Name ______________________________________

Lab Day ______________Lab Time______________

Measuring Temperature with a Thermistor

Lab 2

Introduction: A thermistor is a temperature sensitive resistor with a well-defined resistance vs. temperature response. The resistance of a thermistor at different temperatures can be calculated from a mathematical model and information provided by the manufacturer's. In this lab you will compare the RT response of your thermistor against the manufacture's model and convert the changing thermistor resistance into a changing voltage that correlates to temperature.

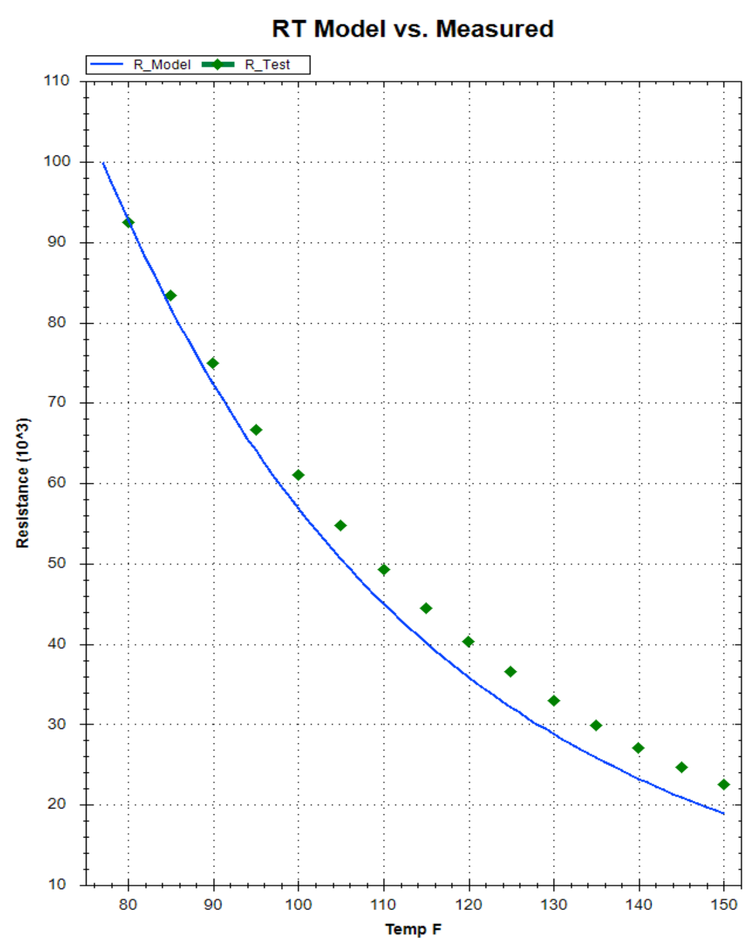
Lab Requirements:

1. Prep your thermistor by lengthening and insulating the leads then complete resistance vs. temperature table.

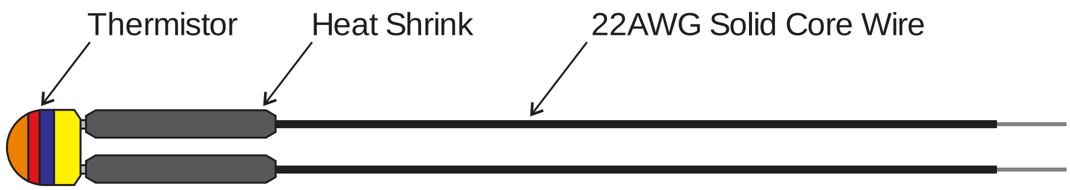
2. Build a circuit to convert a changing resistance to a changing temperature and record the results.

3. Generate a plot of your RT results against the manufacturer's data.

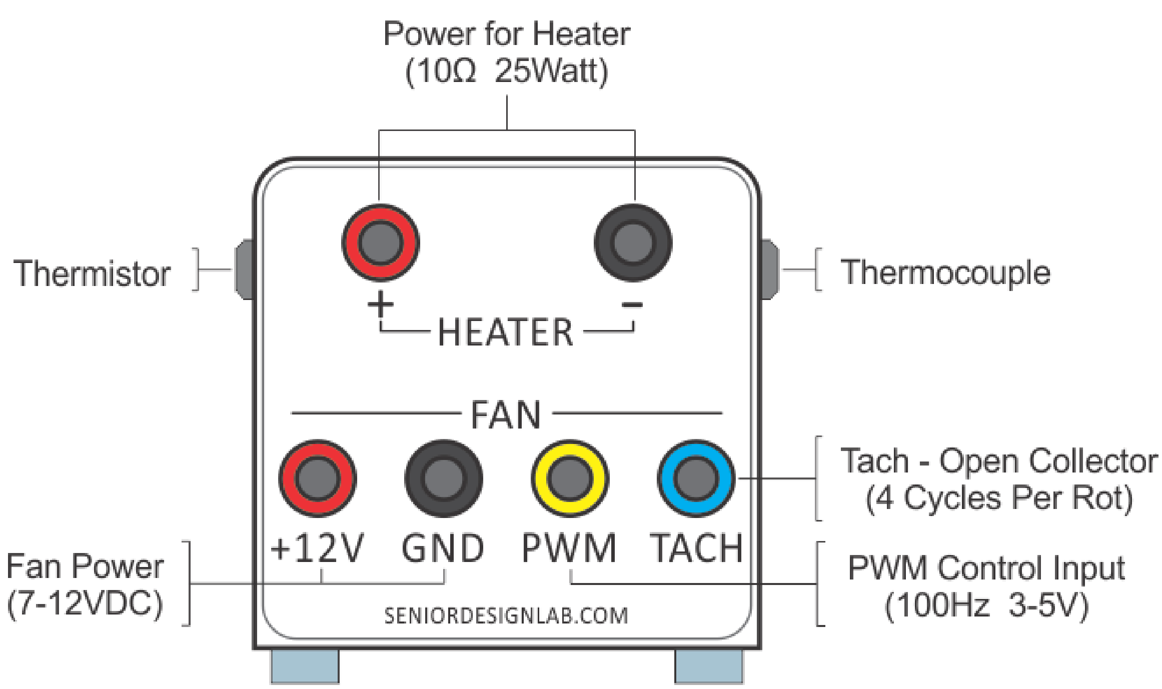
RT Measured	
Temperature F	**Resistance Ω**
80	92.5k
85	83.4k
90	74.9k
95	66.7k
100	61.0k
105	54.7k
110	49.3k
115	44.5k
120	40.3k
125	36.6k
130	33.0k
135	29.8k
140	27.0k
145	24.6k
150	22.5k



Preparing the thermistor for the Lab: In the following experiment the thermistor will be attached to a heat source located a short distance from your breadboard. Use 6 to 8 inches of 22 AWG solid core wire to extent the leads of the thermistor. Solder the wire to each of the thermistor leads and insulate the connections using heat shrink tubing. A demonstration of how to do this will be given at the beginning of the lab session.



Thermal Test Fixture: A test fixture has been built to help measure the thermistor's response against a lab thermometer. The heat source is a 10Ω power resistor fitted with an aluminum insert. When current is passed through the power resistor it will heat the aluminum insert in a controllable manner. The test fixture is also fitted with a fan that can be used to rapidly cool the heat source after the test is completed.

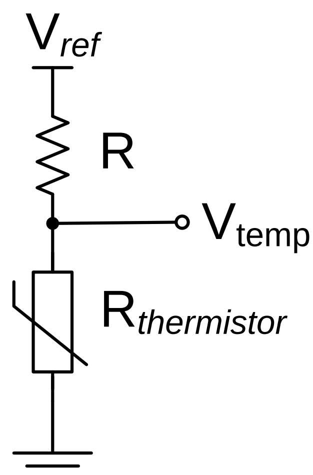


Making Resistance Measurements: Insert your thermistor into the left side of the test fixture making sure it is seated against the bottom of the hole in the aluminum insert. Fully Insert the K-type thermocouple from the Amprobe TMD-56 thermometer into the right side of the test fixture. Record the starting temperature and resistance then slowly heat the test fixture by applying a current through the resistor. A good starting current may be around 400mA. As the temperature rises you will need to increase the current in the resistor. The response time for the thermistor is fairly slow so keep the current at a level that provides a relatively slow but steady increase in temperature. Record your thermistor's resistance from 80° to 150° Fahrenheit in the table below.

Thermistor Temperature vs. Resistance	
Temperature	Resistance
Start Temp. ________° F	________kΩ
80° F	________kΩ
85° F	________kΩ
90° F	________kΩ
95° F	________kΩ
100° F	________kΩ
105° F	________kΩ
110° F	________kΩ
115° F	________kΩ
120° F	________kΩ
125° F	________kΩ
130° F	________kΩ
135° F	________kΩ
140° F	________kΩ
145° F	________kΩ
150° F	________kΩ

Making Voltage Measurements: The first step when using resistive sensors in a circuit is to convert their changing resistance into a changing voltage. This is typically done by forcing a constant current through the sensor resulting in a voltage drop across the sensor. Another way to achieve a voltage change correlating to a varying resistance is to place the sensor in series with a fixed value resistor creating a voltage divider. When a stable DC reference voltage is applied across the pair the varying resistance will result in a varying DC voltage across the sensor. This method does result in a changing current through the sensor but this will not be an issue in our application.

Selection of the resistance "R" depends on a number of factors such as signal range, current consumption, and thermistor self-heating. One way to maximize the output signal over the span of interest (80° to 150° F) is to select "R" to be approximately equal to the resistance of your thermistor at the midpoint of the span (115° F).



The voltage at the node V_{temp} represents the current temperature as determined by the following voltage divider equation:

$$V_{temp} = V_{ref}\left(\frac{R_{Thermistor}}{R + R_{Thermistor}}\right)$$

Build the voltage divider circuit using a V_{ref} of 5Vdc. Complete the table below:

Resistor Value Used: ________________

Thermistor Temperature vs. Voltage	
Temperature	Voltage
Start Temp. ________° F	________V
80° F	________V
85° F	________V
90° F	________V
95° F	________V
100° F	________V
105° F	________V
110° F	________V
115° F	________V
120° F	________V
125° F	________V
130° F	________V
135° F	________V
140° F	________V
145° F	________V
150° F	________V

On a separate sheet of paper attach a plot of your resistance vs temperature data against the manufacturer's modeled response curve. You can use any data plotting software as long as the plot is clear and easy to read. A link to a free data plotter (DatPlot) is available on the class website.