

Magnetic Sensors

Overview: Wouldn't it be cool to have an alarm sound each time someone opened your door, lunch box, or secret drawer? It's easy when you use a reed switch in your circuit! If you've built the burglar alarm from the unit on *Electricity*, this is a great addition to your stash of top-secret spy alarms.

What to Learn: Today, you get to learn how to wire up and utilize a magnetically-operated switch.

Materials

- Reed switch
- Magnet
- LED
- AA case
- 2 alligator wires
- 2 AA batteries

Lab Time

1. First, you need to light up the LED. If you haven't done this before, here are the steps:
 - a. Use the materials to wire up a simple circuit and get the LED to light up:
 - i. Insert your batteries into the case. Flat side (minus) goes to the spring.
 - ii. Attach one alligator clip to each of the metal tips of the wires from the battery case. Make sure you've got a good metal-to-metal connection. You should now have two alligator clips attached to the battery pack.
 - iii. Attach the end of the alligator clips that's connected to the black wire (negative) from the battery case to the flat side of the LED. It doesn't matter what color the alligator clip wire is.
 - iv. Attach the other alligator clip that's connected to the red wire (positive) from the battery case to the longer LED wire. Again, it doesn't matter what color the alligator clip wire is.
 - v. Your LED should light up!
 - b. Troubleshooting a circuit that doesn't work:
 - i. Batteries inserted into the case the wrong way? (Flat side of the battery should go to the metal spring inside the case.)
 - ii. LED is in the circuit the wrong way? Remember, LEDs are picky about plus and minus, meaning that it matters which way they are in the circuit. If you choose a bipolar LED, then you don't have to worry about this one, since there are two LEDs, one in each direction, in one LED package which will illuminate no matter which way you have it in your circuit. LEDs are polarized.
 - iii. Is there a metal-to-metal connection? You're not grabbing hold of the plastic insulation, are you? Not even a tiny bit? Sometimes kids have the edge of the alligator clip lead propped up on the edge of the plastic insulation, which will make your connection not work.
 - iv. Once in a while, you'll get a bad alligator wire. There's an easy to check this: Remove your alligator clip leads from the circuit and touch each of the metal tips from the battery pack

wires to the LED wires. If the LED lights up, swap out your alligator clip lead wires for new ones and that should fix it.

2. Back to the lab... go ahead and light up your LED in a simple circuit. Don't put in the reed switch yet – we want to be sure everything works before introducing a new electronic element.
3. Remove one of the alligator clips from an LED wire and replace it with a third alligator clip lead.
4. Attach each one of the two free ends of alligator wires to either end of the reed switch. You should now have a complete circuit that looks a lot like a circle when you stretch it out.
5. Bring your magnet close to the switch. Where do you have to position your magnet so your LED lights up?
6. Draw a picture of how you can use this circuit in a door or drawer:

Reading

A reed switch is a switch that turns on and off, depending on if a magnet is close or not. A reed switch has two strips of metal that are close but not touching inside. When the magnet is close, the two strips of metal move closer together, until they touch which allows the current to flow and makes the LED light up.

Exercises

1. Where does the magnet need to be located in order for your circuit to work?
2. How does the switch work? Draw a picture and label the parts that make it work in the circuit.
3. Can the switch be activated through the side of a drawer, so that the switch is in the inside and the magnet is on the outside?
4. Which way does the magnet activate the switch the best? How are the poles oriented relative to the switch?

Answers to Exercises: Magnetic Sensors

1. Where does the magnet need to be located in order for your circuit to work? (You need to have the switch lined up so that the magnet is hovering over the top of one of the strips.)
2. How does the switch work? Draw a picture and label the parts that make it work in the circuit.
3. Can the switch be activated through the side of a drawer, so that the switch is in the inside and the magnet is on the outside? (Yes, magnetic forces can go through materials like paper, plastic and wood as long as they are thin enough for the magnetic field to penetrate.)
4. Which way does the magnet activate the switch the best? How are the poles oriented relative to the switch? (One pole will be pointing to the top of one of the metal strips.)