Thermistors and Diodes

Thermistors are temperature sensitive resistors that exhibit negative temperature coefficient of resistance, which means that the thermistor experiences decreasing resistance as the temperature goes up. The relationship between Temperature and Resistance of Thermistor can be fitted using the Steinhart-Hart Equation,

This experiment was conducted in two parts, first part was to measure the resistance of the thermistor as the temperature around it changed. The multimeter was connected to the thermistor, which was inside a thermos, with a thermometer attached to it. Boiling water was placed inside the thermos and the temperature and resistance was recorded. Ice was slowly added to cool down the water, each time ice was added the temperature and resistance was recorded. The following data was collected and used to fit the Steinhart-Hart Equation.

The second half of the experiment involved two multimeters (one to measure voltage and one to measure the current), a power supply and a silicon diode. The power supply, diode, and ammeter were connected in series while the voltmeter was connected in parallel across the diode. The power supply had a knob that could increase power gradually. The data was collected for different voltage and the corresponding change in current. The collected data was plotted using Shockley Equation. The data was also collected for the reversed circuit as well.

Data and Results

<https://web.archive.org/web/20110708192840/http://www.cornerstonesensors.com/reports/ABC%20Coefficients%20for%20Steinhart-Hart%20Equation.pdf>

<https://www.thinksrs.com/downloads/pdfs/applicationnotes/LDC%20Note%204%20NTC%20Calculator.pdf>

Discussion and conclusions

The expected results of the first half of the experiment was to check if the relation between a temperature and resistance in an NTP thermistor is inversely proportional. Which after analyzing the curve fit data can be affirmed. The steinhart hart equation also returned the values of the coefficient which is within the range of the given measures data.

The second part of the experiment was to check how a silicon diode behaves and to fit the shockley equation to find the

When the data was collected in the opposite direction the value of current remained at zero because diodes only allow current to flow in one direction.

The first experiment was conducted in two separate parts, the first half of the experiment was                                                  conducted by running Direct Current through a few circuits. The first circuit was built using the model in Figure one, where the battery, switch, a capacitor, and a resistor were connected in a series and the oscilloscope was connected in parallel across the resistance to measure the change in voltage with the switch on and off.

The next three circuits were built following Figure two, where the battery and switch were replaced with a square wave generator and a transformer. The three circuits included two of the three components of a LCR circuit in series (i.e. RC, LR, and LC circuits in that order) and the wave generator and oscilloscope are connected in parallel to the series (Note that L is inductance, C is capacitance, and R is resistance). In each circuit wave generator was used to create the flow of current and oscilloscope was used to measure, the Voltage(V), Voltage across resistor (VR) were measured for RC and LR circuit, and, Voltage across inductor (VL), and Voltage across capacitor(VC) are measured in LC circuit.Using the data collected, time constant and inductance values were calculated.

The second half of the experiment was done using Alternating Current to measure the phase difference between the AC and DC (first half of the experiment) circuits. For this part a LCR circuit was built using Figure 3, where resistor, capacitor, inductor and the transformer were connected in series. The oscilloscope and the wave generator were connected in parallel. Using different frequencies on the wave generator the phase change was observed and the data was collected to be plotted in python.

The transient behaviour of a circuit can be derived from Kirchhoff’s law and solving the differential equation. Which returns the Ohms law where voltage is measured a function of time, for a certain time and time constant. Time constant depends on the values of resistance and capacitance on a RC circuit and values of resistance and inductance for a LR circuit. LC circuit will not have a time constant because those circuits are used for storing energy oscillating at the circuit's resonant frequency. When the resistance is added to an LC circuit over time the resonance frequency dampens. And that is the transient behaviour of this circuit. The concept of resistance is expanded when AC current flows through a circuit. The magnitude of the impedance Z of a circuit is equal to the maximum value of the potential difference (voltage) across the circuit divided by the maximum value of the current flowing through the circuit. However because in AC circuit the voltage and current oscillating at an angular frequency and therefore  differ by a phase difference.