

(x2) We will do a parameter selection example  $R_{25} = 10000 \Omega$

All NTCs have same principal resistor/temperature dependence but with some parameter differences. Important is the  $B_{25/85}$  value.



www.vishay.com

NTCLE100E3

Vishay BCcomponents

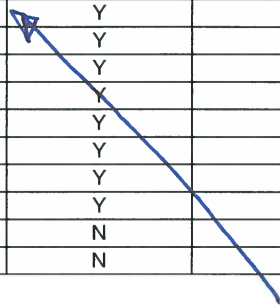
> 10k Example <

C CODE IN END!

**ELECTRICAL DATA AND ORDERING INFORMATION**

$R_{25}$ ( $\Omega$ )	$B_{25/85}$ -VALUE		UL APPROVED (Y/N)	SAP MATERIAL NUMBER NTCLE100E3...B0/T1/T2 (2)	OLD 12NC CODE 2381 640 3/4/6... (1)	COLOR CODE (3)		
	(K)	( $\pm$ %)				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

10k →

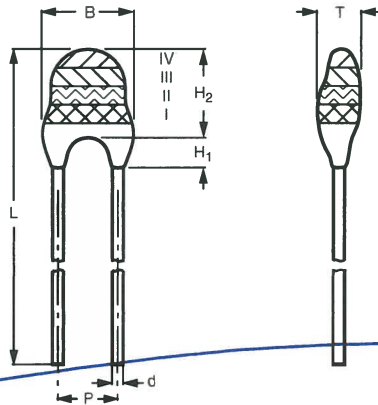


**Notes**

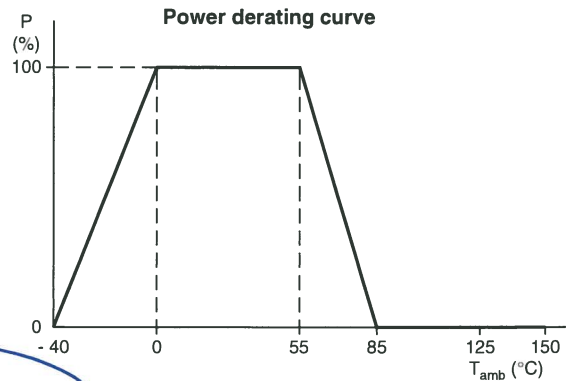
- (1) Replace \* in 12NC by 3 for 5 %, 6 for 3 %, 4 for 2 %
- (2) Replace \* in SAP by J for 5 %, H for 3 %, G for 2 %
- (3) For  $R_{25} \pm 2$  % band IV is red,  $\pm 3$  % band IV is orange,  $\pm 5$  % band IV is gold

!! The magic number to remember is 3977.

**DIMENSIONS** in millimeters



**DERATING AND TEMPERATURE TOLERANCES**



**Note**

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

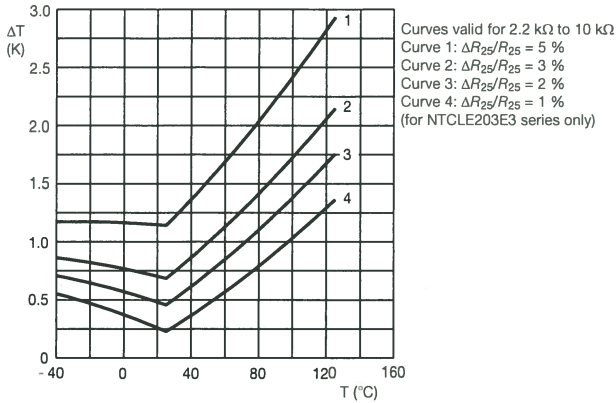
IN THIS COPY A 10k NTC example

**PHYSICAL DIMENSIONS FOR RELEVANT TYPE** (all dimensions in millimeters)

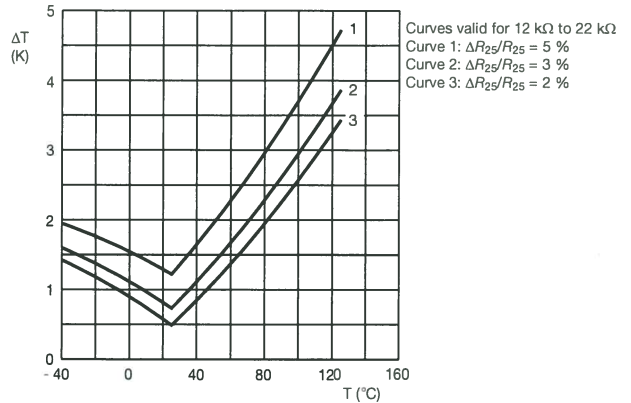
$R_{25}$ -VALUE	$B_{MAX}$	d	$H_1$		$H_2$ MAX.	L	P	$T_{MAX}$
			MIN.	MAX.				
3.3 $\Omega$ to 220 $\Omega$	5.0	0.6 $\pm$ 0.06	1.0	4.0	6.0	24 $\pm$ 1.5	2.54	4.0
330 $\Omega$ to 470 k $\Omega$	3.3 $\pm$ 0.5	0.6 $\pm$ 0.06	1.0	3.0	6.0	24 $\pm$ 1.5	2.54	3.0



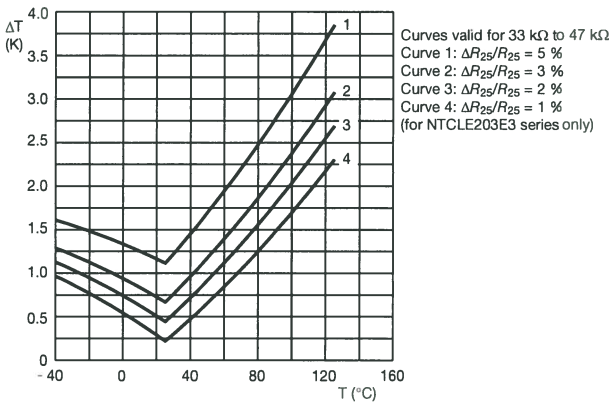
TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



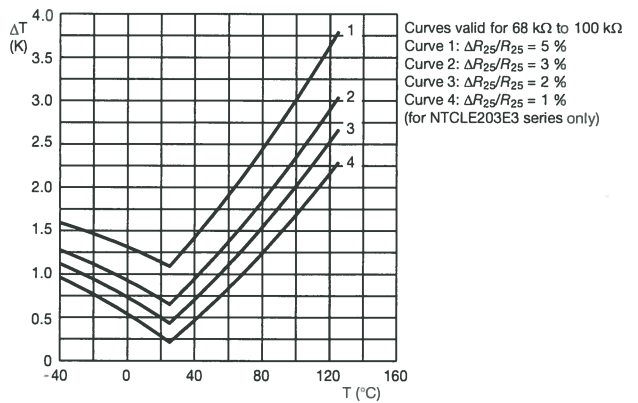
TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



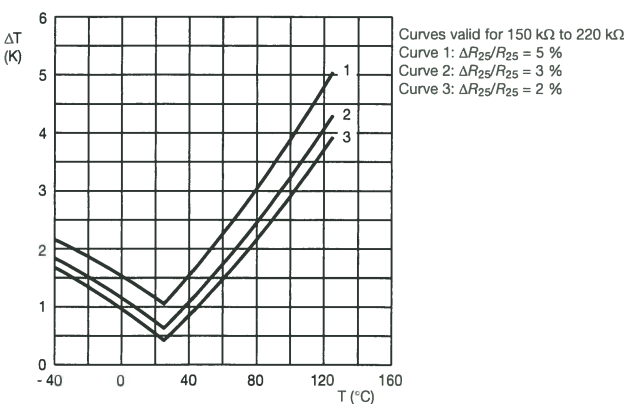
TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



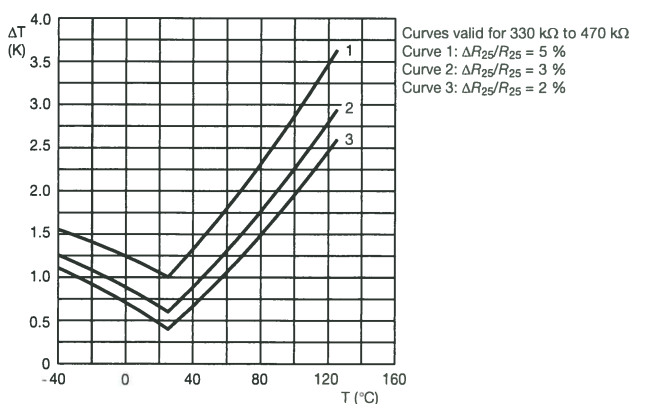
TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE

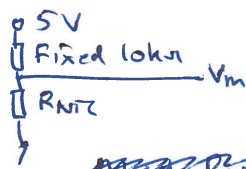


TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



We will measure actual NTC resistance.

Example:



$$V_m = \frac{R_{NTC}}{R_{NTC} + I_{oh}} \cdot 5V \Rightarrow V_m (R_{NTC} + I_{oh}) = R_{NTC} \cdot 5V \Rightarrow R_{NTC} (5V - V_m) = V_m I_{oh}$$

$$\Rightarrow R_{NTC} = \frac{I_{oh} \cdot V_m}{5V - V_m}$$

VISHAY

www.vishay.com

NTCLE100E3

Vishay BCcomponents

### R<sub>T</sub> 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.

With R<sub>25</sub> we can calculate temperature

### 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"):



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

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

where:

A, B, C, D, A<sub>1</sub>, B<sub>1</sub>, C<sub>1</sub> and D<sub>1</sub> are constant values depending on the material concerned; see table below.

R<sub>ref</sub> is the resistance value at a reference temperature (in this event 25 °C, R<sub>ref</sub> = R<sub>25</sub>).

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.

NEED TO FIND COEFFICIENTS BY B2578

### DETERMINATION OF THE RESISTANCE/TEMPERATURE DEVIATION FROM NOMINAL VALUE

The total resistance deviation is obtained by combining the "R<sub>25</sub>-tolerance" and the "resistance deviation due to B-tolerance".

When:

X = R<sub>25</sub>-tolerance

Y = resistance deviation due to B-tolerance

Z = complete resistance deviation,

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

When:

TCR = temperature coefficient

ΔT = temperature deviation,

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

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 R<sub>25</sub>-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 <sub>25/85</sub> (K)	NAME	TOL. B (%)	A	B (K)	C (K <sup>2</sup> )	D (K <sup>3</sup> )	A <sub>1</sub>	B <sub>1</sub> (K <sup>-1</sup> )	C <sub>1</sub> (K <sup>-2</sup> )	D <sub>1</sub> (K <sup>-3</sup> )
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

DATA ALL ! See Arduino code in end !

See next page for rough tables Temp > < R<sub>25</sub> (p10/p11)





For complete Curve Computation, visit: [www.vishay.com/resistors-non-linear/curve-computation-list/](http://www.vishay.com/resistors-non-linear/curve-computation-list/)

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH $R_{25}$ AT (3.3, 4.7, 6.8) $\Omega$					
$T_{OPER}$ (°C)	PART NUMBER NTCLE100E3338***	PART NUMBER NTCLE100E3478***	PART NUMBER NTCLE100E3688***	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol.}$ (%)
	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )		
- 40	45.00	64.09	92.73	- 4.97	8.08
- 35	35.25	50.20	72.63	- 4.80	7.30
- 30	27.84	39.64	57.36	- 4.64	6.55
- 25	22.16	31.56	45.66	- 4.48	5.84
- 20	17.78	25.32	36.63	- 4.33	5.15
- 15	14.37	20.46	29.60	- 4.19	4.49
- 10	11.69	16.65	24.09	- 4.05	3.85
- 5	9.582	13.65	19.74	- 3.92	3.24
0	7.904	11.26	16.29	- 3.79	2.65
5	6.560	9.344	13.52	- 3.66	2.08
10	5.479	7.803	11.29	- 3.55	1.54
15	4.602	6.554	9.482	- 3.43	1.01
20	3.886	5.535	8.008	- 3.32	0.49
25	3.300	4.700	6.800	- 3.22	0.00
30	2.816	4.011	5.803	- 3.12	0.48
35	2.415	3.440	4.977	- 3.02	0.94
40	2.081	2.964	4.289	- 2.93	1.39
45	1.801	2.566	3.712	- 2.84	1.82
50	1.566	2.230	3.227	- 2.76	2.24
55	1.367	1.947	2.817	- 2.68	2.65
60	1.198	1.706	2.469	- 2.60	3.04
65	1.054	1.501	2.172	- 2.52	3.43
70	0.9308	1.326	1.918	- 2.45	3.80
75	0.8248	1.175	1.700	- 2.38	4.16
80	0.7334	1.044	1.511	- 2.32	4.51
85	0.6542	0.9318	1.348	- 2.25	4.85
90	0.5854	0.8338	1.206	- 2.19	5.19
95	0.5255	0.7484	1.083	- 2.13	5.51
100	0.4730	0.6737	0.9748	- 2.07	5.82
105	0.4270	0.6082	0.8799	- 2.02	6.13
110	0.3865	0.5505	0.7965	- 1.97	6.43
115	0.3508	0.4996	0.7228	- 1.92	6.72
120	0.3192	0.4545	0.6576	- 1.87	7.00
125	0.2911	0.4145	0.5998	- 1.82	7.28
130	0.2661	0.3789	0.5483	- 1.77	7.55
135	0.2438	0.3472	0.5023	- 1.73	7.81
140	0.2238	0.3188	0.4612	- 1.69	8.07
145	0.2059	0.2933	0.4244	- 1.65	8.32
150	0.1899	0.2704	0.3912	- 1.61	8.56



For complete Curve Computation, visit: [www.vishay.com/resistors-non-linear/curve-computation-list/](http://www.vishay.com/resistors-non-linear/curve-computation-list/)

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH $R_{25}$ AT (10, 15, 22) $\Omega$									
$T_{OPER}$ (°C)	PART NUMBER NTCLE100E3109***			PART NUMBER NTCLE100E3159***			PART NUMBER NTCLE100E3229***		
	$R_T$ ( $\Omega$ )	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol}$ (%)	$R_T$ ( $\Omega$ )	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol}$ (%)	$R_T$ ( $\Omega$ )	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol}$ (%)
-40	136.7	-4.86	8.39	224.8	-5.16	8.65	374.9	-5.54	8.80
-35	107.6	-4.72	7.58	174.5	-4.98	7.79	285.8	-5.31	7.95
-30	85.32	-4.58	6.81	136.6	-4.80	6.98	220.4	-5.10	7.14
-25	68.10	-4.44	6.06	107.9	-4.64	6.21	171.7	-4.90	6.36
-20	54.72	-4.31	5.35	85.94	-4.48	5.47	135.0	-4.71	5.61
-15	44.25	-4.18	4.66	68.96	-4.33	4.76	107.2	-4.53	4.89
-10	36.02	-4.06	4.00	55.74	-4.19	4.08	85.79	-4.37	4.20
-5	29.49	-3.94	3.37	45.37	-4.05	3.43	69.21	-4.22	3.53
0	24.30	-3.82	2.75	37.17	-3.92	2.81	56.26	-4.07	2.89
5	20.13	-3.71	2.16	30.65	-3.80	2.20	46.05	-3.94	2.27
10	16.77	-3.60	1.59	25.42	-3.68	1.62	37.94	-3.81	1.67
15	14.04	-3.50	1.04	21.21	-3.57	1.06	31.45	-3.69	1.10
20	11.82	-3.39	0.51	17.79	-3.46	0.52	26.23	-3.57	0.54
25	10.00	-3.30	0.00	15.00	-3.36	0.00	22.00	-3.47	0.00
30	8.500	-3.20	0.50	12.76	-3.26	0.49	18.55	-3.36	0.52
35	7.259	-3.11	0.98	10.86	-3.17	0.98	15.72	-3.26	1.02
40	6.226	-3.03	1.44	9.291	-3.08	1.46	13.38	-3.17	1.51
45	5.363	-2.94	1.89	7.982	-2.99	1.92	11.45	-3.08	1.98
50	4.639	-2.86	2.33	6.887	-2.91	2.36	9.833	-3.00	2.44
55	4.029	-2.78	2.75	5.966	-2.83	2.79	8.482	-2.92	2.88
60	3.512	-2.71	3.16	5.189	-2.75	3.21	7.346	-2.84	3.32
65	3.073	-2.64	3.56	4.529	-2.68	3.62	6.386	-2.76	3.73
70	2.698	-2.57	3.95	3.968	-2.61	4.02	5.572	-2.69	4.14
75	2.377	-2.50	4.32	3.488	-2.54	4.41	4.879	-2.62	4.53
80	2.101	-2.43	4.69	3.077	-2.48	4.78	4.286	-2.56	4.91
85	1.864	-2.37	5.04	2.722	-2.41	5.15	3.777	-2.50	5.29
90	1.658	-2.31	5.38	2.416	-2.35	5.51	3.339	-2.44	5.65
95	1.479	-2.25	5.72	2.151	-2.30	5.85	2.960	-2.38	6.00
100	1.323	-2.20	6.05	1.920	-2.24	6.19	2.632	-2.32	6.34
105	1.187	-2.14	6.36	1.719	-2.19	6.53	2.347	-2.27	6.68
110	1.068	-2.09	6.67	1.543	-2.13	6.85	2.098	-2.22	7.00
115	0.9635	-2.04	6.98	1.389	-2.08	7.17	1.880	-2.17	7.32
120	0.8712	-1.99	7.27	1.253	-2.03	7.48	1.689	-2.12	7.62
125	0.7897	-1.94	7.56	1.133	-1.99	7.78	1.521	-2.07	7.93
130	0.7174	-1.90	7.84	1.027	-1.94	8.08	1.373	-2.03	8.22
135	0.6533	-1.85	8.11	0.9326	-1.90	8.37	1.242	-1.98	8.50
140	0.5961	-1.81	8.37	0.8490	-1.86	8.65	1.126	-1.94	8.78
145	0.5451	-1.77	8.63	0.7744	-1.82	8.93	1.023	-1.90	9.06
150	0.4995	-1.73	8.89	0.7079	-1.78	9.20	0.9309	-1.86	9.32



For complete Curve Computation, visit: [www.vishay.com/resistors-non-linear/curve-computation-list/](http://www.vishay.com/resistors-non-linear/curve-computation-list/)

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH $R_{25}$ AT (33, 47, 68) $\Omega$					
$T_{OPER}$ (°C)	PART NUMBER NTCLE100E3339***	PART NUMBER NTCLE100E3479***	PART NUMBER NTCLE100E3689***	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol.}$ (%)
	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )		
- 40	707.0	1007	1457	- 5.94	9.30
- 35	528.5	752.7	1089	- 5.70	8.44
- 30	399.5	569.0	823.3	- 5.49	7.60
- 25	305.3	434.8	629.1	- 5.28	6.79
- 20	235.6	335.6	485.5	- 5.09	6.01
- 15	183.5	261.4	378.2	- 4.90	5.25
- 10	144.3	205.5	297.3	- 4.73	4.51
- 5	114.3	162.8	235.6	- 4.57	3.80
0	91.34	130.1	188.2	- 4.42	3.11
5	73.51	104.7	151.5	- 4.27	2.45
10	59.59	84.87	122.8	- 4.13	1.80
15	48.63	69.26	100.2	- 4.00	1.18
20	39.94	56.88	82.29	- 3.88	0.58
25	33.00	47.00	68.00	- 3.76	0.00
30	27.43	39.06	56.51	- 3.64	0.56
35	22.92	32.64	47.23	- 3.54	1.11
40	19.26	27.42	39.68	- 3.43	1.63
45	16.26	23.16	33.50	- 3.34	2.14
50	13.79	19.65	28.42	- 3.24	2.63
55	11.76	16.74	24.23	- 3.15	3.11
60	10.06	14.33	20.74	- 3.07	3.57
65	8.652	12.32	17.83	- 2.98	4.02
70	7.468	10.64	15.39	- 2.90	4.45
75	6.471	9.216	13.33	- 2.83	4.87
80	5.628	8.015	11.60	- 2.76	5.27
85	4.912	6.996	10.12	- 2.69	5.66
90	4.302	6.127	8.865	- 2.62	6.04
95	3.780	5.384	7.790	- 2.55	6.41
100	3.332	4.746	6.867	- 2.49	6.77
105	2.946	4.196	6.071	- 2.43	7.11
110	2.613	3.721	5.384	- 2.37	7.45
115	2.324	3.310	4.788	- 2.32	7.77
120	2.072	2.951	4.270	- 2.26	8.09
125	1.853	2.639	3.818	- 2.21	8.39
130	1.661	2.365	3.422	- 2.16	8.69
135	1.492	2.125	3.075	- 2.11	8.97
140	1.344	1.914	2.770	- 2.07	9.25
145	1.213	1.728	2.500	- 2.02	9.52
150	1.098	1.564	2.262	- 1.98	9.79



For complete Curve Computation, visit: [www.vishay.com/resistors-non-linear/curve-computation-list/](http://www.vishay.com/resistors-non-linear/curve-computation-list/)

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH $R_{25}$ AT (100, 150, 220, 330, 470, 680) $\Omega$								
$T_{OPER}$ (°C)	PART NUMBER NTCLE100E3101***	PART NUMBER NTCLE100E3151***	PART NUMBER NTCLE100E3221***	PART NUMBER NTCLE100E3331***	PART NUMBER NTCLE100E3471***	PART NUMBER NTCLE100E3681***	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol.}$ (%)
	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )		
-40	2193	3289	4824	7236	10 305	14 910	-5.75	4.99
-35	1652	2478	3635	5452	7766	11 235	-5.57	4.51
-30	1256	1884	2763	4144	5902	8540	-5.40	4.05
-25	962.5	1444	2117	3176	4524	6545	-5.24	3.61
-20	743.6	1115	1636	2454	3495	5057	-5.08	3.19
-15	579.0	868.5	1274	1911	2721	3937	-4.93	2.78
-10	454.2	681.2	999.1	1499	2135	3088	-4.78	2.38
-5	358.8	538.2	789.4	1184	1686	2440	-4.64	2.01
0	285.4	428.2	628.0	942.0	1342	1941	-4.51	1.64
5	228.6	342.9	502.9	754.4	1074	1554	-4.38	1.29
10	184.2	276.4	405.3	608.0	866.0	1253	-4.25	0.95
15	149.4	224.1	328.7	493.1	702.2	1016	-4.13	0.62
20	121.9	182.8	268.2	402.2	572.9	828.8	-4.01	0.31
25	100.0	150.0	220.0	330.0	470.0	680.0	-3.90	0.00
30	82.49	123.7	181.5	272.2	387.7	561.0	-3.80	0.30
35	68.41	102.6	150.5	225.8	321.5	465.2	-3.69	0.58
40	57.02	85.54	125.5	188.2	268.0	387.8	-3.59	0.86
45	47.77	71.65	105.1	157.6	224.5	324.8	-3.50	1.13
50	40.20	60.30	88.44	132.7	188.9	273.3	-3.40	1.39
55	33.98	50.98	74.76	112.1	159.7	231.1	-3.31	1.64
60	28.86	43.28	63.48	95.23	135.6	196.2	-3.23	1.88
65	24.61	36.91	54.13	81.20	115.6	167.3	-3.15	2.12
70	21.07	31.60	46.35	69.52	99.01	143.3	-3.07	2.35
75	18.11	27.16	39.84	59.76	85.11	123.1	-2.99	2.57
80	15.62	23.43	34.37	51.56	73.43	106.2	-2.91	2.79
85	13.53	20.29	29.76	44.65	63.59	92.00	-2.84	3.00
90	11.76	17.63	25.86	38.80	55.26	79.95	-2.77	3.21
95	10.25	15.38	22.55	33.83	48.18	69.71	-2.71	3.41
100	8.968	13.45	19.73	29.59	42.15	60.98	-2.64	3.60
105	7.871	11.81	17.32	25.97	36.99	53.52	-2.58	3.79
110	6.928	10.39	15.24	22.86	32.56	47.11	-2.52	3.97
115	6.117	9.176	13.46	20.19	28.75	41.60	-2.46	4.15
120	5.416	8.125	11.92	17.87	25.46	36.83	-2.41	4.33
125	4.809	7.214	10.58	15.87	22.60	32.70	-2.35	4.50
130	4.282	6.422	9.419	14.13	20.12	29.11	-2.30	4.66
135	3.822	5.732	8.408	12.61	17.96	25.99	-2.25	4.83
140	3.420	5.130	7.523	11.29	16.07	23.25	-2.20	4.99
145	3.068	4.601	6.749	10.12	14.42	20.86	-2.15	5.14
150	2.758	4.137	6.068	9.102	12.96	18.76	-2.10	5.29



For complete Curve Computation, visit: [www.vishay.com/resistors-non-linear/curve-computation-list/](http://www.vishay.com/resistors-non-linear/curve-computation-list/)

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH $R_{25}$ AT (1, 1.5, 2) k $\Omega$					
$T_{OPER}$ (°C)	PART NUMBER NTCLE100E3102***	PART NUMBER NTCLE100E3152***	PART NUMBER NTCLE100E3202***	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol}$ (%)
	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )		
-40	23 342	35 013	46 684	- 6.06	1.65
-35	17 336	26 004	34 672	- 5.84	1.49
-30	13 018	19 526	26 035	- 5.62	1.34
-25	9877	14 816	19 754	- 5.42	1.19
-20	7569	11 353	15 138	- 5.23	1.05
-15	5855	8782	11 709	- 5.05	0.92
-10	4569	6854	9138	- 4.87	0.79
-5	3596	5395	7193	- 4.71	0.66
0	2854	4280	5707	- 4.55	0.54
5	2282	3422	4563	- 4.40	0.43
10	1838	2757	3675	- 4.26	0.31
15	1491	2236	2981	- 4.12	0.21
20	1217	1826	2434	- 3.99	0.10
25	1000	1500	2000	- 3.87	0.00
30	826.6	1240	1653	- 3.75	0.10
35	687.3	1031	1375	- 3.63	0.19
40	574.6	861.9	1149	- 3.53	0.28
45	482.7	724.0	965.4	- 3.42	0.37
50	407.4	611.0	814.7	- 3.32	0.46
55	345.2	517.8	690.5	- 3.23	0.54
60	293.7	440.6	587.4	- 3.14	0.62
65	250.8	376.2	501.6	- 3.05	0.70
70	214.9	322.4	429.8	- 2.97	0.78
75	184.7	277.1	369.5	- 2.89	0.86
80	159.3	238.9	318.6	- 2.81	0.93
85	137.7	206.6	275.5	- 2.73	1.01
90	119.4	179.1	238.8	- 2.66	1.08
95	103.8	155.7	207.6	- 2.59	1.15
100	90.45	135.7	180.9	- 2.53	1.22
105	79.00	118.5	158.0	- 2.46	1.29
110	69.15	103.7	138.3	- 2.40	1.35
115	60.66	90.99	121.3	- 2.34	1.42
120	53.32	79.98	106.6	- 2.29	1.48
125	46.96	70.44	93.92	- 2.23	1.55
130	41.43	62.15	82.87	- 2.18	1.61
135	36.63	54.94	73.25	- 2.13	1.67
140	32.43	48.65	64.87	- 2.08	1.73
145	28.77	43.16	57.54	- 2.03	1.79
150	25.56	38.34	51.12	- 1.98	1.85





For complete Curve Computation, visit: [www.vishay.com/resistors-non-linear/curve-computation-list/](http://www.vishay.com/resistors-non-linear/curve-computation-list/)

↓ look NTC

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH $R_{25}$ AT (2.2, 2.7, 3.3, 4.7, 5.0, 6.8, 10) k $\Omega$									
$T_{OPER}$ (°C)	PART NUMBER NTCLE100E3222***	PART NUMBER NTCLE100E3272***	PART NUMBER NTCLE100E3332***	PART NUMBER NTCLE100E3472***	PART NUMBER NTCLE100E3502***	PART NUMBER NTCLE100E3682***	PART NUMBER NTCLE100E3103***	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol.}$ (%)
	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )	$R_T$ ( $\Omega$ )		
-40	73 061	89 665	109 591	156 084	166 047	225 824	332 094	-6.62	2.79
-35	52 778	64 773	79 167	112 753	119 950	163 132	239 900	-6.39	2.52
-30	38 544	47 304	57 816	82 344	87 600	119 136	175 200	-6.18	2.26
-25	28 443	34 907	42 665	60 765	64 643	87 915	129 287	-5.98	2.02
-20	21 199	26 017	31 798	45 288	48 179	65 524	96 358	-5.78	1.78
-15	15 950	19 575	23 925	34 075	36 250	49 300	72 500	-5.60	1.55
-10	12 110	14 862	18 165	25 872	27 523	37 431	55 046	-5.42	1.33
-5	9275	11 382	13 912	19 814	21 078	28 667	42 157	-5.25	1.12
0	7162	8790	10 743	15 300	16 277	22 137	32 554	-5.09	0.92
5	5574	6841	8362	11 909	12 669	17 230	25 339	-4.93	0.72
10	4372	5365	6558	9340	9936	13 513	19 872	-4.79	0.53
15	3454	4239	5180	7378	7849	10 675	15 698	-4.64	0.35
20	2747	3372	4121	5869	6244	8492	12 488	-4.51	0.17
25	2200	2700	3300	4700	5000	6800	10 000	-4.38	0.00
30	1773	2176	2659	3788	4030	5480	8059	-4.25	0.17
35	1438	1764	2156	3071	3267	4444	6535	-4.13	0.32
40	1173	1439	1759	2505	2665	3624	5330	-4.02	0.48
45	961.8	1180	1443	2055	2186	2973	4372	-3.91	0.63
50	793.2	973.4	1190	1694	1803	2452	3605	-3.80	0.77
55	657.5	806.9	986.3	1405	1494	2032	2989	-3.70	0.91
60	547.8	672.3	821.7	1170	1245	1693	2490	-3.60	1.05
65	458.6	562.8	687.9	979.7	1042	1417	2084	-3.51	1.18
70	385.7	473.3	578.5	823.9	876.5	1192	1753	-3.42	1.31
75	325.8	399.8	488.7	696.0	740.5	1007	1481	-3.33	1.44
80	276.4	339.2	414.6	590.5	628.2	854.3	1256	-3.25	1.56
85	235.5	289.0	353.2	503.0	535.2	727.8	1070	-3.17	1.68
90	201.4	247.2	302.1	430.2	457.7	622.5	915.4	-3.09	1.79
95	172.9	212.2	259.4	369.4	393.0	534.5	786.0	-3.01	1.90
100	149.0	182.9	223.5	318.3	338.6	460.6	677.3	-2.94	2.01
105	128.9	158.2	193.3	275.3	292.9	398.3	585.7	-2.87	2.12
110	111.8	137.2	167.7	238.9	254.2	345.7	508.3	-2.80	2.22
115	97.37	119.5	146.1	208.0	221.3	301.0	442.6	-2.74	2.32
120	85.05	104.4	127.6	181.7	193.3	262.9	386.6	-2.67	2.42
125	74.52	91.46	111.8	159.2	169.4	230.3	338.7	-2.61	2.51
130	65.49	80.38	98.24	139.9	148.8	202.4	297.7	-2.55	2.61
135	57.72	70.84	86.59	123.3	131.2	178.4	262.4	-2.50	2.70
140	51.02	62.62	76.53	109.0	116.0	157.7	231.9	-2.44	2.78
145	45.22	55.49	67.83	96.60	102.8	139.8	205.5	-2.39	2.87
150	40.18	49.31	60.27	85.84	91.32	124.2	182.6	-2.34	2.96



For complete Curve Computation, visit: [www.vishay.com/resistors-non-linear/curve-computation-list/](http://www.vishay.com/resistors-non-linear/curve-computation-list/)

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH $R_{25}$ AT (12, 15, 22) k $\Omega$					
$T_{OPER}$ (°C)	PART NUMBER NTCLE100E3123***	PART NUMBER NTCLE100E3153***	PART NUMBER NTCLE100E3223***	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol}$ (%)
	$R_T$ (k $\Omega$ )	$R_T$ (k $\Omega$ )	$R_T$ (k $\Omega$ )		
-40	309.4	386.7	567.2	-6.07	7.00
-35	229.5	286.9	420.8	-5.88	6.32
-30	171.8	214.8	315.0	-5.70	5.68
-25	129.8	162.3	238.0	-5.52	5.06
-20	98.93	123.7	181.4	-5.35	4.46
-15	76.02	95.02	139.4	-5.19	3.89
-10	58.88	73.60	107.9	-5.03	3.34
-5	45.95	57.44	84.25	-4.88	2.81
0	36.13	45.16	66.24	-4.74	2.30
5	28.61	35.76	52.45	-4.60	1.80
10	22.80	28.51	41.81	-4.47	1.33
15	18.30	22.87	33.55	-4.34	0.87
20	14.77	18.47	27.08	-4.22	0.43
25	12.00	15.00	22.00	-4.10	0.00
30	9.804	12.25	17.97	-3.99	0.41
35	8.054	10.07	14.77	-3.88	0.81
40	6.652	8.315	12.20	-3.77	1.20
45	5.522	6.903	10.12	-3.67	1.58
50	4.607	5.759	8.447	-3.58	1.94
55	3.862	4.828	7.081	-3.48	2.29
60	3.252	4.066	5.963	-3.39	2.64
65	2.751	3.439	5.044	-3.30	2.97
70	2.337	2.921	4.284	-3.22	3.29
75	1.993	2.492	3.654	-3.14	3.60
80	1.707	2.134	3.129	-3.06	3.91
85	1.467	1.834	2.690	-2.99	4.20
90	1.266	1.582	2.321	-2.92	4.49
95	1.096	1.370	2.010	-2.85	4.77
100	0.9524	1.190	1.746	-2.78	5.04
105	0.8302	1.038	1.522	-2.71	5.31
110	0.7260	0.9075	1.331	-2.65	5.56
115	0.6369	0.7961	1.168	-2.59	5.82
120	0.5604	0.7005	1.027	-2.53	6.06
125	0.4945	0.6181	0.9065	-2.47	6.30
130	0.4375	0.5469	0.8022	-2.42	6.53
135	0.3882	0.4853	0.7117	-2.37	6.76
140	0.3454	0.4317	0.6332	-2.31	6.98
145	0.3080	0.3850	0.5647	-2.26	7.20
150	0.2754	0.3442	0.5049	-2.22	7.41



For complete Curve Computation, visit: [www.vishay.com/resistors-non-linear/curve-computation-list/](http://www.vishay.com/resistors-non-linear/curve-computation-list/)

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH $R_{25}$ AT (33, 47, 50, 68, 100) k $\Omega$									
$T_{OPER}$ (°C)	PART NUMBER NTCLE100E3								
	333***	473***	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol.}$ (%)	503***	683***	104***	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol.}$ (%)
	$R_T$ (k $\Omega$ )	$R_T$ (k $\Omega$ )			$R_T$ (k $\Omega$ )	$R_T$ (k $\Omega$ )	$R_T$ (k $\Omega$ )		
-40	1116	1589	-6.54	5.74	1833	2493	3666	-6.69	5.88
-35	808.6	1152	-6.34	5.19	1319	1794	2638	-6.49	5.31
-30	591.7	842.8	-6.15	4.66	958.3	1303	1917	-6.29	4.77
-25	437.1	622.6	-5.96	4.15	703.1	956.2	1406	-6.10	4.25
-20	325.9	464.1	-5.79	3.66	520.6	708.0	1041	-5.92	3.75
-15	245.0	349.0	-5.62	3.19	388.9	528.9	777.8	-5.75	3.27
-10	185.8	264.6	-5.45	2.74	293.0	398.5	586.1	-5.58	2.80
-5	142.0	202.3	-5.30	2.30	222.6	302.8	445.3	-5.42	2.36
0	109.4	155.8	-5.14	1.88	170.5	231.8	340.9	-5.26	1.93
5	84.91	120.9	-5.00	1.48	131.5	178.9	263.1	-5.11	1.52
10	66.37	94.53	-4.86	1.09	102.2	139.0	204.4	-4.97	1.12
15	52.24	74.40	-4.72	0.71	80.01	108.8	160.0	-4.83	0.73
20	41.39	58.95	-4.59	0.35	63.04	85.74	126.1	-4.70	0.36
25	33.00	47.00	-4.47	0.00	50.00	68.00	100.0	-4.57	0.00
30	26.47	37.71	-4.35	0.34	39.90	54.27	79.81	-4.45	0.35
35	21.37	30.43	-4.23	0.67	32.04	43.57	64.08	-4.33	0.68
40	17.34	24.70	-4.12	0.99	25.87	35.19	51.75	-4.22	1.01
45	14.15	20.15	-4.01	1.29	21.01	28.57	42.02	-4.11	1.33
50	11.61	16.53	-3.91	1.59	17.15	23.33	34.31	-4.00	1.63
55	9.572	13.63	-3.81	1.88	14.08	19.15	28.16	-3.90	1.93
60	7.931	11.30	-3.71	2.16	11.61	15.79	23.22	-3.80	2.21
65	6.603	9.404	-3.62	2.43	9.623	13.09	19.25	-3.71	2.49
70	5.522	7.865	-3.53	2.70	8.012	10.90	16.02	-3.62	2.76
75	4.639	6.607	-3.44	2.95	6.701	9.114	13.40	-3.53	3.03
80	3.913	5.573	-3.36	3.20	5.629	7.655	11.26	-3.45	3.28
85	3.315	4.721	-3.28	3.45	4.748	6.457	9.496	-3.36	3.53
90	2.819	4.015	-3.20	3.68	4.021	5.469	8.042	-3.28	3.77
95	2.406	3.427	-3.13	3.91	3.419	4.649	6.837	-3.21	4.01
100	2.062	2.936	-3.05	4.13	2.918	3.968	5.835	-3.13	4.24
105	1.773	2.525	-2.98	4.35	2.499	3.399	4.998	-3.06	4.46
110	1.530	2.179	-2.92	4.56	2.148	2.921	4.296	-2.99	4.68
115	1.324	1.886	-2.85	4.77	1.853	2.519	3.705	-2.93	4.89
120	1.150	1.638	-2.79	4.97	1.603	2.180	3.206	-2.86	5.09
125	1.002	1.427	-2.73	5.17	1.392	1.892	2.783	-2.80	5.29
130	0.8757	1.247	-2.67	5.36	1.212	1.648	2.423	-2.74	5.49
135	0.7675	1.093	-2.61	5.54	1.058	1.439	2.116	-2.68	5.68
140	0.6746	0.9608	-2.55	5.73	0.9269	1.261	1.854	-2.62	5.87
145	0.5946	0.8468	-2.50	5.90	0.8141	1.107	1.628	-2.57	6.05
150	0.5254	0.7483	-2.45	6.08	0.7170	0.9752	1.434	-2.51	6.23



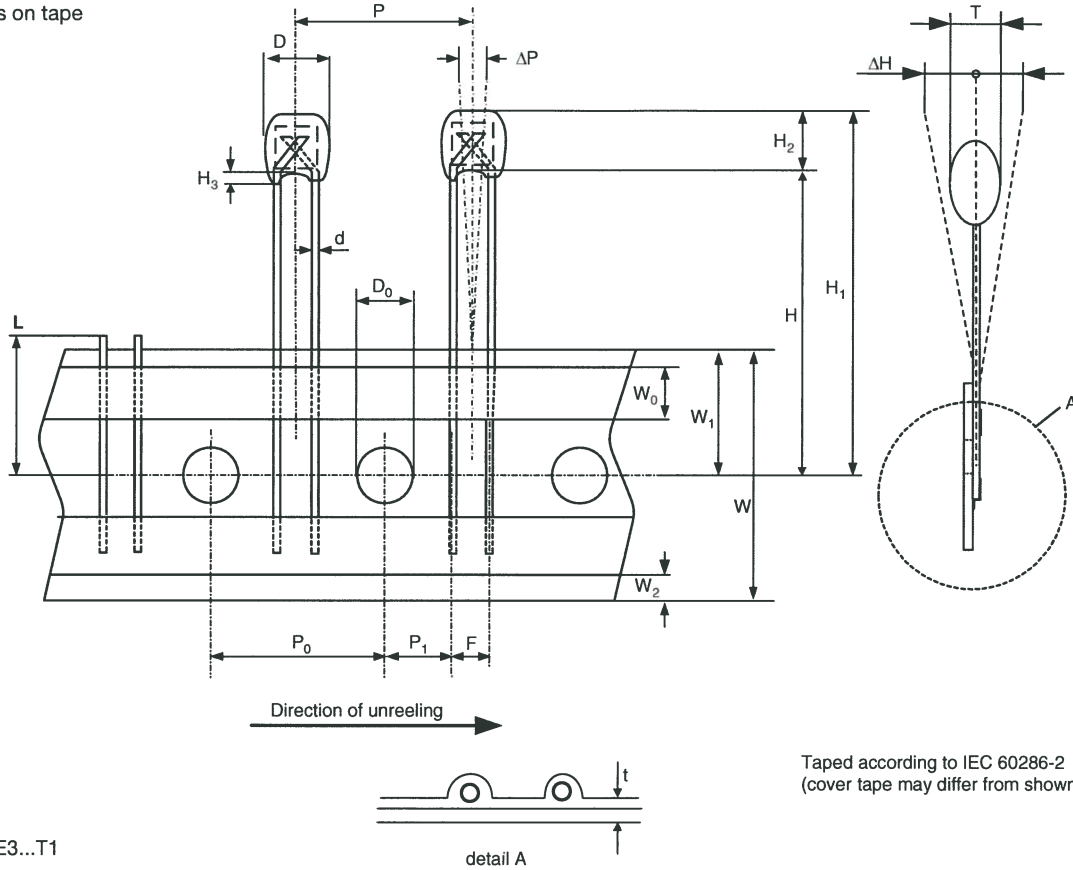
For complete Curve Computation, visit: [www.vishay.com/resistors-non-linear/curve-computation-list/](http://www.vishay.com/resistors-non-linear/curve-computation-list/)

RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH $R_{25}$ AT (150, 220, 330, 470) k $\Omega$								
$T_{OPER}$ (°C)	PART NUMBER NTCLE100E3							
	154***	224***	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol.}$ (%)	334***	474***	TCR (%/K)	$\Delta R/R$ DUE TO $B_{tol.}$ (%)
	$R_T$ (k $\Omega$ )	$R_T$ (k $\Omega$ )			$R_T$ (k $\Omega$ )	$R_T$ (k $\Omega$ )		
- 40	6153	9024	- 6.83	10.22	16 044	22 850	- 7.14	6.41
- 35	4394	6444	- 6.64	9.24	11 282	16 068	- 6.94	5.80
- 30	3168	4646	- 6.45	8.29	8013	11 413	- 6.74	5.20
- 25	2305	3381	- 6.27	7.39	5747	8185	- 6.55	4.64
- 20	1693	2483	- 6.09	6.52	4161	5926	- 6.37	4.09
- 15	1254	1839	- 5.92	5.68	3040	4329	- 6.19	3.57
- 10	936.4	1373	- 5.75	4.88	2240	3190	- 6.02	3.06
- 5	705.0	1034	- 5.60	4.10	1665	2371	- 5.85	2.57
0	535.0	784.7	- 5.44	3.36	1248	1777	- 5.69	2.11
5	409.1	600.0	- 5.29	2.64	942.3	1342	- 5.54	1.65
10	315.1	462.1	- 5.15	1.94	717.1	1021	- 5.39	1.22
15	244.4	358.4	- 5.01	1.27	549.8	783.0	- 5.24	0.80
20	190.8	279.9	- 4.88	0.63	424.5	604.6	- 5.10	0.39
25	150.0	220.0	- 4.75	0.00	330.0	470.0	- 4.97	0.00
30	118.6	174.0	- 4.63	0.60	258.2	367.8	- 4.84	0.38
35	94.42	138.5	- 4.51	1.19	203.4	289.6	- 4.72	0.75
40	75.58	110.9	- 4.39	1.76	161.1	229.5	- 4.59	1.10
45	60.85	89.24	- 4.28	2.30	128.4	182.9	- 4.48	1.45
50	49.25	72.24	- 4.17	2.83	103.0	146.7	- 4.37	1.78
55	40.08	58.78	- 4.07	3.35	83.00	118.2	- 4.26	2.10
60	32.78	48.08	- 3.97	3.85	67.26	95.80	- 4.15	2.41
65	26.94	39.51	- 3.87	4.33	54.79	78.04	- 4.05	2.72
70	22.25	32.63	- 3.78	4.80	44.85	63.88	- 3.95	3.01
75	18.46	27.07	- 3.69	5.26	36.90	52.55	- 3.86	3.30
80	15.38	22.56	- 3.60	5.70	30.49	43.43	- 3.77	3.58
85	12.87	18.88	- 3.52	6.14	25.31	36.05	- 3.68	3.85
90	10.82	15.87	- 3.44	6.56	21.10	30.06	- 3.59	4.11
95	9.129	13.39	- 3.36	6.96	17.67	25.16	- 3.51	4.37
100	7.732	11.34	- 3.28	7.36	14.85	21.15	- 3.43	4.62
105	6.574	9.642	- 3.21	7.75	12.53	17.85	- 3.35	4.86
110	5.610	8.228	- 3.14	8.13	10.62	15.12	- 3.28	5.10
115	4.804	7.046	- 3.07	8.49	9.029	12.86	- 3.21	5.33
120	4.128	6.054	- 3.00	8.85	7.704	10.97	- 3.14	5.55
125	3.559	5.219	- 2.94	9.20	6.597	9.396	- 3.07	5.77
130	3.078	4.514	- 2.87	9.54	5.668	8.072	- 3.00	5.99
135	2.670	3.916	- 2.81	9.87	4.885	6.958	- 2.94	6.20
140	2.323	3.408	- 2.75	10.20	4.224	6.016	- 2.88	6.40
145	2.028	2.974	- 2.69	10.52	3.663	5.217	- 2.82	6.60
150	1.774	2.603	- 2.64	10.83	3.186	4.538	- 2.76	6.79



**PACKAGING  
TAPE SPECIFICATIONS**

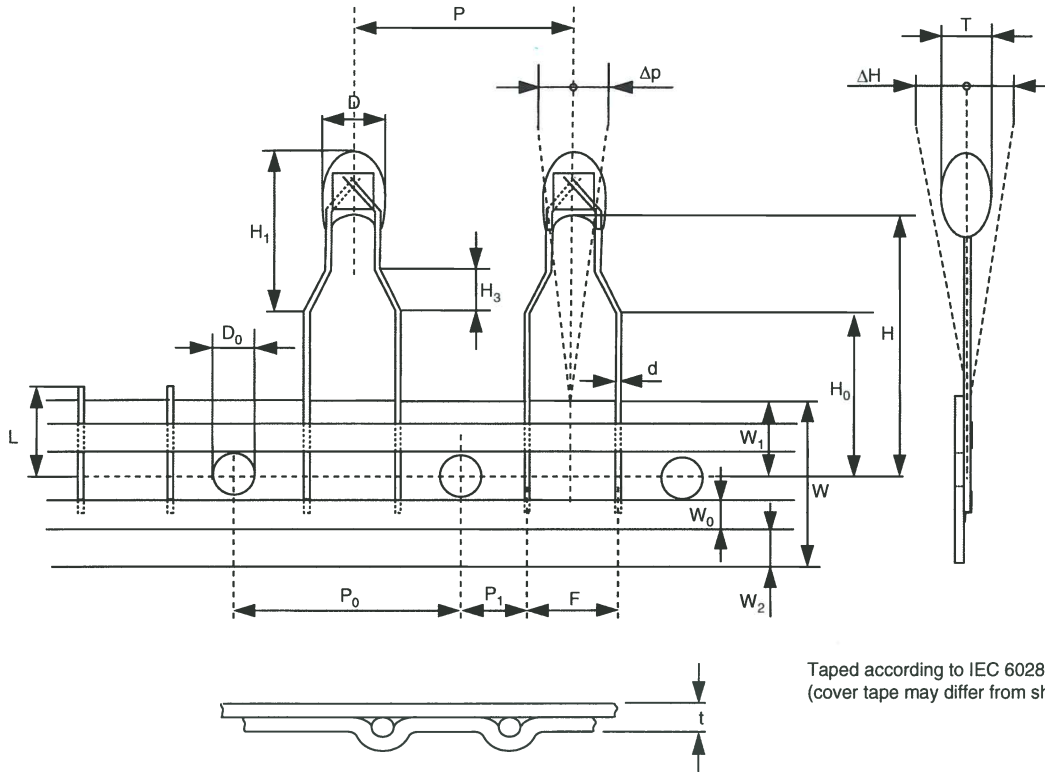
Thermistors on tape



1E pitch  
NTCLE100E3...T1

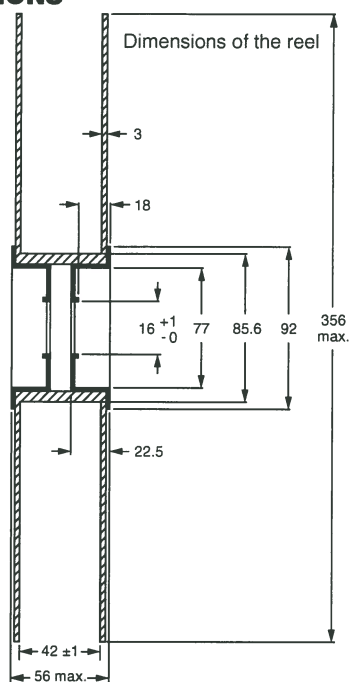
DIMENSIONS in millimeters				
DETAILS	SYMBOL	DIMENSIONS NOMINAL	TOLERANCE	REMARKS
Body diameter	D	3.3	± 0.5	5 max. for 3.3 Ω to 220 Ω
Lead diameter	d	0.6	± 0.06	
Feed hole diameter	D <sub>0</sub>	4.0	± 0.2	
Lead to lead distance	F	2.54	± 0.3	Guaranteed between component and tape
Distance component to tape centre	H	22.0	± 1.0	1 to 4 max. for 3.3 Ω to 220 Ω
Component height	H <sub>1</sub>	32.2	max.	
Component alignment	Δh	0	± 2.0	
Distance top/bottom of components	H <sub>2</sub>	6	max.	
Length of lacquer under the comp. bottom	H <sub>3</sub>	2	± 1	
Length of snipped lead	L	11.0	max.	
Pitch between thermistors	P	12.7	± 1.0	Cumulative pitch error ± 1 mm/20 pitches guaranteed between component and tape
Feed hole pitch	P <sub>0</sub>	12.7	± 0.3	
Feed hole center to lead center	P <sub>1</sub>	5.08	± 0.7	
Component alignment	Δp	0	± 1.3	
Total thickness	T	3.0	max.	4 max. for 3.3 Ω to 220 Ω with cardboard tape 0.5 ± 0.1
Total tape thickness	t	0.9	max.	
Tape width	W	18.0	± 1.0	None of the hold down tapes may cover the holes
Hold down tape width	W <sub>0</sub>	5.0	± 0.3	
Hole position	W <sub>1</sub>	9.0	± 0.5	
Hold down tape position	W <sub>2</sub>	1.5	± 1.0	

## Thermistors on tape


**2E pitch**

NTCLE100E3...T2

DIMENSIONS in millimeters				
DETAILS	SYMBOL	DIMENSIONS NOMINAL	TOLERANCE	REMARKS
Body diameter	D	3.3	± 0.5	5 max. for 3.3 Ω to 220 Ω
Lead diameter	d	0.6	± 0.06	
Feed hole diameter	D <sub>0</sub>	4.0	± 0.2	
Lead to lead distance	F	5.0	+ 0.6 - 0.1	Guaranteed between component and tape
Distance component to tape centre	H	20.0	± 2.0	12 max. for 100 Ω to 220 Ω
Component height	H <sub>0</sub>	16.0	± 0.5	
Component alignment	H <sub>1</sub>	10.0	max.	
Distance top/bottom of components	Δh	0.0	± 2.0	
Length of lacquer under the comp. bottom	H <sub>3</sub>	0.0	± 2.0	
Length of snapped lead	L	11.0	max.	
Pitch between thermistors	P	12.7	± 1.0	Cumulative pitch error ± 1 mm/20 pitches guaranteed between component and tape
Feed hole pitch	P <sub>0</sub>	12.7	± 0.3	
Feed hole center to lead center	P <sub>1</sub>	3.81	± 0.7	
Component alignment	Δp	0.0	± 1.3	
Total thickness	T	3.0	max.	4 max. for 3.3 Ω to 220 Ω with cardboard tape 0.5 ± 0.1
Total tape thickness	t	0.9	max.	
Tape width	W	18.0	± 1.0	None of the hold down tapes may cover the holes
Hold down tape width	W <sub>0</sub>	5.0	- 0.5 ± 0.3	
Hole position	W <sub>1</sub>	9.0	± 0.5	
Hold down tape position	W <sub>2</sub>	1.5	± 1.0	

**REEL SPECIFICATIONS**


CODE NUMBERS AND RELEVANT		
PARAMETER		Quantity
BULK	NTCLE100E3....B0	500
TAPE AND REEL 1E PITCH <sup>(1)</sup>	NTCLE100E3....T1	1500 per reel, 2 reels per box
TAPE AND REEL 2E PITCH <sup>(1)</sup>	NTCLE100E3....T2	1500 per reel, 2 reels per box

**CHARACTERISTICS OF TAPED PRODUCTS**

Minimum pull-out force of the component: 5 N

Minimum peel-off force of adhesive tape: 6 N

Minimum tearing force tape: 15 N

Minimum pull-off force of tape-reel: 5 N

**STORAGE CONDITIONS**

Storage temperature range: - 25 °C to + 40 °C

Maximum relative humidity: 80 %, non-condensing

**TESTS AND REQUIREMENTS**

Essentially all tests are carried out in accordance with "IEC publication 60068-2; Environmental testing", except where indicated.

STABILITY TESTS				
CECC 32 100 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS
D3; 4.20.1		Endurance	25 °C; 1000 h	$\Delta R/R < 1 \%$
	1	Endurance	- 40 °C; 1000 h	$\Delta R/R < 1 \%$
	539	Endurance	500 mW; 55 °C; 1000 h	$\Delta R/R < 3 \%$ <sup>(1)</sup>
	2	Dry heat, (steady state)	125 °C; 1000 h	$\Delta R/R < 3 \%$
D1; 4.19	3	Damp heat (steady state)	56 days at 40 °C; 90 % to 95 % RH	$\Delta R/R < 3 \%$
C2; 4.14	14	Rapid change of temperature	- 40 °C to + 125 °C; 50 cycles	$\Delta R/R < 2 \%$
Other applicable tests				
	21	Robustness of leads: Tensile strength Bending	Loading force 10 N Loading force 5 N	$\Delta R/R \leq 1 \%$
	58	Soldering: Solderability Resistance to heat	240 °C max.; duration 4 s max. 265 °C max.; duration 5 s max.	$\Delta R/R \leq 1 \%$ <sup>(2)</sup>
	27	Impact	Free fall; 1 m	$\Delta R/R \leq 1 \%$
	29	Shock	490 m/s; half sinewave	$\Delta R/R \leq 1 \%$
	45	Resistance to solvent (isopropanol)	Ambient temp for 5 minutes; 5 N with hydrophylic cotton wool	No traces of lacquer on cotton wool
	6	Vibration	1.5 mm peak to peak; 10 Hz to 58 Hz 10 gp: 50 Hz to 500 Hz 1 octave/min. 2 h in each direction in three orthogonal directions	No visible damage $\Delta R/R < 1 \%$
	60695-2-2	Inflammability	1980, needle flame test	Non-flammable

**Notes**
<sup>(1)</sup> For  $R_{25} \geq 100 \text{ k}\Omega$  the drift requirement is  $\Delta R/R < 5 \%$ 
<sup>(2)</sup> For  $R_{25}$  from 2.2 k $\Omega$  to 10 k $\Omega$ , requirement is  $\pm 2 \%$  max.



## **Disclaimer**

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay's knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer's technical experts. Product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.





```
/Jens
Ohm B-25/85
3.3 2880
4.7 2880
6.8 2880
10 2990
15 3041
22 3136
33 3390
47 3390
68 3390
100 3560
150 3560
220 3560
330 3560
470 3560
680 3560
1000 3528
1500 3528
2000 3528
2200 3977
2700 3977
3300 3977
4700 3977
5000 3977
6800 3977
10000 3977
12000 3740
15000 3740
22000 3740
33000 4090
47000 4090
50000 4190
68000 4190
100000 4190
150000 4370
220000 4370
330000 4570
470000 4570
*/
#ifdef NTC_R_3.3
#define NTC2880
#define NTC_REF_R 3.3
#endif

#ifdef NTC_R_4.7
#define NTC2880
#define NTC_REF_R 4.7
#endif

#ifdef NTC_R_6.8
#define NTC2880
#define NTC_REF_R 6.8
#endif

#ifdef NTC_R_10
#define NTC2990
#define NTC_REF_R 10
#endif

#ifdef NTC_R_15
#define NTC3041
#define NTC_REF_R 15
#endif

#ifdef NTC_R_22
#define NTC3136
#define NTC_REF_R 22
#endif

#ifdef NTC_R_33
```

```
#define NTC3390
#define NTC_REF_R 33
#endif

#ifdef NTC_R_47
#define NTC3390
#define NTC_REF_R 47
#endif

#ifdef NTC_R_68
#define NTC3390
#define NTC_REF_R 68
#endif

#ifdef NTC_R_100
#define NTC3560
#define NTC_REF_R 100
#endif

#ifdef NTC_R_150
#define NTC3560
#define NTC_REF_R 150
#endif

#ifdef NTC_R_220
#define NTC3560
#define NTC_REF_R 220
#endif

#ifdef NTC_R_330
#define NTC3560
#define NTC_REF_R 330
#endif

#ifdef NTC_R_470
#define NTC3560
#define NTC_REF_R 470
#endif

#ifdef NTC_R_680
#define NTC3560
#define NTC_REF_R 680
#endif

#ifdef NTC_R_1000
#define NTC3528
#define NTC_REF_R 1000
#endif

#ifdef NTC_R_1500
#define NTC3528
#define NTC_REF_R 1500
#endif

#ifdef NTC_R_2000
#define NTC3528
#define NTC_REF_R 2000
#endif

#ifdef NTC_R_2200
#define NTC3977
#define NTC_REF_R 2200
#endif

#ifdef NTC_R_2700
#define NTC3977
#define NTC_REF_R 2700
#endif

#ifdef NTC_R_3300
#define NTC3977
#define NTC_REF_R 3300
```

```
#endif

#ifdef NTC_R_4700
#define NTC3977
#define NTC_REF_R 4700
#endif

#ifdef NTC_R_5000
#define NTC3977
#define NTC_REF_R 5000
#endif

#ifdef NTC_R_6800
#define NTC3977
#define NTC_REF_R 6800
#endif

#ifdef NTC_R_10000
#define NTC3977
#define NTC_REF_R 10000
#endif

#ifdef NTC_R_12000
#define NTC3740
#define NTC_REF_R 12000
#endif

#ifdef NTC_R_15000
#define NTC3740
#define NTC_REF_R 15000
#endif

#ifdef NTC_R_22000
#define NTC3740
#define NTC_REF_R 22000
#endif

#ifdef NTC_R_33000
#define NTC4090
#define NTC_REF_R 33000
#endif

#ifdef NTC_R_47000
#define NTC4090
#define NTC_REF_R 47000
#endif

#ifdef NTC_R_50000
#define NTC4190
#define NTC_REF_R 50000
#endif

#ifdef NTC_R_68000
#define NTC4190
#define NTC_REF_R 68000
#endif

#ifdef NTC_R_100000
#define NTC4190
#define NTC_REF_R 100000
#endif

#ifdef NTC_R_150000
#define NTC4370
#define NTC_REF_R 150000
#endif

#ifdef NTC_R_220000
#define NTC4370
#define NTC_REF_R 220000
#endif
```

! yep it's up with 10000  $\Omega$  NTC  
see "magic" number 3977



```
#ifdef NTC_R_330000
#define NTC4570
#define NTC_REF_R 330000
#endif

#ifdef NTC_R_470000
#define NTC4570
#define NTC_REF_R 470000
#endif

#ifdef NTC2880
#define NTC_A -9.094
#define NTC_B 2251.74
#define NTC_C 229098
#define NTC_D -2.744820E+07
#define NTC_A1 3.354016E-03
#define NTC_B1 3.495020E-04
#define NTC_C1 2.095959E-06
#define NTC_D1 4.260615E-07
//NTC2880 3 -9.094 2251.74 229098 -2.744820E+07 3.354016E-03 3.495020E-04 2.095959E-06 4.260615E-07
#endif

#ifdef NTC2990
#define NTC_A -10.2296
#define NTC_B 2887.62
#define NTC_C 132336
#define NTC_D -2.502510E+07
#define NTC_A1 3.354016E-03
#define NTC_B1 3.415560E-04
#define NTC_C1 4.955455E-06
#define NTC_D1 4.364236E-07
//NTC2990 3 -10.2296 2887.62 132336 -2.502510E+07 3.354016E-03 3.415560E-04 4.955455E-06 4.364236E-07
#endif

#ifdef NTC3041
#define NTC_A -11.1334
#define NTC_B 3658.73
#define NTC_C -102895
#define NTC_D 5.166520E+05
#define NTC_A1 3.354016E-03
#define NTC_B1 3.349290E-04
#define NTC_C1 3.683843E-06
#define NTC_D1 7.050455E-07
//NTC3041 3 -11.1334 3658.73 -102895 5.166520E+05 3.354016E-03 3.349290E-04 3.683843E-06 7.050455E-07
#endif

#ifdef NTC3136
#define NTC_A -12.4493
#define NTC_B 4702.74
#define NTC_C -402687
#define NTC_D 3.196830E+07
#define NTC_A1 3.354016E-03
#define NTC_B1 3.243880E-04
#define NTC_C1 2.658012E-06
#define NTC_D1 -2.701560E-07
//NTC3136 3 -12.4493 4702.74 -402687 3.196830E+07 3.354016E-03 3.243880E-04 2.658012E-06 -2.701560E-07
#endif

#ifdef NTC3390
#define NTC_A -12.6814
#define NTC_B 4391.97
#define NTC_C -232807
#define NTC_D 1.509643E+07
#define NTC_A1 3.354016E-03
#define NTC_B1 2.993410E-04
#define NTC_C1 2.135133E-06
#define NTC_D1 -5.672000E-09
//NTC3390 3 -12.6814 4391.97 -232807 1.509643E+07 3.354016E-03 2.993410E-04 2.135133E-06 -5.672000E-09
#endif

#ifdef NTC3528
#define NTC_A -12.0596
```

```
#define NTC_B 3687.667
#define NTC_C -7617.13
#define NTC_D -5.914730E+06
#define NTC_A1 3.354016E-03
#define NTC_B1 2.909670E-04
#define NTC_C1 1.632136E-06
#define NTC_D1 7.192200E-08
//NTC3528 0.5 -12.0596 3687.667 -7617.13 -5.914730E+06 3.354016E-03 2.909670E-04 1.632136E-06
7.192200E-08
#endif
```

```
#ifdef NTC3528
#define NTC_A -21.0704
#define NTC_B 11903.95
#define NTC_C -2504699
#define NTC_D 2.470338E+08
#define NTC_A1 3.354016E-03
#define NTC_B1 2.933908E-04
#define NTC_C1 3.494314E-06
#define NTC_D1 -7.712690E-07
//NTC3528 0.5 -21.0704 11903.95 -2504699 2.470338E+08 3.354016E-03 2.933908E-04 3.494314E-06
-7.712690E-07
#endif
```

```
#ifdef NTC3560
#define NTC_A -13.0723
#define NTC_B 4190.574
#define NTC_C -47158.4
#define NTC_D -1.199256E+07
#define NTC_A1 3.354016E-03
#define NTC_B1 2.884193E-04
#define NTC_C1 4.118032E-06
#define NTC_D1 1.786790E-07
//NTC3560 1.5 -13.0723 4190.574 -47158.4 -1.199256E+07 3.354016E-03 2.884193E-04 4.118032E-06
1.786790E-07
#endif
```

```
#ifdef NTC3470
#define NTC_A -13.8973
#define NTC_B 4557.725
#define NTC_C -98275
#define NTC_D -7.522357E+06
#define NTC_A1 3.354016E-03
#define NTC_B1 2.744032E-04
#define NTC_C1 3.666944E-06
#define NTC_D1 1.375492E-07
//NTC3470 2.0 -13.8973 4557.725 -98275 -7.522357E+06 3.354016E-03 2.744032E-04 3.666944E-06
1.375492E-07
#endif
```

```
#ifdef NTC3977
#define NTC_A -14.6337
#define NTC_B 4791.842
#define NTC_C -115334
#define NTC_D -3.730535E+06
#define NTC_A1 3.354016E-03
#define NTC_B1 2.569850E-04
#define NTC_C1 2.620131E-06
#define NTC_D1 6.383091E-08
//NTC3977 0.75 -14.6337 4791.842 -115334 -3.730535E+06 3.354016E-03 2.569850E-04 2.620131E-06
6.383091E-08
#endif
```

```
#ifdef NTC4090
#define NTC_A -15.5322
#define NTC_B 5229.973
#define NTC_C -160451
#define NTC_D -5.414091E+06
#define NTC_A1 3.354016E-03
#define NTC_B1 2.519107E-04
#define NTC_C1 3.510939E-06
#define NTC_D1 1.105179E-07
```

} yes - It's coefficients for our 10000  $\Omega$  NTC

```
//NTC4090 1.5 -15.5322 5229.973 -160451 -5.414091E+06 3.354016E-03 2.519107E-04 3.510939E-06
1.105179E-07
#endif
```

```
#ifdef NTC4190
#define NTC_A -16.0349
#define NTC_B 5459.339
#define NTC_C -191141
#define NTC_D -3.328322E+06
#define NTC_A1 3.354016E-03
#define NTC_B1 2.460382E-04
#define NTC_C1 3.405377E-06
#define NTC_D1 1.034240E-07
//NTC4190 1.5 -16.0349 5459.339 -191141 -3.328322E+06 3.354016E-03 2.460382E-04 3.405377E-06
1.034240E-07
#endif
```

```
#ifdef NTC4370
#define NTC_A -16.8717
#define NTC_B 5759.15
#define NTC_C -194267
#define NTC_D -6.869149E+06
#define NTC_A1 3.354016E-03
#define NTC_B1 2.367720E-04
#define NTC_C1 3.585140E-06
#define NTC_D1 1.255349E-07
//NTC4370 2.5 -16.8717 5759.15 -194267 -6.869149E+06 3.354016E-03 2.367720E-04 3.585140E-06
1.255349E-07
#endif
```

```
#ifdef NTC4570
#define NTC_A -17.6439
#define NTC_B 6022.726
#define NTC_C -203157
#define NTC_D -7.183526E+06
#define NTC_A1 3.354016E-03
#define NTC_B1 2.264097E-04
#define NTC_C1 3.278184E-06
#define NTC_D1 1.097628E-07
//NTC4570 1.5 -17.6439 6022.726 -203157 -7.183526E+06 3.354016E-03 2.264097E-04 3.278184E-06
1.097628E-07
#endif
```

```
// Steinhart and HArt formula and coefficients from above given
// by your define of NTC_R_10000 etc
// See top
```

```
float NTCResToTemp(float r)
{
    int i;
    float logV,vv,t;
    vv = logV = log(r /NTC_REF_R);
    //formula t = 1.0 / (NTC_A1 + NTC_B1 * logV + NTC_C1 * logV * logV + NTC_D1 * logV * logV * logV);
    // doing a little bit more efficient ...
    t = NTC_A1 + NTC_B1 * vv;
    vv *= logV; // logV^2
    t += NTC_C1 * vv;
    vv *= logV; // logV^3
    t += NTC_D1 * vv;
    return (1.0 / t); // in Kelvin !!!
}
```

*Formula on page 4 in Vishay datasheet*