**Technical Reference**
TR_RTD_Basics_2102_EN

# RTDs

## Basic Information

## Overview

The measurement principle of an RTD (Resistance Temperature Detector) consists of the sensor element with an electrical resistance that varies with temperature. In the case of the Pt100 sensor, it has a resistance of 100 Ω at 0ºC, increasing this value with increasing temperature, due to the characteristic of the platinum coefficient used in this type of sensor. Extremely linear, it makes temperature probes based on this measurement principle the most used in the industry, by complying with IEC 60751 with a coefficient α = 3.85 * 10-3 ºC-1, calculated between 0 and 100ºC.
The sensor element is available in two versions, Thin-film (TF) or ceramic (Wire Wound), the second with a wider measurement range, greater long-term stability and better accuracy.
If there are vibrations, the Thin-film (TF) sensor can offer advantages, but its behavior depends on the intensity, direction and frequency of the main harmonic of the vibration. This type of sensor also presents a faster response time when assembled in a similar way to the ceramic sensor.
The most used configurations are for single elements with 2, 3 and 4 wires and with redundancy, double elements with 4 and 6 wires. The 4-wire configuration guarantees the best accuracy, due to impedance full compensation introduced by the signal transmission cables, or even by the connections within an extended length immersion sheath, which in the case of the configuration single to two wires or double to 4 wires adds to the resistive value of the Pt100, contributing to the loss of accuracy. In single 3-wire or double 6-wire configurations, the associated error is practically null.

For the range of -200ºC to 0ºC we have:
$R_t = R_0[1 + At + Bt^2 + C(t - 100°C)\, t^3]$

For the range of 0ºC to 850ºC we have:
$R_t = R_0(1 + At + Bt^2)$

where:
$R_t$ is the resistance to a temperature $t$; $R_0$ is resistance with $t$ = 0ºC

The constants in these equations are:
$A = 3.9083 \cdot 10^{-3}$ ºC$^{-1}$ $B = -5.775 \cdot 10^{-7}$ ºC$^{-2}$ $C = -4.183 \cdot 10^{-12}$ ºC$^{-4}$

The validity temperature ranges of the tolerance classes are classified in the following table.
These tolerances apply to thermometers of any value of $R_0$.

## Tolerance Classes

| Tolerance Class | Validity Temperature Range [°C] | | Tolerance Values 1) [°C] |
|---|---|---|---|
| | Ceramic Sensors (Wire Wound) | TF (Thin-Film) | |
| AA | -50 to +250 | 0 to +150 | ±(0.1 + 0.0017 \|t\|) |
| A | -100 to +450 | -30 to +300 | ±(0.15 + 0.002 \|t\|) |
| B | -196 to +600 | -50 to +500 | ±(0.3 + 0.005 \|t\|) |
| C | -196 to +600 | -50 to +600 | ±(0.6 + 0.01 \|t\|) |

1) |t| Temperature modulus in ºC.

## Contact


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