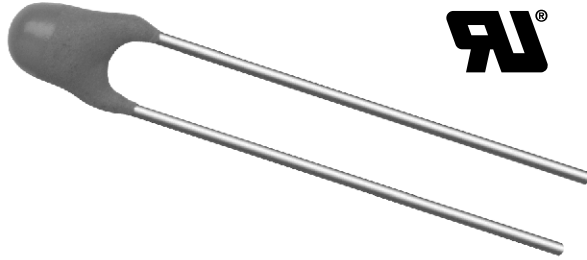


NTC Thermistors, Radial Leaded, Standard Precision



FEATURES

- Accuracy over a wide temperature range
- High stability over a long life
- Excellent price/performance ratio
- UL recognized, file E148885
- Old part number was 2322 640 3/4/6....
- Component in accordance to RoHS 2002/95/EC and WEEE 2002/96/EC


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/thermistors/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 |
| Resistance value at 25 °C | 3.3 Ω to 470 kΩ |
| Tolerance on R_{25} - value | ± 2 %; ± 3 %; ± 5 % |
| $B_{25/85}$ - value | 2880K to 4570K |
| Tolerance on $B_{25/85}$ - value | ± 0.5 % to ± 3 % |
| Maximum dissipation | 500 mW |
| Dissipation factor δ (for information only) | 7 mW/K 8.5 mW/K (for R_{25} value ≤ 680 Ω) |
| Response time | 1.2 s |
| Thermal time constant τ (for information only) | 15 s |
| Operating temperature range: | |
| at zero dissipation; continuously | - 40 °C to + 125 °C |
| at zero dissipation; for short periods | ≤ 150 °C |
| at maximum dissipation | 0 °C to 55 °C |
| Climatic category acc. IEC 60068-1 | 40/125/56 |
| Weight | ≈ 0.3 g |

ELECTRICAL DATA AND ORDERING INFORMATION

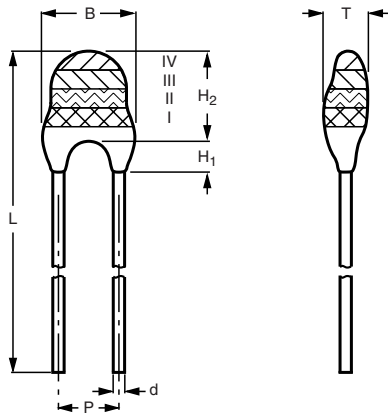
| R_{25} [Ω] | $B_{25/85}$ - VALUE | | UL APPROVED [Y/N] | 12NC ORDERING CODE 2381 640 6.... (1) | SAP MATERIAL NO. NTCLE100E3..... (2) | COLOR CODE (3) | | |
|-----------------|---------------------|-------|-------------------------|--|---|----------------|--------|-------|
| | [K] | [± %] | | | | I | II | III |
| 3.3 | 2880 | 3 | N | *338 | 338*B0 | Orange | Orange | Gold |
| 4.7 | 2880 | 3 | N | *478 | 478*B0 | Yellow | Violet | Gold |
| 6.8 | 2880 | 3 | N | *688 | 688*B0 | Blue | Grey | Gold |
| 10 | 2990 | 3 | N | *109 | 109*B0 | Brown | Black | Black |
| 15 | 3041 | 3 | N | *159 | 159*B0 | Brown | Green | Black |
| 22 | 3136 | 3 | N | *229 | 229*B0 | Red | Red | Black |
| 33 | 3390 | 3 | Y | *339 | 339*B0 | Orange | Orange | Black |
| 47 | 3390 | 3 | Y | *479 | 479*B0 | Yellow | Violet | Black |
| 68 | 3390 | 3 | Y | *689 | 689*B0 | Blue | Grey | Black |
| 100 | 3560 | 1.5 | N | *101 | 101*B0 | Brown | Black | Brown |
| 150 | 3560 | 1.5 | N | *151 | 151*B0 | Brown | Green | Brown |
| 220 | 3560 | 1.5 | N | *221 | 221*B0 | Red | Red | Brown |
| 330 | 3560 | 1.5 | N | *331 | 331*B0 | Orange | Orange | Brown |
| 470 | 3560 | 1.5 | N | *471 | 471*B0 | Yellow | Violet | Brown |

| ELECTRICAL DATA AND ORDERING INFORMATION | | | | | | | | |
|--|----------------------------|------------|-------------------------|--|---|----------------|--------|--------|
| R_{25} [Ω] | $B_{25/85}$ - VALUE [K] | | UL APPROVED [Y/N] | 12NC ORDERING CODE 2381 640 6.... (1) | SAP MATERIAL NO. NTCLE100E3..... (2) | COLOR CODE (3) | | |
| | | [\pm %] | | | | I | II | III |
| 680 | 3560 | 1.5 | N | *681 | 681*B0 | Blue | Grey | Brown |
| 1000 | 3528 | 0.5 | N | *102 | 102*B0 | Brown | Black | Red |
| 1500 | 3528 | 0.5 | N | *152 | 152*B0 | Brown | Green | Red |
| 2000 | 3528 | 0.5 | N | *202 | 202*B0 | Red | Black | Red |
| 2200 | 3977 | 0.75 | Y | *222 | 222*B0 | Red | Red | Red |
| 2700 | 3977 | 0.75 | Y | *272 | 272*B0 | Red | violet | Red |
| 3300 | 3977 | 0.75 | Y | *332 | 332*B0 | Orange | Orange | Red |
| 4700 | 3977 | 0.75 | Y | *472 | 472*B0 | Yellow | Violet | Red |
| 5000 | 3977 | 0.75 | Y | *502 | 502*B0 | Green | Black | Red |
| 6800 | 3977 | 0.75 | Y | *682 | 682*B0 | Blue | Grey | Red |
| 10 000 | 3977 | 0.75 | Y | *103 | 103*B0 | Brown | Black | Orange |
| 12 000 | 3740 | 2 | Y | *123 | 123*B0 | Brown | Red | Orange |
| 15 000 | 3740 | 2 | Y | *153 | 153*B0 | Brown | Green | Orange |
| 22 000 | 3740 | 2 | Y | *223 | 223*B0 | Red | Red | Orange |
| 33 000 | 4090 | 1.5 | N | *333 | 333*B0 | Orange | Orange | Orange |
| 47 000 | 4090 | 1.5 | N | *473 | 473*B0 | Yellow | Violet | Orange |
| 50 000 | 4190 | 1.5 | N | *503 | 503*B0 | Green | Black | Orange |
| 68 000 | 4190 | 1.5 | N | *683 | 683*B0 | Blue | Grey | Orange |
| 100 000 | 4190 | 1.5 | N | *104 | 104*B0 | Brown | Black | Yellow |
| 150 000 | 4370 | 2.5 | Y | *154 | 154*B0 | Brown | Green | Yellow |
| 220 000 | 4370 | 2.5 | Y | *224 | 224*B0 | Red | Red | Yellow |
| 330 000 | 4570 | 1.5 | N | *334 | 334*B0 | Orange | Orange | Yellow |
| 470 000 | 4570 | 1.5 | N | *474 | 474*B0 | Yellow | Violet | Yellow |

Notes

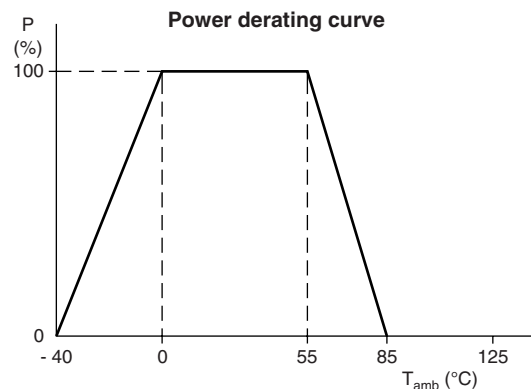
- (1) Replace * in 12NC by 3 for 5 %, 6 for 3 %, 4 for 2 %
- (2) Replace * in SAP by J for 5 %, H for 3 %, G for 2 %
- (3) For $R_{25} \pm 2$ % band IV is red, ± 3 % band IV is orange, ± 5 % band IV is gold

DIMENSIONS in millimeters



2381 640 6.338 to 6.474

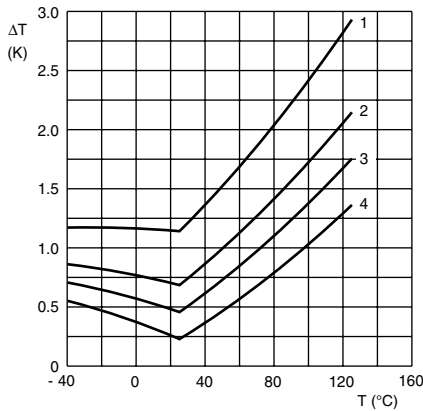
DERATING AND TEMPERATURE TOLERANCES



| PHYSICAL DIMENSIONS FOR RELEVANT TYPE (all dimensions in millimeters) | | | | | | | | |
|---|---------------|----------------|-------|------|------------|--------------|------|------------|
| CODE NUMBER 2381 640 | $B_{max.}$ | d | H_1 | | H_2 max. | L | P | $T_{max.}$ |
| | | | Min. | Max. | | | | |
| 6.338 to 6.221 | 5.0 | 0.6 ± 0.06 | 1.0 | 4.0 | 6.0 | 24 ± 1.5 | 2.54 | 4.0 |
| 6.331 to 6.474 | 3.3 ± 0.5 | 0.6 ± 0.06 | 1.0 | 3.0 | 6.0 | 24 ± 1.5 | 2.54 | 3.0 |

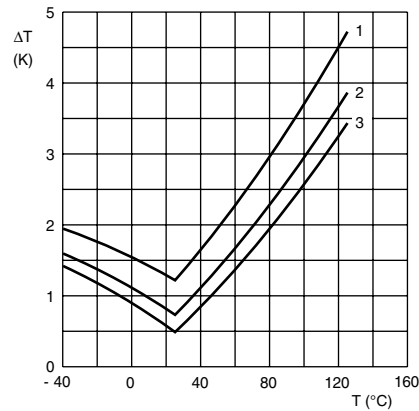


TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



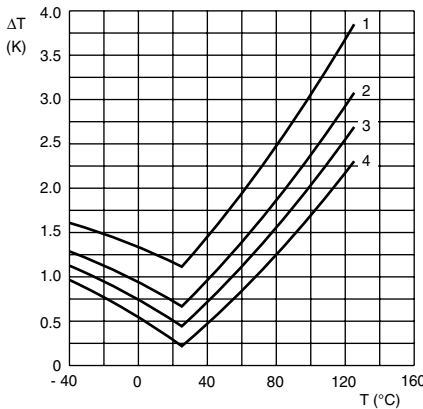
Curves valid for 2.2 to 10 kΩ
Curve 1: $\Delta R_{25}/R_{25} = 5\%$
Curve 2: $\Delta R_{25}/R_{25} = 3\%$
Curve 3: $\Delta R_{25}/R_{25} = 2\%$
Curve 4: $\Delta R_{25}/R_{25} = 1\%$
(for 2381 640 5.... series only)

TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



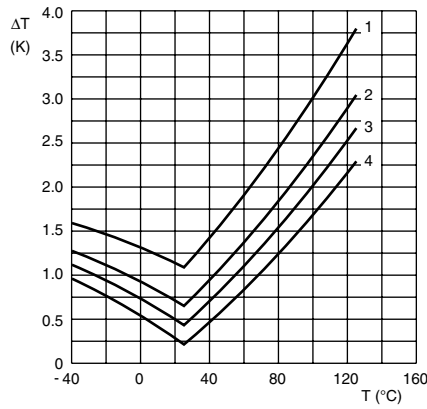
Curves valid for 12 to 22 kΩ
Curve 1: $\Delta R_{25}/R_{25} = 5\%$
Curve 2: $\Delta R_{25}/R_{25} = 3\%$
Curve 3: $\Delta R_{25}/R_{25} = 2\%$

TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



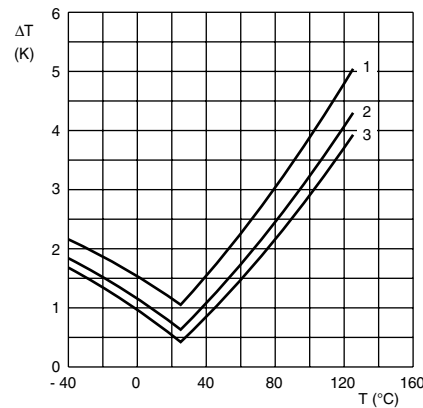
Curves valid for 33 to 47 kΩ
Curve 1: $\Delta R_{25}/R_{25} = 5\%$
Curve 2: $\Delta R_{25}/R_{25} = 3\%$
Curve 3: $\Delta R_{25}/R_{25} = 2\%$
Curve 4: $\Delta R_{25}/R_{25} = 1\%$
(for 2381 640 5.... series only)

TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



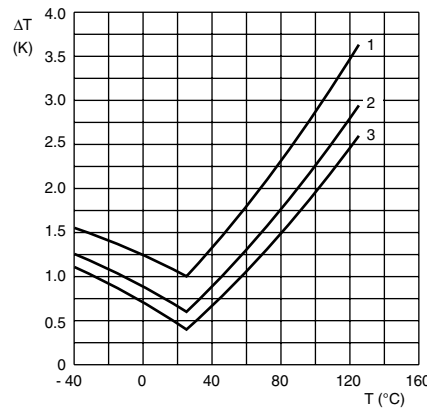
Curves valid for 68 to 100 kΩ
Curve 1: $\Delta R_{25}/R_{25} = 5\%$
Curve 2: $\Delta R_{25}/R_{25} = 3\%$
Curve 3: $\Delta R_{25}/R_{25} = 2\%$
Curve 4: $\Delta R_{25}/R_{25} = 1\%$
(for 2381 640 5.... series only)

TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



Curves valid for 150 to 220 kΩ
Curve 1: $\Delta R_{25}/R_{25} = 5\%$
Curve 2: $\Delta R_{25}/R_{25} = 3\%$
Curve 3: $\Delta R_{25}/R_{25} = 2\%$

TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



Curves valid for 330 to 470 kΩ
Curve 1: $\Delta R_{25}/R_{25} = 5\%$
Curve 2: $\Delta R_{25}/R_{25} = 3\%$
Curve 3: $\Delta R_{25}/R_{25} = 2\%$

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"):

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

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

where:

A, B, C, D, 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).

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 and + 1.17 °C.

| PARAMETER FOR DETERMINING NOMINAL RESISTANCE VALUES | | | | | | | | | | | |
|---|------------------------|------------------------------------|----------------|-----------|----------|---------------------|---------------------|----------------|-----------------------------------|-----------------------------------|-----------------------------------|
| NUMBER | B _{25/85} (K) | NAME | TOL. B VALUE % | 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 B _n = 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 B _n = 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 B _n = 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 B _n = 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 B _n = 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 B _n = 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 B _n = 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 B _n = 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 B _n = 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 B _n = 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 B _n = 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 B _n = 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 B _n = 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



2381 640 3/4/6.../NTCLE100E3...B0/T1/T2

NTC Thermistors, Radial Leaded, Vishay BCcomponents
Standard Precision

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

| RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 3.3, 4.7 AND 6.8 Ω | | | | | |
|--|--|--|--|--------------|---------------------------------------|
| T_{oper} [°C] | PART NR. 2381 640 **338 NTCLE100E3338*** | PART NR. 2381 640 **478 NTCLE100E3478*** | PART NR. 2381 640 **688 NTCLE100E3688*** | TCR [%/K] | $\Delta R/R$ DUE TO $B_{tol.}$ [%] |
| | R_T [Ω] | R_T [Ω] | R_T [Ω] | | |
| - 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 |

2381 640 3/4/6..../NTCLE100E3...B0/T1/T2



Vishay BCcomponents NTC Thermistors, Radial Leaded,
Standard Precision

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

| RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 10, 15 AND 22 Ω | | | | | | | | | |
|---|--|--------------|--|--|--------------|--|--|--------------|--|
| T_{oper} [°C] | PART NR. 2381 640 **109 NTCLE100E3109*** | | | PART NR. 2381 640 **159 NTCLE100E3159*** | | | PART NR. 2381 640 **229 NTCLE100E3229*** | | |
| | R_T [Ω] | TCR [%/K] | $\Delta R/R$ DUE TO $B_{tol.}$ [%] | R_T [Ω] | TCR [%/K] | $\Delta R/R$ DUE TO $B_{tol.}$ [%] | R_T [Ω] | 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 |



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| RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 33, 47 AND 68 Ω | | | | | |
|---|--|--|--|--------------|---------------------------------------|
| T_{oper} [°C] | PART NR. 2381 640 **339 NTCLE100E3339*** | PART NR. 2381 640 **479 NTCLE100E3479*** | PART NR. 2381 640 **689 NTCLE100E3689*** | TCR [%/K] | $\Delta R/R$ DUE TO $B_{tol.}$ [%] |
| | R_T [Ω] | R_T [Ω] | R_T [Ω] | | |
| - 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 |

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| RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 100, 150, 220, 330, 470 AND 680 Ω | | | | | | | | |
|--|--|--|--|--|--|--|--------------|--|
| T_{oper} [°C] | PART NR. 2381 640 **101 NTCLE100E3101*** | PART NR. 2381 640 **151 NTCLE100E3151*** | PART NR. 2381 640 **221 NTCLE100E3221*** | PART NR. 2381 640 **331 NTCLE100E3331*** | PART NR. 2381 640 **471 NTCLE100E3471*** | PART NR. 2381 640 **681 NTCLE100E3681*** | TCR [%/K] | $\Delta R/R$ DUE TO $B_{tot.}$ [%] |
| | R_T [Ω] | R_T [Ω] | R_T [Ω] | R_T [Ω] | R_T [Ω] | R_T [Ω] | | |
| -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 |



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| RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R₂₅ AT 1, 1.5 AND 2 kΩ | | | | | |
|--|--|--|--|--------------|--------------------------------------|
| T _{oper} [°C] | PART NR. 2381 640 **102 NTCLE100E3102*** | PART NR. 2381 640 **152 NTCLE100E3152*** | PART NR. 2381 640 **202 NTCLE100E3202*** | TCR [%/K] | ΔR/R DUE TO B _{tol.} [%] |
| | R _T [Ω] | R _T [Ω] | R _T [Ω] | | |
| - 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 |

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| RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 2.2, 2.7, 3.3, 4.7, 5.0, 6.8 AND 10 kΩ | | | | | | | | | |
|--|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|--------------|--|
| T_{oper} [°C] | PART NR. 2381 640 **222 | PART NR. 2381 640 **272 | PART NR. 2381 640 **332 | PART NR. 2381 640 **472 | PART NR. 2381 640 **502 | PART NR. 2381 640 **682 | PART NR. 2381 640 **103 | TCR [%/K] | $\Delta R/R$ DUE TO $B_{tol.}$ [%] |
| | NTCLE100E3222*** | NTCLE100E3272*** | NTCLE100E3332*** | NTCLE100E3472*** | NTCLE100E3502*** | NTCLE100E3682*** | NTCLE100E3103*** | | |
| | R_T [Ω] | R_T [Ω] | R_T [Ω] | R_T [Ω] | R_T [Ω] | R_T [Ω] | R_T [Ω] | | |
| -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 |



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| RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 12, 15 AND 22 kΩ | | | | | |
|--|--|--|--|--------------|---------------------------------------|
| T_{oper} [°C] | PART NR. 2381 640 **123 NTCLE100E3123*** | PART NR. 2381 640 **153 NTCLE100E3153*** | PART NR. 2381 640 **223 NTCLE100E3223*** | TCR [%/K] | $\Delta R/R$ DUE TO $B_{tol.}$ [%] |
| | R_T [k Ω] | R_T [k Ω] | R_T [k Ω] | | |
| - 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 |

2381 640 3/4/6.../NTCLE100E3...B0/T1/T2



Vishay BCcomponents NTC Thermistors, Radial Leaded,
Standard Precision

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

| RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R_{25} AT 33, 47, 50, 68 AND 100 kΩ | | | | | | | | | |
|---|------------------------------------|------------------------|--------------|--|------------------------|------------------------|------------------------|--------------|--|
| T_{oper} [°C] | PART NR. 2381 640 NTCLE100E3 | | | | | | | | |
| | **333 333** | **473 473** | TCR [%/K] | $\Delta R/R$ DUE TO $B_{tol.}$ [%] | **503 503** | **683 683** | **104 104** | TCR [%/K] | $\Delta R/R$ DUE TO $B_{tol.}$ [%] |
| | R_T [k Ω] | R_T [k Ω] | | | R_T [k Ω] | R_T [k Ω] | R_T [k Ω] | | |
| - 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 |



2381 640 3/4/6.../NTCLE100E3...B0/T1/T2

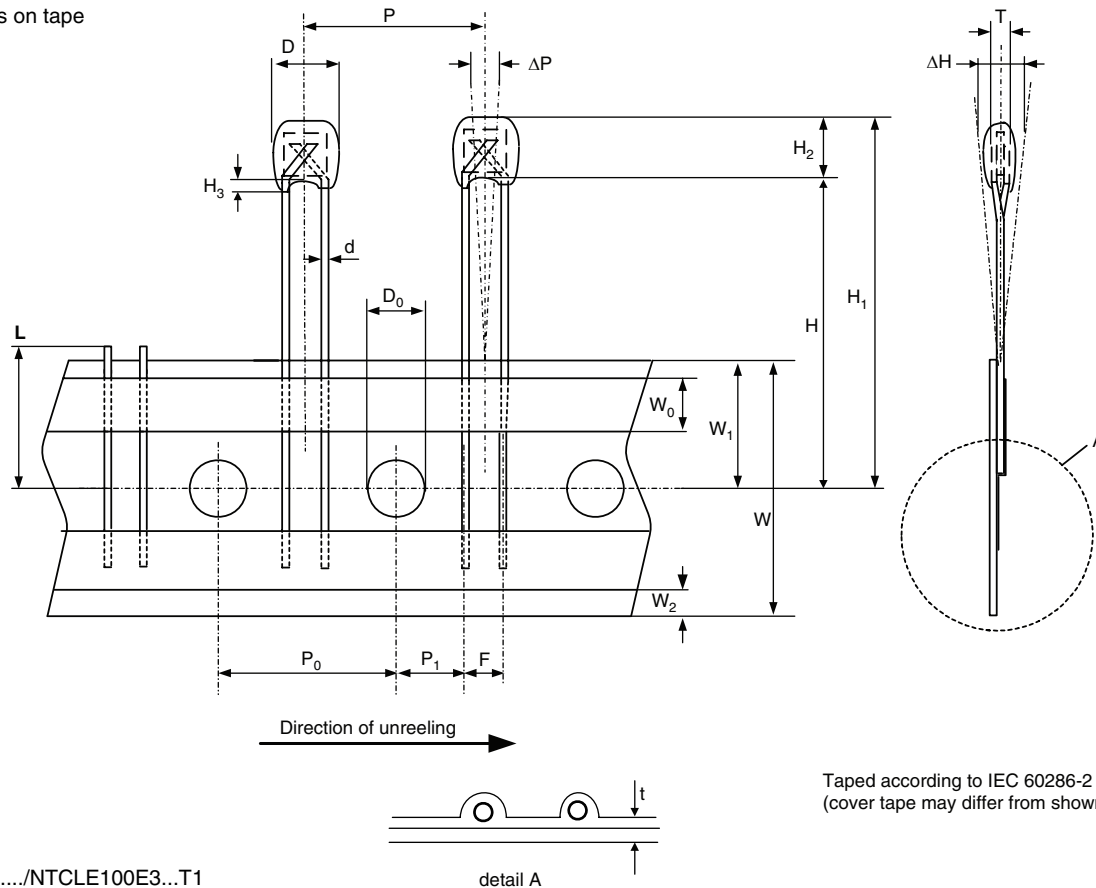
NTC Thermistors, Radial Leaded, Vishay BCcomponents
Standard Precision

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

| RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH R₂₅ AT 150, 220, 330 AND 470 kΩ | | | | | | | | |
|---|------------------------------------|------------------------|--------------|--|------------------------|------------------------|--------------|--|
| T _{oper} [°C] | PART NR. 2381 640 NTCLE100E3 | | | | | | | |
| | **154 154*** | **224 224*** | TCR [%/K] | ΔR/RDUE TO B _{tol.} [%] | **334 334*** | **474 474*** | TCR [%/K] | ΔR/RDUE TO B _{tol.} [%] |
| | R _T [kΩ] | R _T [kΩ] | | | R _T [kΩ] | R _T [kΩ] | | |
| - 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**

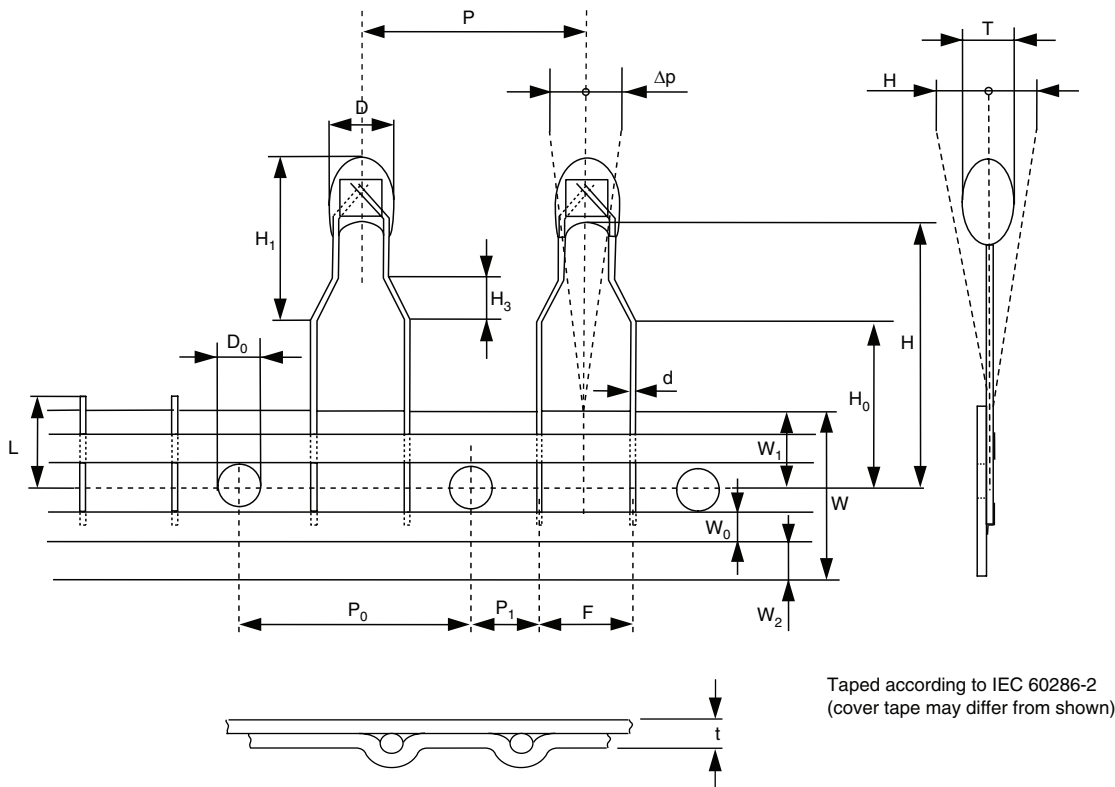
Thermistors on tape



1E pitch
2381 640 4.../NTCLE100E3...T1

| DIMENSIONS in millimeters | | | | |
|--|----------------|--------------------|----------------|--|
| DETAILS | SYMBOL | DIMENSIONS NOMINAL | TOLERANCE | REMARKS |
| Body diameter | D | 3.3 | ± 0.5 | 5 max. for 4.338 to 4.221 |
| Lead diameter | d | 0.6 | ± 10 % | |
| Feed hole diameter | D ₀ | 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 | Guaranteed between component and tape |
| Component height | H ₁ | 32.2 | max. | |
| Component alignment | Δh | 0 | ± 2.0 | |
| Distance top/bottom of components | H ₂ | 6 | max. | |
| Length of lacquer under the comp. bottom | H ₃ | 2 | ± 1 | |
| Length of snapped lead | L | 11.0 | max. | Cumulative pitch error ± 1 mm/20 pitches guaranteed between component and tape |
| Pitch between thermistors | P | 12.7 | ± 1.0 | |
| Feed hole pitch | P ₀ | 12.7 | ± 0.3 | |
| Feed hole center to lead center | P ₁ | 5.08 | ± 0.7 | |
| Component alignment | Δp | 0 | ± 1.3 | |
| Total thickness | T | 3.0 | max. | 4 max. for 4.338 to 4.221 with cardboard tape 0.5 ± 0.1 |
| Total tape thickness | t | 0.9 | max. | |
| Tape width | W | 18.0 | ± 1.0 - 0.5 | None of the hold down tapes may cover the holes |
| Hold down tape width | W ₀ | 5.0 | ± 0.3 | |
| Hole position | W ₁ | 9.0 | ± 0.5 | |
| Hold down tape position | W ₂ | 1.5 | ± 1 | |
| Inspection level: mechanical: S3 | | | | |

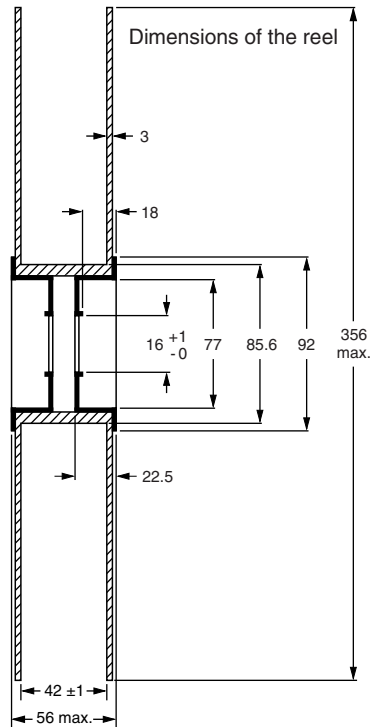
Thermistors on tape



2E pitch

| DIMENSIONS in millimeters | | | | |
|-----------------------------------|----------------|--------------------|----------------|--|
| DETAILS | SYMBOL | DIMENSIONS NOMINAL | TOLERANCE | REMARKS |
| Body diameter | D | 3.3 | ± 0.5 | 5 max. for 3.338 to 3.221 |
| Lead diameter | d | 0.6 | ± 10 % | |
| Feed hole diameter | D ₀ | 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 | 12 max. for 3.101 to 3.221 |
| Component height | H ₀ | 16.0 | ± 0.5 | |
| Component top to seating plane | H ₁ | 10.0 | max. | |
| Component alignment | Δh | 0.0 | ± 2.0 | |
| Distance top - bottom lead clinch | not defined | | | |
| 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 ₀ | 12.7 | ± 0.3 | |
| Feed hole center to lead center | P ₁ | 3.81 | ± 0.7 | |
| Component alignment | Δp | 0.0 | ± 1.3 | |
| Total thickness | T | 3.0 | max. | 4 max. for 3.338 to 3.221 with cardboard tape 0.5 ± 0.1 |
| Total tape thickness | t | 0.9 | max. | |
| Tape width | W | 18.0 | ± 1.0 - 0.5 | None of the hold down tapes may cover the holes |
| Hold down tape width | W ₀ | 5.0 | ± 0.3 | |
| Hole position | W ₁ | 9.0 | ± 0.5 | |
| Hold down tape position | W ₂ | 1.5 | ± 1.0 | |
| Inspection level: mechanical: S3 | | | | |

REEL SPECIFICATIONS



| CODE NUMBERS AND RELEVANT PACKAGING QUANTITIES | | | |
|--|-----------------------------------|--|--|
| PARAMETER | BULK | TAPE AND REEL ⁽¹⁾ 1E PITCH | TAPE AND REEL ⁽¹⁾ 2E PITCH |
| | 2381 640 6.../ NTCLE100E3...B0 | 2381 640 4.../ NTCLE100E3...T1 | 2381 640 3.../ NTCLE100E3...T2 |
| Quantity | 500 | 1500 per reel, 2 reels per box | 1500 per reel, 2 reels per box |

Note
⁽¹⁾ Taped according IEC 60286-2

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 | $\Delta R/R < 3 \%$ ⁽¹⁾ |
| | 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. | $\Delta R/R \leq 1 \%$ ⁽²⁾ |
| | 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
⁽¹⁾ For $R_{25} \geq 100 \text{ k}\Omega$ the drift requirement is $\Delta R/R < 5 \%$
⁽²⁾ For R_{25} from 2.2 k Ω to 10 k Ω , requirement is $\pm 2 \%$ max.



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