The NTC Thermistors

This is a Negative Temperature Coefficient Resistor whose resistance changes as ambient temperature changes. Thermistor comprises 2 or 4 kinds of metal oxides of iron, nickel, cobalt, manganese and copper, being shaped and sintered at high temperature (1200 to 1500 °C)

■ Features

- Temperature Coefficient of Resistance is negative and extremely large
- Various kinds of types especially smaller ones are available.
- Resistance values are available from 22 Ω to 470 kΩ

■ Physical Characteristics of NTC Thermistors

Thermistor is a resistor sensitive to temperature utilizing the large temperature-coefficient of metal oxide semiconductor. And its temperature dependency of resistance value is indicated by the following equation:

$$R=R_0 \exp\left[B\left(\frac{1}{T}-\frac{1}{T_0}\right)\right] \quad \cdots\cdots(1)$$

T_0: Standard Temperature 298.15 K(25 °C)
R_0: Resistance at T_0 K
B: Thermistor Constant (K)

So called Temperature Coefficient (α) is generally indicated as follows:

$$\alpha = -\frac{B}{T^2} \quad \cdots\cdots(2)$$

But α is not adequate for use as a constant, because a change by temperature is considerably large, so B Value is used as a coefficient of thermistor.

■ Major Characteristics of NTC Thermistors

The relation between resistance and temperature of a thermistor is linear as shown in Fig. 2, in which resistance is shown in vertical direction in a logarithmic scale and reciprocal of absolute temperature in horizontal direction. Bias degrees in these straight lines are determined according to the B Value expressed by the following equation.

$$B = \frac{\ell nR_1 - \ell nR_2}{\frac{1}{T_1}-\frac{1}{T_2}} \quad \cdots\cdots(3)$$

R_1: Resistance at T_1 K
R_2: Resistance at T_2 K

When calculated from this equation, B Value is a variable in a strict sense, and the resistance is expressed by the following equation:

$R = AT^{-C} \exp D/T \cdots\cdots(4)$

In (4), C is a small positive or negative constant and quite negligible except use in precision temperature-measuring device, thereby the B Value is, in practical usage, to be considered as a constant. In Fig. 1,
the relation between the resistance ratio R_T/R_{25}
(R_{25}: Resistance at 25 °C, R_T: Resistance at T °C) and B Value is shown with T °C, in the horizontal direction.

■ Recommended Applications

- For temperature measurement or temperature detection : thermometer, temperature controller
- For temperature compensation : transistor circuit, measuring instruments

Fig. 1

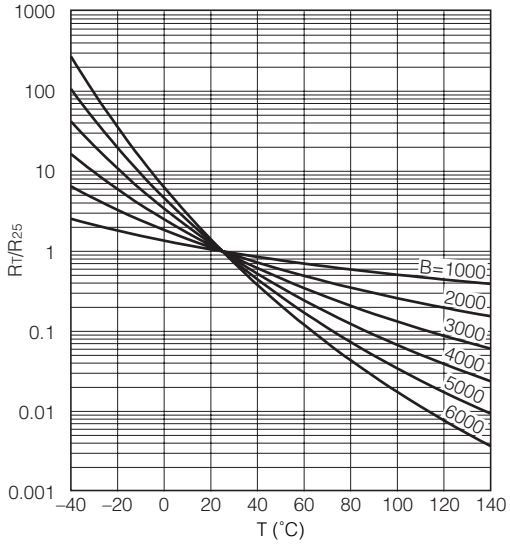

Fig. 2