The NTC Thermistors

NTC Thermistors is a negative temperature coefficient resistor that significantly reduces its resistance value as the heat/ ambient temperaturerises. Thermistors is sintered in high-temperature (1200 °C to 1500 °C), and manufactured in various shapes. It's comprised of 2 to 4 kinds of metal oxides: iron, nickel, cobalt, manganese and copper.

Features

- Temperature Coefficient of Resistance is negative, and it's extremely large (−2.8 to −5.1 [%/°C]).
- Various shapes, especially compact size components are available.
- Selection of resistance vale is comparatively free, it's available from several 10 Ω to 100 kΩ.

Recommended Applications

- For temperature measurement or temperature detection : Thermometer, temperature controller
- For temperature compensation : Transistor, transistor circuit, quarts oscillation circuit, and measuring instruments

Physical Characteristics of NTC Thermistors

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

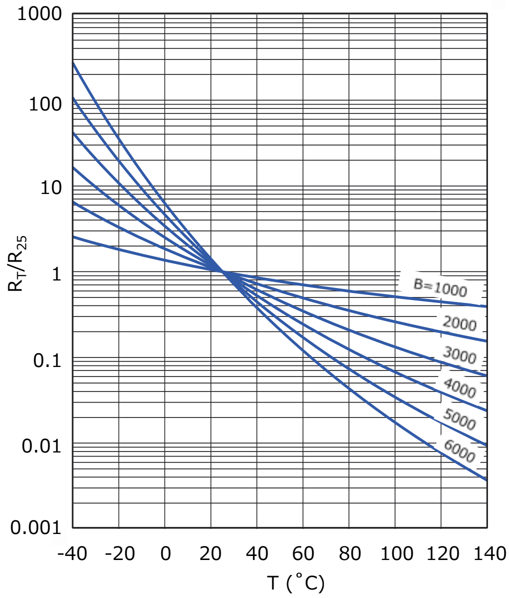
$$R=R_0 \exp\left[B\left(\frac{1}{T}-\frac{1}{T_0}\right)\right] \quad \text{------------} \quad (1)$$

T_0 : Standard Temperature 298.15 K (25 ℃)
R_0 : Resistance at T_0 [K] , B : Thermistor Constant [K]
Temperature coefficient (α) in general meaning is indicated as follows :

$$\alpha \quad - \frac{B}{T_2} \quad \text{------------} \quad (2)$$

Since the change by temperature is considerably large, α is not appropriate as a constant. Therefore, B value (constant) is generally used as a coefficient of thermistors.

Fig. 1



Major Characteristics of NTC Thermistors

The relation between resistance and temperature of a thermistor is linear as shown in Fig. 2. The resistance value is shown in vertical direction in a logarithmic scale and reciprocal of absolute temperature (adding 273.15 to centigrade) is shown in horizontal direction. The B value (constant) determines the gradient of these straight lines. The B value (constant) is calculated by using following equation

$$B=\frac{\ln R_1-\ln R_2}{\frac{1}{T_1}-\frac{1}{T_2}} \quad \text{------------} \quad (3)$$

R_1 : Resistance at T_1 K , R_2 : Resistance at T_2 K
When you calculate this equation, you'll find that B value is not exactly constant. The resistance is expressed by the following

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

In (4), C is a small positive or negative constant and quite negligible except for use in precision temperature-measuring device, therefore, the B value can be considered as constant number.
In Fig. 1, the relation between the resistance ratio R_T/R_{25} (R_{25} : Resistance at 25 °C, RT : Resistance at T °C), and B Value is

Fig. 2