Basic and limit values of platinum temperature sensors

Platinum temperature sensors function on the basis of the change in electrical resistance of Pt vs. temperature. The relationship can be described by the following characteristic polynomial:

For a temperature range between –200°C to 0°C:

$$R_t = R_0 [1 + at + bt^2 + c\,(t-100°C)\,t^3]$$

For a temperature range between 0°C to 850°C:

$$R_t = R_0 (1 + at + bt^2)$$

b is so small such for most applications it can be assumed that R_t and temperature are linearly dependent.

The polynomial constants are specified in the international standards for platinum temperature sensors (IEC 60751 / DIN EN 60751), as follows:

$$a = 3.9083 \times 10^{-3}°C^{-1}$$

$$b = -5.775 \times 10^{-7}°C^{-2}$$

$$c = -4.183 \times 10^{-12}°C^{-4}$$

The temperature coefficient (TCR or α) of platinum temperature sensors is positive, and defined as:

$$\alpha = \frac{(R_{100} - R_0)}{(100 - R_0)}$$

Where R_{100} is the resistance at 100°C and R_0 the resistance at 0°C.

This value is the slope of the linear approximation of the characteristic polynomial between 0°C and 100°C. The standard DIN EN 60751 for platinum temperature sensors specifies a TCR of 0.00385055°C^{-}. In addition to this standardized temperature coefficient, other customer-specific sensors with temperature coefficients of 0.003750/°C as well as other intermediate values are on request available.

Depending on the materials and processes used to manufacture the platinum temperature sensors, slight specific deviations from the ideal constants and the optimal characteristic curve can occur. These deviations determine the working temperature range and the accuracy classes for each type of platinum temperature sensor. Within these limits, platinum temperature sensors are completely interchangeable.

The platinum resistance thermometers are divided into two classes according to their limit deviations:

Class	Limit deviation in °C
F0,15 (A)	0.15 + 0.002 t [1)]
F0,30 (B)	0.3 + 0.005 t
[1)] t is the absolute value of temperature in °C	

Heraeus Nexensos GmbH supplies platinum temperature sensors in accordance to DIN EN 60751 in accuracy classes F0,15 (A), F0,30 (B) or F0,10 (1/3B).

Proportionally limited tolerances are based upon: $\Delta t = \pm 1 / a (0.3°C + 0.005 t)$

´a´ is equal to 1 for class F0,30 (B), 2 for class F0,15 (A) and 3 for class F0,10 (1/3B), t = absolute temperature value in °C

For measuring resistors whose nominal resistance is a value equal to n x 100 Ω, the basic values and resistance tolerances must be multiplied by n.

All restricted tolerance classes are measured at 0°C and 100°C.