

## BAE 1022

### LABORATORY 10. Application of thermistor devices for sensing temperature

#### Overview

This laboratory focuses on the application of thermistors in temperature measurement. A thermistor's type and room temperature resistance will be determined first. A bridge circuit will then be assembled and the voltage output of the circuit will be calibrated to temperature. An experiment will then be designed to determine the error effect of self-heating in the thermistor. After the instructor approves the experiment, the experiment will be executed and the effect determined.

This laboratory is intended to provide you with experience in the application of thermistors. In addition, you will gain experience in the following areas:

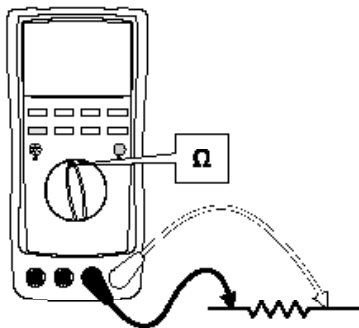
1. Utilization of a multimeter to measure voltage and current.
2. Verification of ohms law in a simple resistive circuit.
3. Design and execution of an experiment to confirm the effect of self-heating in a thermistor.

#### Equipment

1. A thermistor (characteristics must be determined).
2. Multimeter and thermocouple.
3. Powered prototyping board.
4. Assortment of resistors.
5. Beaker.
6. Ice.
7. Warm Water.

#### Procedure

1. Determine the type of thermistor that you have by warming the thermistor in your fingers while measuring the resistance of the thermistor. Record the thermistor type.
  - You must check the meter **before** making a measurement to assure it is set correctly and to assure you do not damage the meter. Do not connect the meter to a voltage or current source when it is set to Ohms.
  - Assure that the RED lead is plugged into the meter's Volts/Ohm/Diode test terminal (see below).
  - Assure that the BLACK lead is plugged into the meter's Common terminal.



- Set the meter to measure Ohms ( $\Omega$ ).

- Measure the resistance of the thermistor at room temperature and at body temperature. Determine if the resistor is a NTC thermistor or a PTC thermistor.
2. Determine the resistance of the thermistor at room temperature. Record the resistance and temperature.
  3. Select a resistor for your circuit that is approximately equal to the resistance of the thermistor at room temperature. Record the resistance value. This value will result in reasonably linear response for the circuit at near room temperature.
  4. Construct a half-bridge circuit using the thermistor, prototyping board, and a resistor following the “Half bridge temperature measurement circuit” diagram on the datasheet.
  5. Calibrate the voltage output of the circuit to medium (water) temperature over a range of temperatures from 0 to 40 °C. Mix warm water and cold water to achieve temperature points. Use the multimeter and thermocouple to determine reference temperatures. Measurement at six points are adequate for this test.
  6. Use the multimeter to measure the current flowing through the thermistor.
    - You must check the meter **before** making a measurement to assure it is set correctly and to assure you do not damage the meter. Do not connect the meter to a voltage or current source when it is set to Ohms.
    - Assure that the RED lead is plugged into the meter’s Milliamps test terminal
    - Assure that the BLACK lead is plugged into the meter’s Common terminal
    - Set the meter to measure DC Current (A).
    - Measure the current through the thermistor at room temperature.
  7. Design an experiment to determine if the self-heating effect in the thermistor significantly effects the thermistor reading.
  8. Have the lab instructor review and approve your experiment design.
  9. Execute your experiment and record the results regarding the effect of self-heating on your thermistor circuit’s accuracy.

## Report

Prepare a report with the following sections:

Title page

Abstract

Objective: “The objectives of this laboratory are to determine; 1) Thermistor type through experimental measurement, 2) A calibration curve for a thermistor using a prototype half-bridge circuit, and 3) Determine if self-heating effects are significant in the circuit selected.

Procedures: Include the procedures listed here with annotations and extensions you have added.

Results: Present the results of measurements and experiments.

Conclusions: Address objectives.

Appendix: Lab data sheet.

*Turn in at the start of Lab 11.*

**BAE 1022**  
**Laboratory 10**  
**Application of thermistors for sensing temperature**  
**Data Sheet**

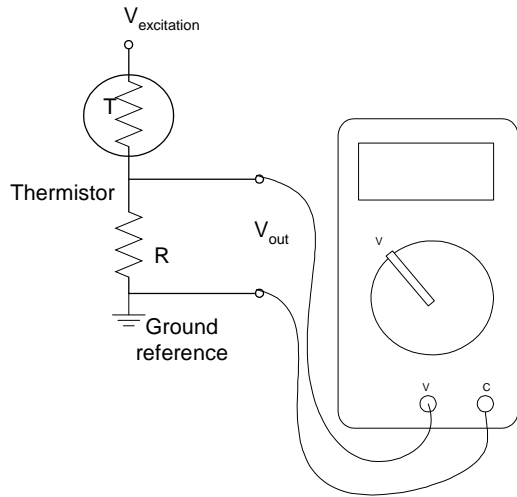
Name \_\_\_\_\_

Team: \_\_\_\_\_

\_\_\_\_\_

1. Thermistor type: \_\_\_\_\_.
2.  $R_{T0}$  (Thermistor resistance at room temperature): \_\_\_\_\_ Room Temperature \_\_\_\_\_  $^{\circ}\text{C}$ .
3. R (Half bridge resistor) \_\_\_\_\_ Ohms.
4. Circuit calibration.

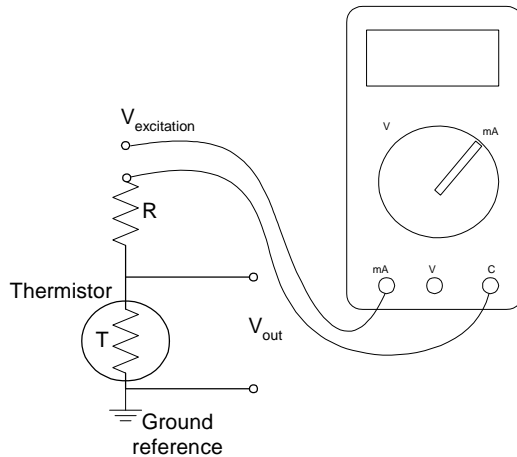
Half bridge temperature measurement circuit



Thermistor circuit temperature calibration data

Reference Temperature ( $^{\circ}\text{C}$ )	Output Voltage (V)

5. Current measurement.
- Current measurement circuit



I (Current through thermistor) \_\_\_\_\_ (ma)

6. Self-heating experiment - Design:  
Objective:

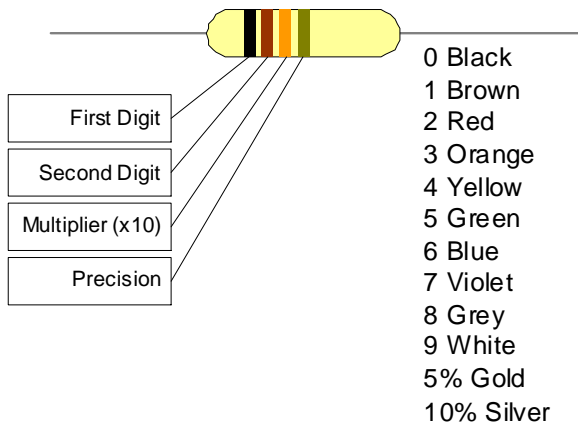
Procedure:

Expected result:

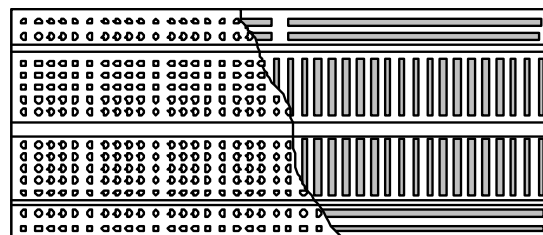
7. Self-heating experiment - Results:

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**Laboratory resources**



Resistor marking guide



Prototype Board Topology