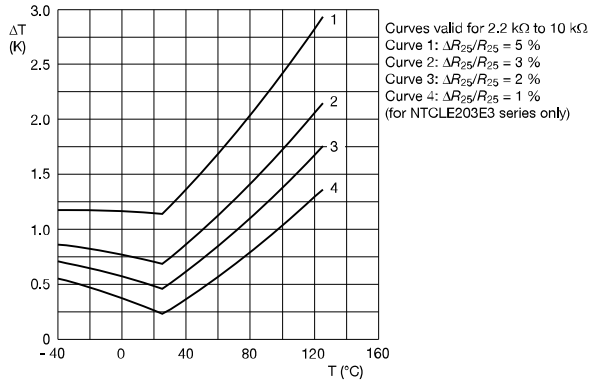
- Zero power is considered as measuring power max. 1 % of max. power.

PHYSICAL DIMENSIONS FOR RELEVANT TYPE (all dimensions in millimeters)

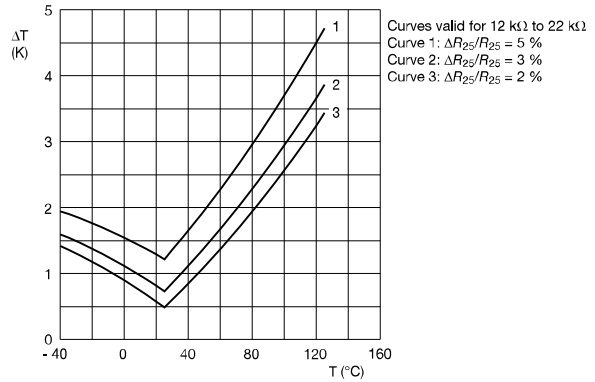
R_{25} -VALUE	$B_{MAX.}$	d	H_1		H_2 MAX.	L	P	$T_{MAX.}$
			MIN.	MAX.				
3.3 Ω to 220 Ω	5.0	0.6 \pm 0.06	1.0	4.0	6.0	24 \pm 1.5	2.54	4.0
330 Ω to 470 k Ω	3.3 \pm 0.5	0.6 \pm 0.06	1.0	3.0	6.0	24 \pm 1.5	2.54	3.0



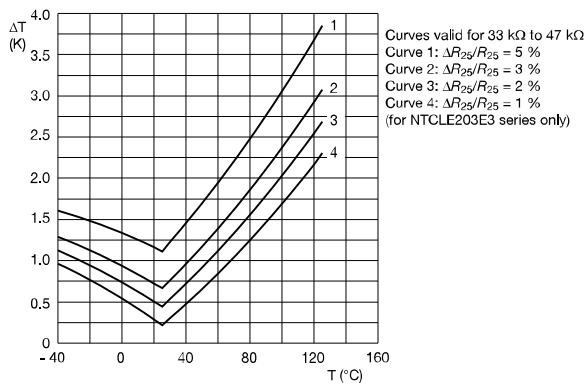
TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



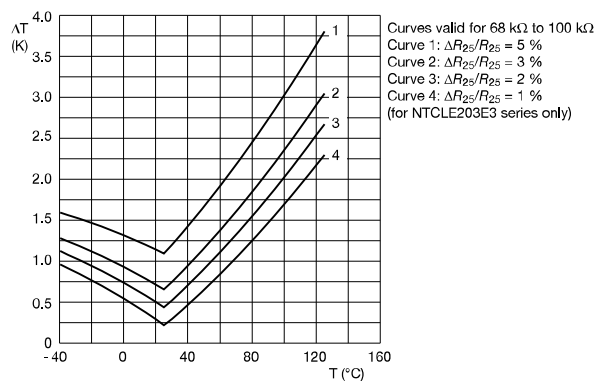
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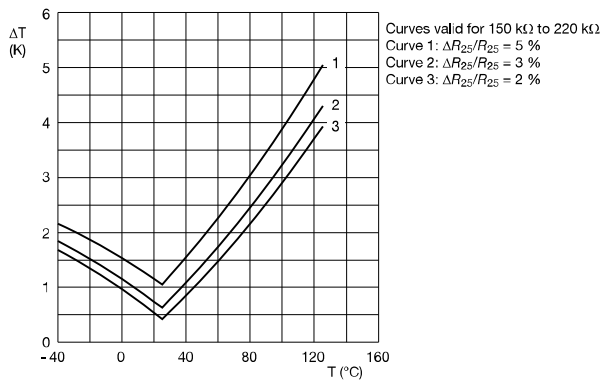
TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



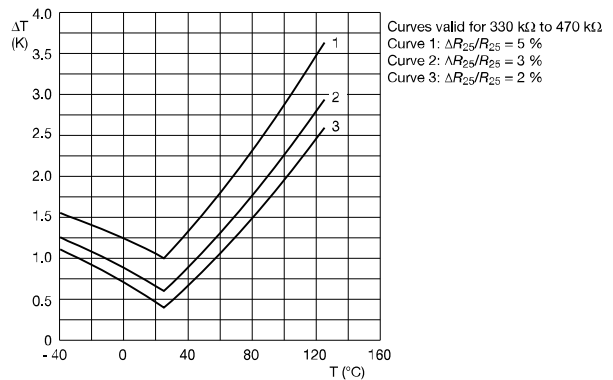
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**R_T VALUE AND TOLERANCE**

These thermistors have a narrow tolerance on the B-value, the result of which provides a very small tolerance on the nominal resistance value over a wide temperature range. For this reason the usual graphs of $R = f(T)$ are replaced by Resistance Values at Intermediate Temperatures Tables, together with a formula to calculate the characteristics with a high precision.

FORMULAE TO DETERMINE NOMINAL RESISTANCE VALUES

The resistance values at intermediate temperatures, or the operating temperature values, can be calculated using the following interpolation laws (extended "Steinhart and Hart"):

$$R_{(T)} = R_{\text{ref}} \times e^{(A + B/T + C/T^2 + D/T^3)} \quad (1)$$

$$T_{(R)} = \left(A_1 + B_1 \ln \frac{R}{R_{\text{ref}}} + C_1 \ln^2 \frac{R}{R_{\text{ref}}} + D_1 \ln^3 \frac{R}{R_{\text{ref}}} \right)^{-1} \quad (2)$$

where:

A, B, C, D, A₁, B₁, C₁ and D₁ are constant values depending on the material concerned; see table below.

R_{ref} is the resistance value at a reference temperature (in this event 25 °C, R_{ref} = R₂₅).

T is the temperature in K.

Formulae numbered and are interchangeable with an error of max. 0.005 °C in the range 25 °C to 125 °C and max. 0.015 °C in the range - 40 °C to + 25 °C.

DETERMINATION OF THE RESISTANCE/TEMPERATURE DEVIATION FROM NOMINAL VALUE

The total resistance deviation is obtained by combining the "R₂₅-tolerance" and the "resistance deviation due to B-tolerance".

When:

X = R₂₅-tolerance

Y = resistance deviation due to B-tolerance

Z = complete resistance deviation,

then: $Z = \left[\left(1 + \frac{X}{100} \right) \times \left(1 + \frac{Y}{100} \right) - 1 \right] \times 100 \%$ or $Z \approx X + Y$

When:

TCR = temperature coefficient

ΔT = temperature deviation,

then: $\Delta T = \frac{Z}{TCR}$

The temperature tolerances are plotted in the graphs on the previous page.

Example: at 0 °C, assume X = 5 %, Y = 0.89 % and TCR = 5.08 %/K (see table), then:

$$Z = \left\{ \left[1 + \frac{5}{100} \right] \times \left[1 + \frac{0.89}{100} \right] - 1 \right\} \times 100 \%$$

$$= \{ 1.05 \times 1.0089 - 1 \} \times 100 \% = 5.9345 \% (\approx 5.93 \%)$$

$$\Delta T = \frac{Z}{TCR} = \frac{5.93}{5.08} = 1.167 \text{ °C } (\approx 1.17 \text{ °C})$$

A NTC with a R₂₅-value of 10 kΩ has a value of 32.56 kΩ between - 1.17 °C and + 1.17 °C.

PARAMETER FOR DETERMINING NOMINAL RESISTANCE VALUES

NUMBER	B _{25/85} (K)	NAME	TOL. B (%)	A	B (K)	C (K ²)	D (K ³)	A ₁	B ₁ (K ⁻¹)	C ₁ (K ⁻²)	D ₁ (K ⁻³)
1	2880	Mat O. with Bn = 2880K	3	- 9.094	2251.74	229098	- 2.744820E+07	3.354016E-03	3.495020E-04	2.095959E-06	4.260615E-07
2	2990	Mat P. with Bn = 3990K	3	- 10.2296	2887.62	132336	- 2.502510E+07	3.354016E-03	3.415560E-04	4.955455E-06	4.364236E-07
3	3041	Mat Q. with Bn = 3041K	3	- 11.1334	3658.73	- 102895	5.166520E+05	3.354016E-03	3.349290E-04	3.683843E-06	7.050455E-07
4	3136	Mat R. with Bn = 3136K	3	- 12.4493	4702.74	- 402687	3.196830E+07	3.354016E-03	3.243880E-04	2.658012E-06	- 2.701560E-07
5	3390	Mat S. with Bn = 3390K	3	- 12.6814	4391.97	- 232807	1.509643E+07	3.354016E-03	2.993410E-04	2.135133E-06	- 5.672000E-09
6	3528 ⁽¹⁾	Mat I. with Bn = 3528K	0.5	- 12.0596	3687.667	- 7617.13	- 5.914730E+06	3.354016E-03	2.909670E-04	1.632136E-06	7.192200E-08
	3528 ⁽²⁾			- 21.0704	11903.95	- 2504699	2.470338E+08	3.354016E-03	2.933908E-04	3.494314E-06	- 7.712690E-07
7	3560	Mat H. with Bn = 3560K	1.5	- 13.0723	4190.574	- 47158.4	- 1.199256E+07	3.354016E-03	2.884193E-04	4.118032E-06	1.786790E-07
8	3740	Mat B. with Bn = 3740K	2	- 13.8973	4557.725	- 98275	- 7.522357E+06	3.354016E-03	2.744032E-04	3.666944E-06	1.375492E-07
9	3977	Mat A. with Bn = 3977K	0.75	- 14.6337	4791.842	- 115334	- 3.730535E+06	3.354016E-03	2.569850E-04	2.620131E-06	6.383091E-08
10	4090	Mat C. with Bn = 4090K	1.5	- 15.5322	5229.973	- 160451	- 5.414091E+06	3.354016E-03	2.519107E-04	3.510939E-06	1.105179E-07
11	4190	Mat D. with Bn = 4190K	1.5	- 16.0349	5459.339	- 191141	- 3.328322E+06	3.354016E-03	2.460382E-04	3.405377E-06	1.034240E-07
12	4370	Mat E. with Bn = 4370K	2.5	- 16.8717	5759.15	- 194267	- 6.869149E+06	3.354016E-03	2.367720E-04	3.585140E-06	1.255349E-07
13	4570	Mat F. with Bn = 4570K	1.5	- 17.6439	6022.726	- 203157	- 7.183526E+06	3.354016E-03	2.264097E-04	3.278184E-06	1.097628E-07

Notes

⁽¹⁾ Temperature < 25 °C

⁽²⁾ Temperature ≥ 25 °C