R_T value and tolerance

These thermistors have a narrow tolerance on the B-value, the result of which provides a very small tolerance on the nominal resistance value over a wide temperature range. For this reason the usual graphs of R = f(T) are replaced by Tables 4 through 16, together with a formula to calculate the characteristics with a high precision.

Formulae to determine nominal resistance values(1)

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

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

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

where:

A, B, C, D, A_1, B_1, C_1 and D_1 are constant values depending on the material concerned; see Table 3.

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

T is the temperature in K.

(1) Formulae numbered (1) and (2) 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_{25}-tolerance' and the 'resistance deviation due to B-tolerance'.

When:

X = R_{25}-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:

TC = temperature coefficient

ΔT = temperature deviation,

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

The temperature tolerances are plotted in Figs 3, 4, 5, 6, 7 and 8.

Example: at 0 °C, assume X = 5%, Y = 0.89% and TC = 5.08%/K (see Table 11), then:

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

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

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

A NTC with a R_{25}-value of 10 kΩ has a value of 32.56 kΩ between –1.17 and +1.17 °C.