

# Motor Speed Controllers

**Overview:** You already know how to turn the LED on and off. You can even make a motor go forward and reverse. But what if you want to change the speed of the motor? Or how bright or dim the LED lights up. Today you'll be able to do just that.

**What to Learn** Once you understand how to use this potentiometer in a circuit, you'll be able to control the speed of your laser light show motors as well as the motors and lights on your robots.

## Materials

- 2 AA batteries
- AA battery case
- 3 alligator wires
- potentiometer (1k works best)
- 1.5-3V DC hobby motor
- LED
- Optional: DMM

## Lab Time

1. Wire up a simple circuit with the LED and make it light up.
2. Replace one of the LED alligator clip leads with a third wire, as we did in *Experiment 11: Conductivity Testers*.
3. Take the two free alligator clips ends and connect one to the middle tab of the potentiometer, and the other to one of the remaining tabs.
4. Turn the knob. What happened?

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5. Move the second alligator clip to the other terminal. How does this change the circuit?

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6. Can you use a motor instead of an LED? Try it now. What happened?

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7. If you have trouble with the motor, here's an alternative circuit you can try that is a Voltage Divider circuit, using a variable voltage supply for the motor:
  - a. Connect the positive battery wires to one of the potentiometer's resistive terminals (*not* the middle terminal) using an alligator clip lead.
  - b. Connect the negative battery wire to the other resistive terminal on the potentiometer (again, *not* the middle wiper terminal) using another alligator clip lead.
  - c. Connect a third alligator clip lead between one of the motor terminals and the wiper.
  - d. Connect a fourth alligator clip lead to the last motor terminal and right on top of the negative battery wire. You will have two alligator clip leads attached at this point. Make sure they all make good contact.
  - e. Turn the knob... does the motor turn?
  
1. Optional: You can do this as a demo piece if you're short on equipment or time.
  - a. Disconnect your potentiometer from the circuit. Use your DMM, turning your dial to the " $\Omega$ " symbol to measure the resistance in ohms.
  - b. Touch your probes to the wiper and one of the resistive ends and read a measurement. What happens to your reading when you turn the knob? How high and low do the numbers go (what is the range of the potentiometer)?

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- c. With a pencil, draw a long line on a sheet of paper. Touch one of the probes to the end of the line. Touch the other probe to a spot anywhere else on the line. What do you read?

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- d. What if you move your pencil further down the line? Does this change the reading? How?

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## Reading

A potentiometer (sometimes referred to as *pot*) is a resistor with three terminals that has a sliding contact to vary the resistance. Resistance is a measure of how easily current flows through a wire. The more the resistance, the less current flows through the circuit. We're going to use ours as a variable resistor. In everyday life, potentiometers are everywhere: volume controls, old radio dials, and inside joysticks as a way to detect position.

If you have an extra, pull it apart so you can see the sliding contact (called a 'wiper') that moves along the resistive element. The wiper is the middle contact and the resistive elements are the terminals on either side.

## Exercises

1. How does a potentiometer work?
2. Does the potentiometer work differently on the LED and the motor?
3. Name three places you've used potentiometers in everyday life.
4. How do you think you might wire up an LED, switch, and potentiometer?

### **Answers to Exercises: Motor Speed Controllers**

1. How does a potentiometer work? (A potentiometer is a resistor with three terminals that has a sliding contact to vary the resistance. Resistance is a measure of how easily current flows through a wire. The more the resistance, the less current flows through the circuit. We're going to use ours as a variable resistor.)
2. Does the potentiometer work differently on the LED and the motor? (No, but the range may differ since the motor draws much more current than the LED.)
3. Name three places you've used potentiometers in everyday life. (Potentiometers are everywhere: volume controls, dimmer switches, radio dials.)
4. How do you think you might wire up an LED, switch, and potentiometer? (They are all in series with each other.)