Name: _____

Potentiometer and Sensor Lab Worksheet

Introduction

In this worksheet, we will examine variable resistors. Some, called potentiometers, are manually adjusted to achieve a certain resistance; others change their resistance based on some environmental change such as temperature or brightness. All of these variable resistors fall under a category of devices called sensors. A potentiometer, for example, senses the mechanical setting of a knob while a thermistor's resistance changes based on the environment's temperature.

Discussion Overview

Potentiometers

A potentiometer is usually a three lead device with the two "end" leads connected to the ends of a fixed resistor. The resistor is either a winding of a long thin wire or a carbon based material. The middle lead of a potentiometer is connected to a conductor that slides over the length of the fixed resistor. In this configuration, while the resistance between to two end leads is constant, the resistance from the middle lead to each of the end leads varies based on the location of the middle conductor on the surface of the resistor.

Two common flavors of potentiometers are linear and logarithmic. To better understand the difference between linear and logarithmic potentiometers, let's assume the length of the fixed resistor is divided into n segments. In a linear potentiometer, the resistance from the center lead to the end leads changes linearly. In other words, every time the distance between the center lead's conductor and one of the end leads is increased by one segment, the resistance between the middle lead and that end lead increases by $1/n^{th}$ of the total resistance of the fixed resistor.

In logarithmic potentiometers, on the other hand, the resistance from the center lead to the end leads changes "exponentially". So, for example, every time the distance from the center lead's conductor to an end lead is increased by one segment, the resistance between the center lead and that end lead is increased by a power of 2. So, when the center lead is on the first segment, the resistance is increased by 2; if it is on segment 2, the resistance is increased by $2^2 = 4$; and if it is on segment n, the resistance is 2^n of the initial resistance. Therefore, the logarithm of the increase is a multiple of n.

Variable Resistors as Sensors

Certain sensors are variable resistors whose resistances change as a function of environment conditions. Two of the most common variable resistor sensors are photo-resistors and thermistors.

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The resistance of photo-resistors decrease as the amount of light shining on them increase. The resistance of thermistors, on the other hand, increases as the temperature they are exposed to is decreased.

Procedure

1. Use the potentiometer in your kit to answer the following questions:
    a. Record the resistance for the positions specified in the table below.

Position	Resistance from Slider to Leg 1	Resistance from Slider to Leg 2	Resistance from Leg 1 to Leg 2
0			
1/4			
1/2			
3/4			
1			

    b. Is the potentiometer linear or logarithmic?

2. Measure the resistances corresponding to the positions in the table below with the DIY potentiometer made with a pencil lead or several feet of nichrome wire

Position	Resistance
0	
1/4	
1/2	
3/4	
1	

3. Shine your cellphone's flashlight on a photo-resistor and record the light intensity versus the resistance.

Distance or position	Resistance
No Direct Light	
Medium Setting	
Bright Setting	

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4. Record the resistance of a thermistor for the different conditions listed in the table below.

Temperature	Resistance
Room ambient	
Cold (ice)	
Warm (breath)	

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5. Heat up or cool down a thermistor using your breath, a hair dryer or some ice. Record your method, the temperature and the corresponding resistance in the table below.

Temperature	Method	Resistance