

# NTC Thermistors, Radial Leaded, Standard Precision



## FEATURES

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


**RoHS**  
COMPLIANT

## APPLICATIONS

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

## DESCRIPTION

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

## PACKAGING

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

## DESIGN-IN SUPPORT

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

## MARKING

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

## MOUNTING

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

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

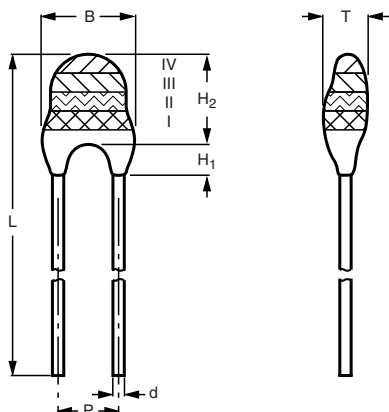
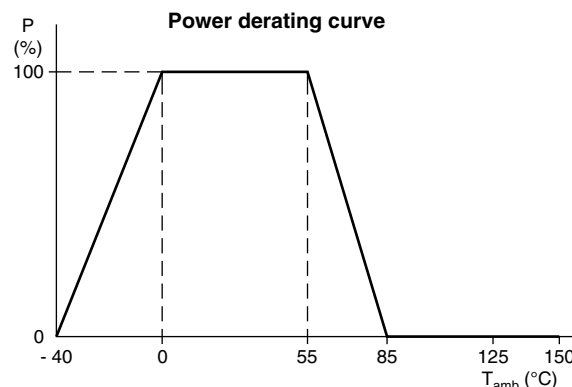
| ELECTRICAL DATA AND ORDERING INFORMATION |                           |       |                      |                                                             |                                                    |                           |        |       |
|------------------------------------------|---------------------------|-------|--------------------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

**ELECTRICAL DATA AND ORDERING INFORMATION**

| $R_{25}$<br>( $\Omega$ ) | $B_{25/85}$ -VALUE<br>(K) | VALUE<br>( $\pm$ %) | UL APPROVED<br>(Y/N) | SAP MATERIAL NUMBER<br>NTCLE100E3...B0/T1/T2 (2) | OLD 12NC CODE<br>2381 640 3/4/6.... (1) | COLOR CODE (3) |        |        |
|--------------------------|---------------------------|---------------------|----------------------|--------------------------------------------------|-----------------------------------------|----------------|--------|--------|
|                          |                           |                     |                      |                                                  |                                         | I              | II     | III    |
| 470                      | 3560                      | 1.5                 | Y                    | 471*B0                                           | *471                                    | Yellow         | Violet | Brown  |
| 680                      | 3560                      | 1.5                 | Y                    | 681*B0                                           | *681                                    | Blue           | Grey   | Brown  |
| 1000                     | 3528                      | 0.5                 | Y                    | 102*B0                                           | *102                                    | Brown          | Black  | Red    |
| 1500                     | 3528                      | 0.5                 | Y                    | 152*B0                                           | *152                                    | Brown          | Green  | Red    |
| 2000                     | 3528                      | 0.5                 | Y                    | 202*B0                                           | *202                                    | Red            | Black  | Red    |
| 2200                     | 3977                      | 0.75                | Y                    | 222*B0                                           | *222                                    | Red            | Red    | Red    |
| 2700                     | 3977                      | 0.75                | Y                    | 272*B0                                           | *272                                    | Red            | violet | Red    |
| 3300                     | 3977                      | 0.75                | Y                    | 332*B0                                           | *332                                    | Orange         | Orange | Red    |
| 4700                     | 3977                      | 0.75                | Y                    | 472*B0                                           | *472                                    | Yellow         | Violet | Red    |
| 5000                     | 3977                      | 0.75                | Y                    | 502*B0                                           | *502                                    | Green          | Black  | Red    |
| 6800                     | 3977                      | 0.75                | Y                    | 682*B0                                           | *682                                    | Blue           | Grey   | Red    |
| 10 000                   | 3977                      | 0.75                | Y                    | 103*B0                                           | *103                                    | Brown          | Black  | Orange |
| 12 000                   | 3740                      | 2                   | Y                    | 123*B0                                           | *123                                    | Brown          | Red    | Orange |
| 15 000                   | 3740                      | 2                   | Y                    | 153*B0                                           | *153                                    | Brown          | Green  | Orange |
| 22 000                   | 3740                      | 2                   | Y                    | 223*B0                                           | *223                                    | Red            | Red    | Orange |
| 33 000                   | 4090                      | 1.5                 | Y                    | 333*B0                                           | *333                                    | Orange         | Orange | Orange |
| 47 000                   | 4090                      | 1.5                 | Y                    | 473*B0                                           | *473                                    | Yellow         | Violet | Orange |
| 50 000                   | 4190                      | 1.5                 | Y                    | 503*B0                                           | *503                                    | Green          | Black  | Orange |
| 68 000                   | 4190                      | 1.5                 | Y                    | 683*B0                                           | *683                                    | Blue           | Grey   | Orange |
| 100 000                  | 4190                      | 1.5                 | Y                    | 104*B0                                           | *104                                    | Brown          | Black  | Yellow |
| 150 000                  | 4370                      | 2.5                 | Y                    | 154*B0                                           | *154                                    | Brown          | Green  | Yellow |
| 220 000                  | 4370                      | 2.5                 | Y                    | 224*B0                                           | *224                                    | Red            | Red    | Yellow |
| 330 000                  | 4570                      | 1.5                 | N                    | 334*B0                                           | *334                                    | Orange         | Orange | Yellow |
| 470 000                  | 4570                      | 1.5                 | N                    | 474*B0                                           | *474                                    | Yellow         | Violet | Yellow |

**Notes**

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

**DIMENSIONS** in millimeters

**DERATING AND TEMPERATURE TOLERANCES**

**Note**

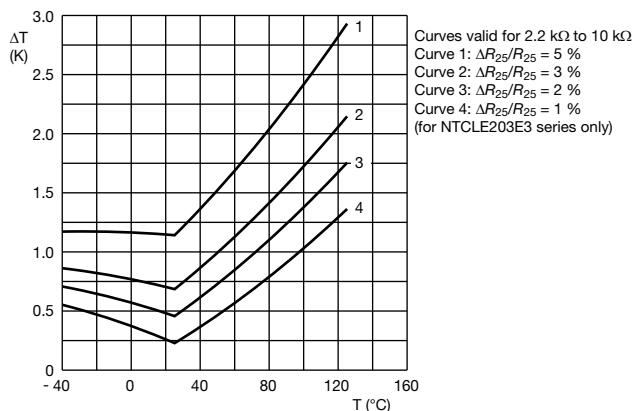
- Zero power is considered as measuring power max. 1 % of max. power.

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

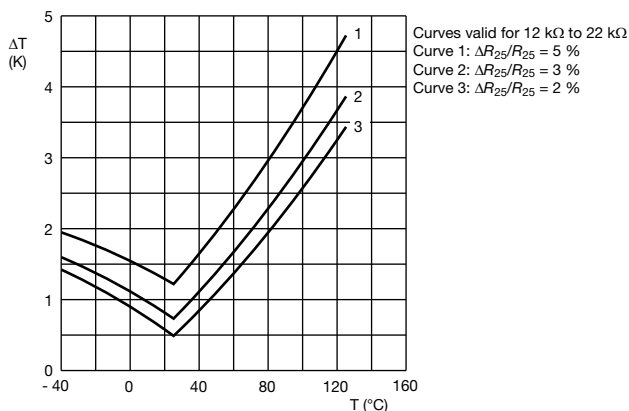
| $R_{25}$ -VALUE                | $B_{MAX.}$    | d              | $H_1$ |      | $H_2$ MAX. | L            | P    | $T_{MAX.}$ |
|--------------------------------|---------------|----------------|-------|------|------------|--------------|------|------------|
|                                |               |                | MIN.  | MAX. |            |              |      |            |
| 3.3 $\Omega$ 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        |



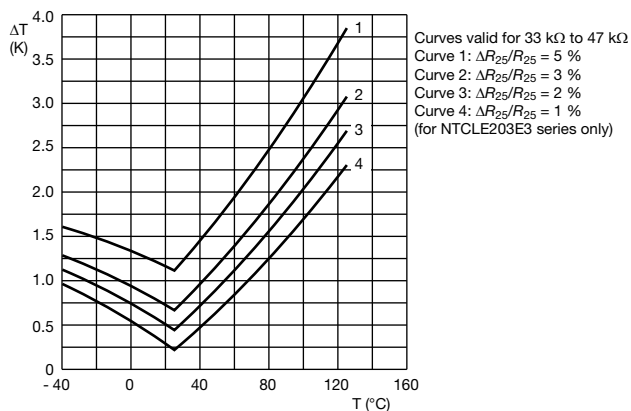
## TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



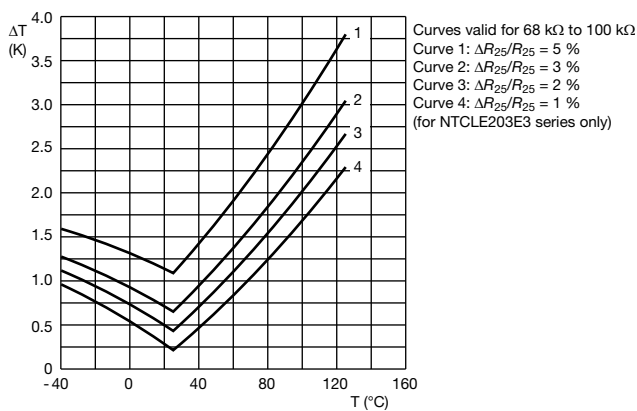
## TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



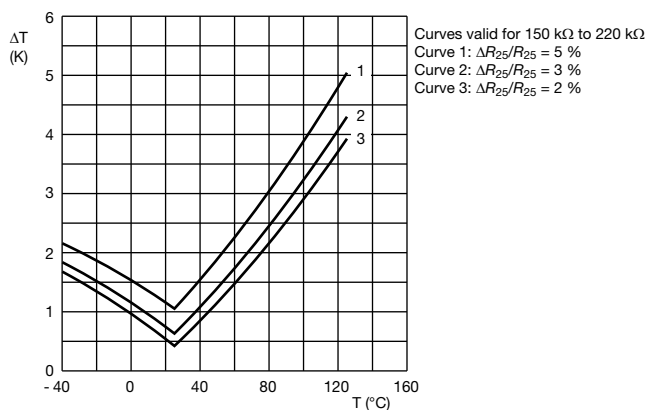
## TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



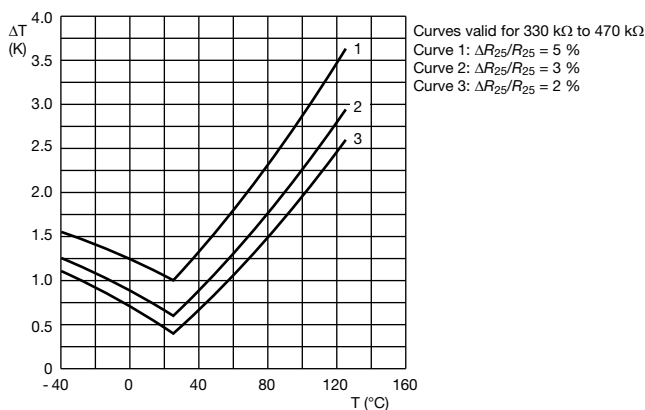
## TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



## TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



## TEMPERATURE DEVIATION AS A FUNCTION OF THE AMBIENT TEMPERATURE



## **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.

## **FORMULAE TO DETERMINE NOMINAL RESISTANCE VALUES**

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

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

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

where:

A, B, C, D, 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.

## **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,

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 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><br>(K) | NAME                                  | TOL. B<br>(%) | A         | B<br>(K) | C<br>(K <sup>2</sup> ) | D<br>(K <sup>3</sup> ) | A <sub>1</sub> | B <sub>1</sub><br>(K <sup>-1</sup> ) | C <sub>1</sub><br>(K <sup>-2</sup> ) | D <sub>1</sub><br>(K <sup>-3</sup> ) |
|--------|---------------------------|---------------------------------------|---------------|-----------|----------|------------------------|------------------------|----------------|--------------------------------------|--------------------------------------|--------------------------------------|
| 1      | 2880                      | Mat O. with<br>B <sub>n</sub> = 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<br>B <sub>n</sub> = 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<br>B <sub>n</sub> = 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<br>B <sub>n</sub> = 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<br>B <sub>n</sub> = 3390K | 3             | - 12.6814 | 4391.97  | - 232807               | 1.509643E+07           | 3.354016E-03   | 2.993410E-04                         | 2.135133E-06                         | - 5.672000E-09                       |
| 6      | 3528 <sup>(1)</sup>       | Mat I. with<br>B <sub>n</sub> = 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 <sup>(2)</sup>       |                                       |               | - 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<br>B <sub>n</sub> = 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<br>B <sub>n</sub> = 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<br>B <sub>n</sub> = 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<br>B <sub>n</sub> = 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<br>B <sub>n</sub> = 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<br>B <sub>n</sub> = 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<br>B <sub>n</sub> = 4570K | 1.5           | - 17.6439 | 6022.726 | - 203157               | - 7.183526E+06         | 3.354016E-03   | 2.264097E-04                         | 3.278184E-06                         | 1.097628E-07                         |

### **Notes**

<sup>(1)</sup> Temperature < 25 °C

<sup>(2)</sup> Temperature ≥ 25 °C



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) $\Omega$ |                                 |                                 |                                 |              |                                       |
|------------------------------------------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|--------------|---------------------------------------|
| $T_{OPER}$<br>(°C)                                                                       | PART NUMBER<br>NTCLE100E3338*** | PART NUMBER<br>NTCLE100E3478*** | PART NUMBER<br>NTCLE100E3688*** | TCR<br>(%/K) | $\Delta R/R$ DUE TO $B_{tol.}$<br>(%) |
|                                                                                          | $R_T$<br>( $\Omega$ )           | $R_T$<br>( $\Omega$ )           | $R_T$<br>( $\Omega$ )           |              |                                       |
| -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) $\Omega$ |                                 |              |                                       |                                 |              |                                       |                                 |              |                                       |
|---------------------------------------------------------------------------------------|---------------------------------|--------------|---------------------------------------|---------------------------------|--------------|---------------------------------------|---------------------------------|--------------|---------------------------------------|
| $T_{OPER}$<br>(°C)                                                                    | PART NUMBER<br>NTCLE100E3109*** |              |                                       | PART NUMBER<br>NTCLE100E3159*** |              |                                       | PART NUMBER<br>NTCLE100E3229*** |              |                                       |
|                                                                                       | $R_T$<br>( $\Omega$ )           | TCR<br>(%/K) | $\Delta R/R$ DUE TO $B_{tol.}$<br>(%) | $R_T$<br>( $\Omega$ )           | TCR<br>(%/K) | $\Delta R/R$ DUE TO $B_{tol.}$<br>(%) | $R_T$<br>( $\Omega$ )           | TCR<br>(%/K) | $\Delta R/R$ DUE TO $B_{tol.}$<br>(%) |
| -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) $\Omega$ |                                 |                                 |                                 |              |                                       |
|---------------------------------------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|--------------|---------------------------------------|
| $T_{OPER}$<br>(°C)                                                                    | PART NUMBER<br>NTCLE100E3339*** | PART NUMBER<br>NTCLE100E3479*** | PART NUMBER<br>NTCLE100E3689*** | TCR<br>(%/K) | $\Delta R/R$ DUE TO $B_{tol.}$<br>(%) |
|                                                                                       | $R_T$<br>( $\Omega$ )           | $R_T$<br>( $\Omega$ )           | $R_T$<br>( $\Omega$ )           |              |                                       |
| - 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 <sub>OPER</sub><br>(°C)                                                                               | PART NUMBER<br>NTCLE100E3101*** | PART NUMBER<br>NTCLE100E3151*** | PART NUMBER<br>NTCLE100E3221*** | PART NUMBER<br>NTCLE100E3331*** | PART NUMBER<br>NTCLE100E3471*** | PART NUMBER<br>NTCLE100E3681*** | TCR<br>(%/K) | $\Delta R/R$<br>DUE<br>TO<br>B <sub>tol.</sub><br>(%) |
|                                                                                                         | $R_T$<br>( $\Omega$ )           | $R_T$<br>( $\Omega$ )           | $R_T$<br>( $\Omega$ )           | $R_T$<br>( $\Omega$ )           | $R_T$<br>( $\Omega$ )           | $R_T$<br>( $\Omega$ )           |              |                                                       |
| -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 $\Omega$ |                                 |                                 |                                 |              |                                       |
|----------------------------------------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|--------------|---------------------------------------|
| $T_{OPER}$<br>(°C)                                                                     | PART NUMBER<br>NTCLE100E3102*** | PART NUMBER<br>NTCLE100E3152*** | PART NUMBER<br>NTCLE100E3202*** | TCR<br>(%/K) | $\Delta R/R$ DUE TO $B_{tol.}$<br>(%) |
|                                                                                        | $R_T$<br>( $\Omega$ )           | $R_T$<br>( $\Omega$ )           | $R_T$<br>( $\Omega$ )           |              |                                       |
| - 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                                  |



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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, 10) k $\Omega$ |                                                          |                                                          |                                                          |                                                          |                                                          |                                                          |                                                          |                                                |
|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|------------------------------------------------|
| $T_{OPER}$<br>(°C)                                                                                            | PART NUMBER<br>NTCLE100E3222***<br>$R_T$<br>( $\Omega$ ) | PART NUMBER<br>NTCLE100E3272***<br>$R_T$<br>( $\Omega$ ) | PART NUMBER<br>NTCLE100E3332***<br>$R_T$<br>( $\Omega$ ) | PART NUMBER<br>NTCLE100E3472***<br>$R_T$<br>( $\Omega$ ) | PART NUMBER<br>NTCLE100E3502***<br>$R_T$<br>( $\Omega$ ) | PART NUMBER<br>NTCLE100E3682***<br>$R_T$<br>( $\Omega$ ) | PART NUMBER<br>NTCLE100E3103***<br>$R_T$<br>( $\Omega$ ) | $\Delta R/R$<br>DUE<br>TO<br>$B_{tol.}$<br>(%) |
| -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, 22) k $\Omega$ |                                 |                                 |                                 |              |                                       |
|-----------------------------------------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|--------------|---------------------------------------|
| $T_{OPER}$<br>(°C)                                                                      | PART NUMBER<br>NTCLE100E3123*** | PART NUMBER<br>NTCLE100E3153*** | PART NUMBER<br>NTCLE100E3223*** | TCR<br>(%/K) | $\Delta R/R$ DUE TO $B_{tol.}$<br>(%) |
|                                                                                         | $R_T$<br>(k $\Omega$ )          | $R_T$<br>(k $\Omega$ )          | $R_T$<br>(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                                  |



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| RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH $R_{25}$ AT (33, 47, 50, 68, 100) k $\Omega$ |                           |                        |              |                                          |                        |                        |                        |              |                                          |
|--------------------------------------------------------------------------------------------------|---------------------------|------------------------|--------------|------------------------------------------|------------------------|------------------------|------------------------|--------------|------------------------------------------|
| $T_{OPER}$<br>(°C)                                                                               | PART NUMBER<br>NTCLE100E3 |                        |              |                                          |                        |                        |                        |              |                                          |
|                                                                                                  | 333***                    | 473***                 | TCR<br>(%/K) | $\Delta R/R$ DUE<br>TO $B_{tol.}$<br>(%) | 503***                 | 683***                 | 104***                 | TCR<br>(%/K) | $\Delta R/R$ DUE<br>TO $B_{tol.}$<br>(%) |
|                                                                                                  | $R_T$<br>(k $\Omega$ )    | $R_T$<br>(k $\Omega$ ) |              |                                          | $R_T$<br>(k $\Omega$ ) | $R_T$<br>(k $\Omega$ ) | $R_T$<br>(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                                     |



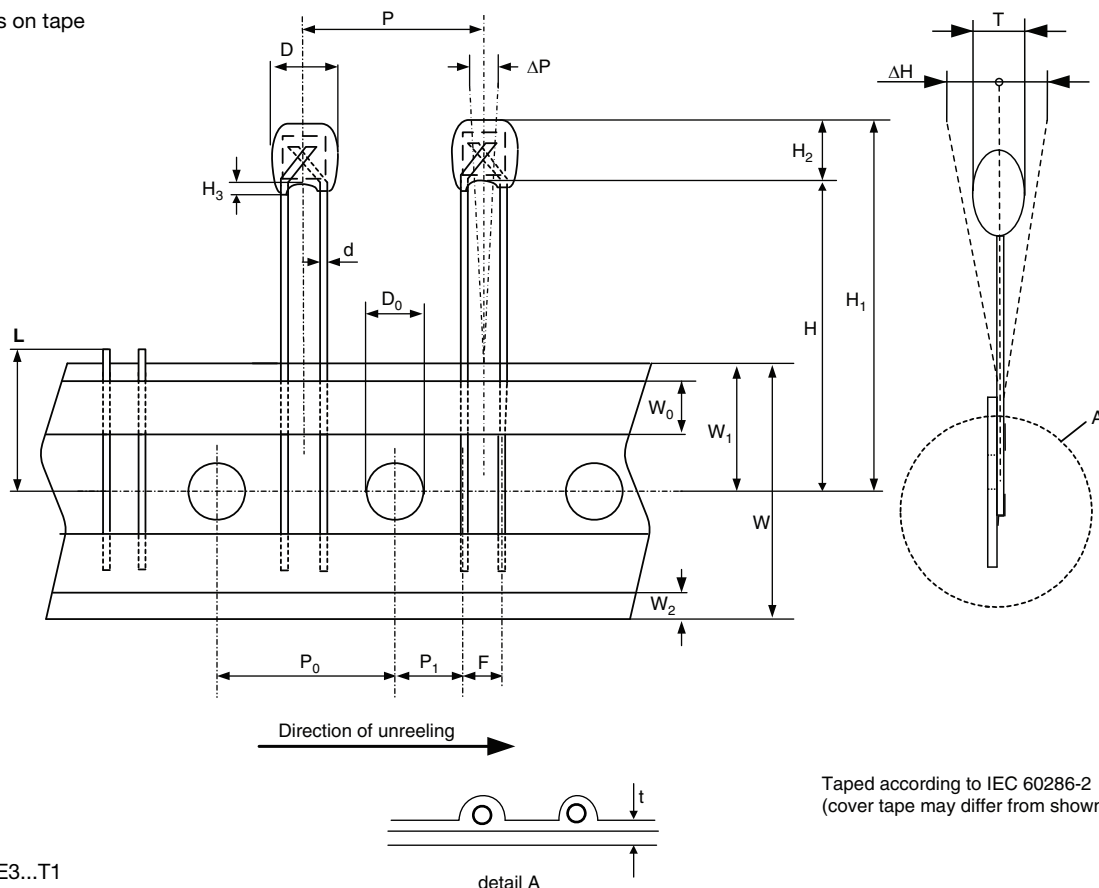
For complete Curve Computation, visit: [www.vishay.com/resistors-non-linear/curve-computation-list/](http://www.vishay.com/resistors-non-linear/curve-computation-list/)

| RESISTANCE VALUES AT INTERMEDIATE TEMPERATURES WITH $R_{25}$ AT (150, 220, 330, 470) k $\Omega$ |                           |                        |              |                                          |                        |                        |              |                                          |
|-------------------------------------------------------------------------------------------------|---------------------------|------------------------|--------------|------------------------------------------|------------------------|------------------------|--------------|------------------------------------------|
| $T_{OPER}$<br>(°C)                                                                              | PART NUMBER<br>NTCLE100E3 |                        |              |                                          |                        |                        |              |                                          |
|                                                                                                 | 154***                    | 224***                 | TCR<br>(%/K) | $\Delta R/R$ DUE<br>TO $B_{tol.}$<br>(%) | 334***                 | 474***                 | TCR<br>(%/K) | $\Delta R/R$ DUE<br>TO $B_{tol.}$<br>(%) |
|                                                                                                 | $R_T$<br>(k $\Omega$ )    | $R_T$<br>(k $\Omega$ ) |              |                                          | $R_T$<br>(k $\Omega$ ) | $R_T$<br>(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

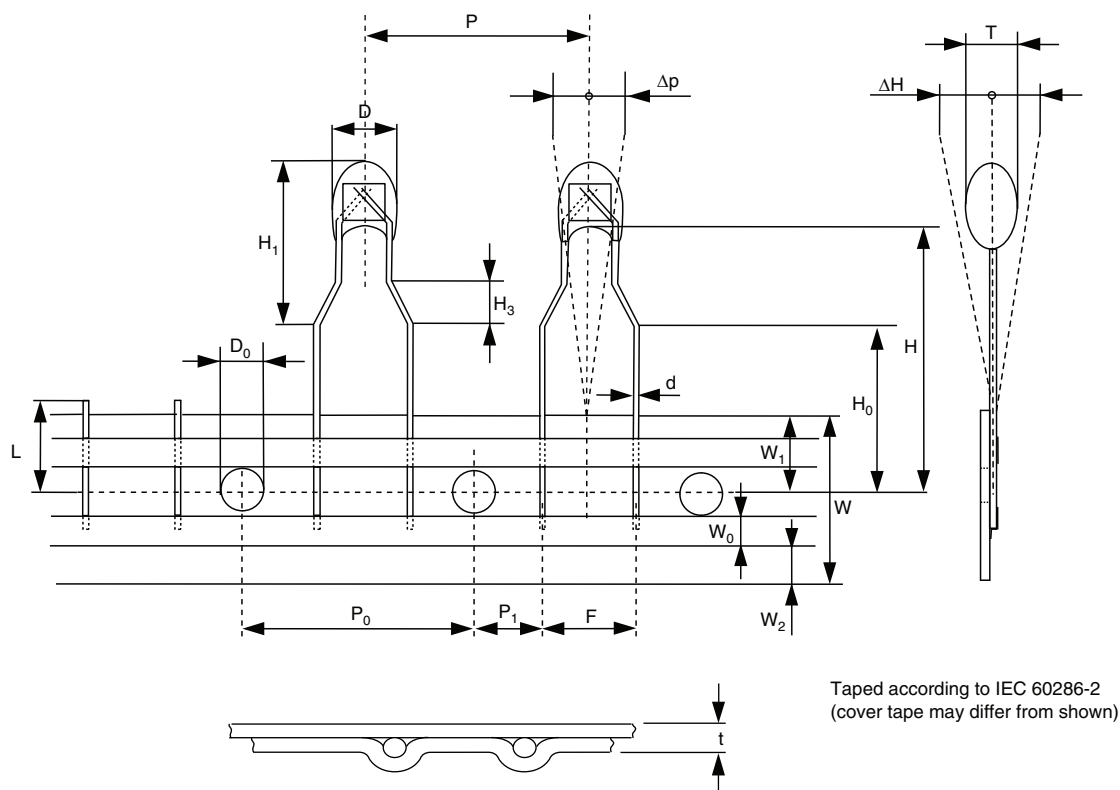


Taped according to IEC 60286-2  
(cover tape may differ from shown)

**1E pitch**  
NTCLE100E3...T1

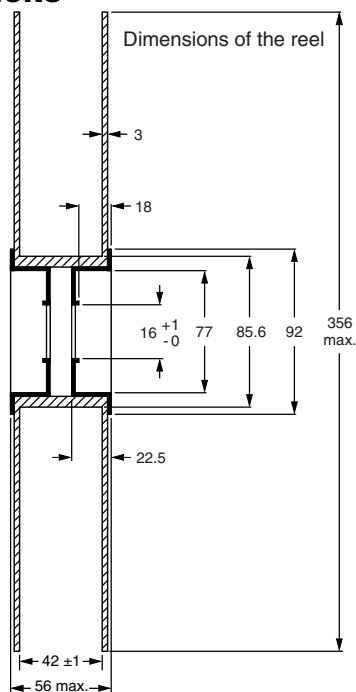
| DIMENSIONS in millimeters                |                |                    |                    |                                                                                             |
|------------------------------------------|----------------|--------------------|--------------------|---------------------------------------------------------------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

## Thermistors on tape


**2E pitch**

NTCLE100E3...T2

| <b>DIMENSIONS</b> in millimeters                                                                                                                              |                                                               |                                    |                                           |                                                                                      |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|------------------------------------|-------------------------------------------|--------------------------------------------------------------------------------------|
| DETAILS                                                                                                                                                       | SYMBOL                                                        | DIMENSIONS NOMINAL                 | TOLERANCE                                 | REMARKS                                                                              |
| Body diameter<br>Lead diameter<br>Feed hole diameter                                                                                                          | D<br>d<br>D <sub>0</sub>                                      | 3.3<br>0.6<br>4.0                  | ± 0.5<br>± 0.06<br>± 0.2                  | 5 max. for 3.3 Ω to 220 Ω                                                            |
| Lead to lead distance                                                                                                                                         | F                                                             | 5.0                                | + 0.6<br>- 0.1                            | Guaranteed between component and tape                                                |
| Distance component to tape centre<br>Component height<br>Component alignment<br>Distance top/bottom of components<br>Length of lacquer under the comp. bottom | H<br>H <sub>0</sub><br>H <sub>1</sub><br>Δh<br>H <sub>3</sub> | 20.0<br>16.0<br>10.0<br>0.0<br>0.0 | ± 2.0<br>± 0.5<br>max.<br>± 2.0           | 12 max. for 100 Ω to 220 Ω<br>Not defined                                            |
| Length of snapped lead                                                                                                                                        | L                                                             | 11.0                               | max.                                      |                                                                                      |
| Pitch between thermistors<br>Feed hole pitch<br>Feed hole center to lead center<br>Component alignment                                                        | P<br>P <sub>0</sub><br>P <sub>1</sub><br>Δp                   | 12.7<br>12.7<br>3.81<br>0.0        | ± 1.0<br>± 0.3<br>± 0.7<br>± 1.3          | Cumulative pitch error<br>± 1 mm/20 pitches<br>guaranteed between component and tape |
| Total thickness<br>Total tape thickness                                                                                                                       | T<br>t                                                        | 3.0<br>0.9                         | max.<br>max.                              | 4 max. for 3.3 Ω to 220 Ω with cardboard tape 0.5 ± 0.1                              |
| Tape width<br>Hold down tape width<br>Hole position<br>Hold down tape position                                                                                | W<br>W <sub>0</sub><br>W <sub>1</sub><br>W <sub>2</sub>       | 18.0<br>5.0<br>9.0<br>1.5          | ± 1.0<br>- 0.5<br>± 0.3<br>± 0.5<br>± 1.0 | None of the hold down tapes may cover the holes                                      |

**REEL SPECIFICATIONS**

**CODE NUMBERS AND RELEVANT**

| PARAMETER                                | Quantity         |                                   |
|------------------------------------------|------------------|-----------------------------------|
| BULK                                     | NTCLE100E3....B0 | 500                               |
| TAPE AND REEL<br>1E PITCH <sup>(1)</sup> | NTCLE100E3....T1 | 1500 per reel,<br>2 reels per box |
| TAPE AND REEL<br>2E PITCH <sup>(1)</sup> | NTCLE100E3....T2 | 1500 per reel,<br>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<br>CLAUSE | IEC 60068-2<br>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:<br>Tensile strength<br>Bending | Loading force 10 N<br>Loading force 5 N                                                                                             | $\Delta R/R \leq 1 \%$                   |
|  | 58        | Soldering:<br>Solderability<br>Resistance to heat   | 240 °C max.; duration 4 s max.<br>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<br>(isopropanol)              | Ambient temp for 5 minutes;<br>5 N with hydrophylic cotton wool                                                                     | No traces of lacquer<br>on cotton wool   |
|  | 6         | Vibration                                           | 1.5 mm peak to peak: 10 Hz to 58 Hz<br>10 gp: 50 Hz to 500 Hz 1 octave/min. 2 h in<br>each direction in three orthogonal directions | No visible damage<br>$\Delta R/R < 1 \%$ |
|  | 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.



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