Thermistor characteristics

Objectives:

1. To know what is a **Thermistor.**
2. To know how to convert the Thermistor resistance reading to temperature.
3. To understand the characteristics of the Thermistor.

Introduction:

Thermistors, like RTDs, are thermally sensitive semiconductors whose resistance varies with temperature. Thermistors are manufactured from metal oxide semiconductor material encapsulated in a glass or epoxy bead. Also, thermistors typically have much higher nominal resistance values than RTDs (anywhere from 2,000 to 10,000 Ω) and can be used for lower currents.

Each sensor has a designated nominal resistance that varies proportionally with temperature according to a linearized approximation. Thermistors have either a negative temperature coefficient (NTC) or a positive temperature coefficient (PTC). The first, more common, has a resistance that decreases with increasing temperature while the latter exhibits increased resistance with increasing temperature.

Thermistors typically have a very high sensitivity (~200 Ω/°C), making them extremely responsive to changes in temperature. Though they exhibit a fast response rate, thermistors are limited for use up to the 300 °C temperature range. This, along with their high nominal resistance, helps to provide precise measurements in lower-temperature applications. In TMT001 we use an NTC thermistor which has a temperature range from 13-85 ^{o}C.

Theory:

In order to measure temperature with the thermistor, you only need to measure the resistance of the thermistor, and then substitute the resistance value in the following equation

$$T = \frac{1}{a + b(lnR) + c(lnR)^3}$$

Where :

T : Calculated temperature in (K)
R: Measured resistance in (Ω)
a, b and c are Steinhart-Hart Constants that have the following values
$a = 1.2407635*10^{-3}$
$b = 2.3612017*10^{-4}$
$c = 8.97975*10^{-8}$

From the above equation you will get the temperature in Kelvin. The value of a, b and c differs from one type of to another.

Experiment Procedure:

1. Refer to running procedure in Thermocouple Experiment.
2. Choose Experiment 3: "**Thermistor Characteristics**".

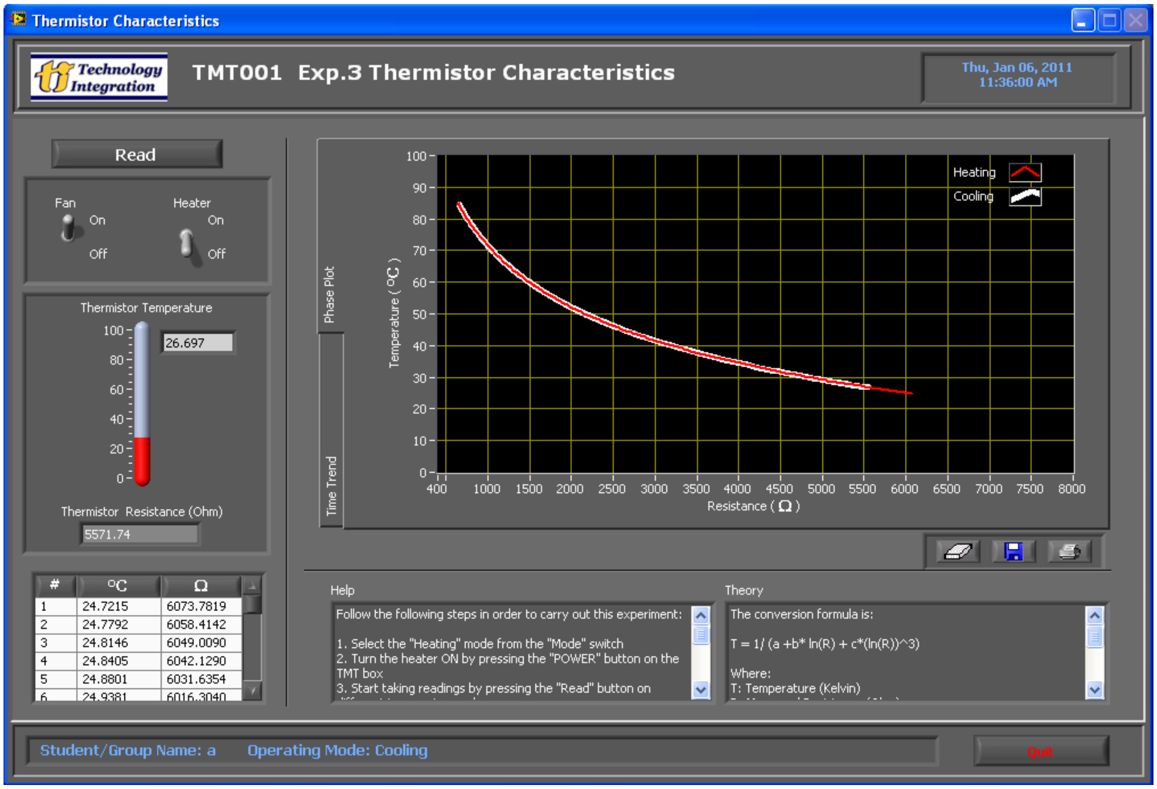

Figure (1): Thermistor Characteristics Experiment

3. Study the front panel carefully and observe the buttons on the screen.

4. Turn the **Heater** ON by pressing ON the **Heater Switch** on the screen (Heating Mode).

5. Start taking readings by pressing **[Read]** button over different temperature values.

6. The acquired readings appear on the Temperature-Resistance graph as **red** points.

7. Compare the read temperature with the temperature of the **glass thermometer**. Is it the same temperature? Why?
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8. Turn the **Heater** OFF by pressing OFF the **Heater Switch** on the screen.

9. Turn the **Fan** ON by pressing ON the **Fan Switch** on the screen (Cooling Mode).

10. Start taking readings by pressing **[Read]** button on different temperature values.

11. The acquired reading appears on the Temperature-Resistance graph as **white** points.

12. Is the cooling curve the same as the heating curve? Why?
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13. Notice the Temperature vs. Resistance curve and answer the following questions:

14. 1 Is the curve linear?
    a) Yes
    b) No

14. 2 Does the Thermistor equation in the "**Theory**" window describe the curve on the Temperature-Resistance graph? If your answer is "No", what is the difference and why?
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15. Choose one of the readings taken before from the **Readings Table** and write down its Resistance (Ω) and Temperature (^{o}C) readings:

    15. 1 Current Resistance (Ω) ………………………..
    15. 2 Current temperature (^{o}C)…………………....
    15. 3 Apply the current resistance in the Thermistor equation
    15. 4 Write down the Calculated temperature (^{o}C)………………....
    15.5 Compare the calculated temperature with the current temperature.

Conclusions

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