Sensor Matching Function

YOKOGAWA
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Field-Mount Temperature Transmitter | YTA610 and YTA710

Yokogawa's Field-Mount Temperature Transmitter uses a standard to link resistance and temperature for RTD sensors. However, due to manufacturing, each sensor has its own unique version, causing some measurement inaccuracies. One of two methods can teach the transmitter, by matching Standard and Real RTD Curve readings, achieve accurate measurements.

Yokogawa's YTA610/YTA710 uses the IEC60751 standard to define the relationship between resistance and temperature for an RTD sensor. This relationship is referred to as the Standard Curve. RTD sensor manufacturers also use the same IEC60751 standard, however, due to the manufacturing process of the sensor, each sensor has a unique temperature/resistance relationship. This is referred to as the Real RTD Curve. Although the Real RTD Curve is within the tolerance level of the IEC60751 standard, there is a difference between the Standard Curve and the Real RTD Curve. This difference is a source of inaccuracy in temperature measurement.

YTA Series

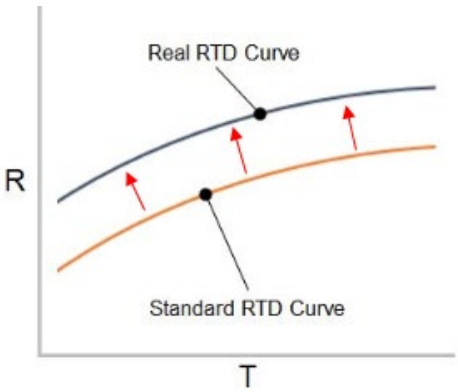

***Figure 1**. Matching the RTD Curves*

Readings

Matching the two curves can significantly improve temperature measurement accuracy. Matching the curves involves teaching the temperature transmitter the Real RTD Curve. Yokogawa can use either of two methods to teach the transmitter: the Callender-Van Dusen equation and the IEC standard curve equation. Both equations are equivalent, and the YTA610/YTA710 with the /CM1 option can use either method.

Applicable Models

YTA610 or YTA710 with option code /CM1

A Pt100, Pt200, Pt500 or Pt1000 RTD Temperature sensor with known constants

Callendar-Van Dusen Equation

The Callendar-Van Dusen equation describes the relationship between the resistance (R) and temperature (t) of Pt100 RTDs. This equation is programmed into every YTA610 and YTA710 with the /CM1 option. Callendar-Van Dusen constants (R0, α, δ, β) supplied with the sensor define the Real RTD Curve. The values can be programmed into the YTA610 or YTA710 transmitter (at the factory or in the field). Entry of these values teaches the transmitter the Real RTD Curve.

$$Rt = R_o\,[1+\alpha(1+0.01\delta)t-\alpha\delta/10^4t^2 -\alpha\beta/10^8(t-100)t^3]$$

Where:

Rt = Resistance (Ω) at Temperature t (^oC)
R_o = Sensor-specific constant
(Resistance at t = 0^oC)
α(alpha) = Sensor-specific constant
δ (delta) = Sensor-specific constant
β(beta) = Sensor-specific constant

IEC Standard

The IEC standard equation works the same way as the Callendar-Van Dusen method. This equation is programmed into every YTA610 and YTA710 with the /CM1 option. IEC constants (R0, A, B, C) supplied with the sensor define the Real RTD Curve. The values can be programmed into the YTA610 or YTA710 transmitter (at the factory or in the field). Entry of these values teaches the transmitter the Real RTD curve.

$$Rt = R_o\,[1 + At-Bt^2 + C\,(t-100)t^3]$$

Where:

Rt = Resistance (Ω) at Temperature t (^oC)
R_o = Sensor-specific constant
(Resistance at t = 0^oC)
A = Sensor-specific constant
B= Sensor-specific constant
C = Sensor-specific constant

Note

Temperature sensor manufacturers do not include these constants with their sensors. Usually, they have a special code in their product's model code to indicate the need to supply them. Suppliers may refer to these sensors as "Calibrated" sensors. Check with your sensor supplier to ensure this information is included with the sensor.

Example

The chart shows the accuracy advantages that can be gained by a YTA710 with the CM1 option with a calibrated Pt100 sensor versus a YTA710 without the CM1 option with a standard Pt100 sensor. The calibrated span is 0 to 100ºC.

		Standard Pt100 RTD Accuracy	Calibrated Pt100 RTD Accuracy	Total System Accuracy
Without /CM1 Option	±0.12ºC	±0.20ºC		±0.32ºC
With/CM1 Option	±0.12ºC		±0.01ºC	±0.13ºC

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