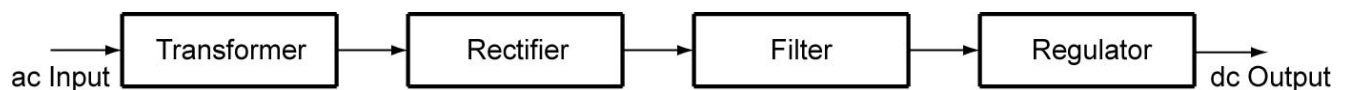


Schematics Tutorial

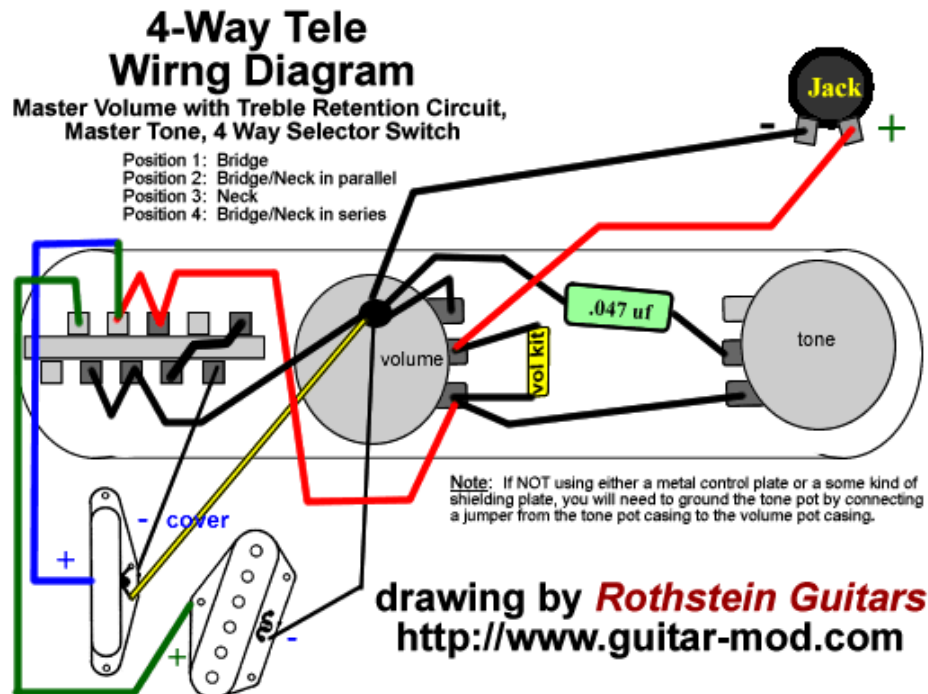
Cornerstone Electronics Technology and Robotics I Week 5

- Administration:
 - Prayer
 - Review measuring voltage, current, and resistance w/ DMM
- Electrical Diagrams:
 - **Schematic Diagrams:** A schematic diagram is a shorthand way to draw an electric circuit. It is a diagram that illustrates components (electrical parts) and how they are connected to each other. Symbols are used to represent circuit components and lines are used to represent wires or connections.
 - Other diagrams include block diagrams and wiring diagrams
 - **Block diagrams** show major electrical systems are related.



Block Diagram of a DC Power Supply

- **Wiring diagrams** are used to help with the actual circuit wiring.



Wiring diagrams Show the Component Parts in Pictorial Form

- Example of an electrical circuit and the corresponding schematic diagram:

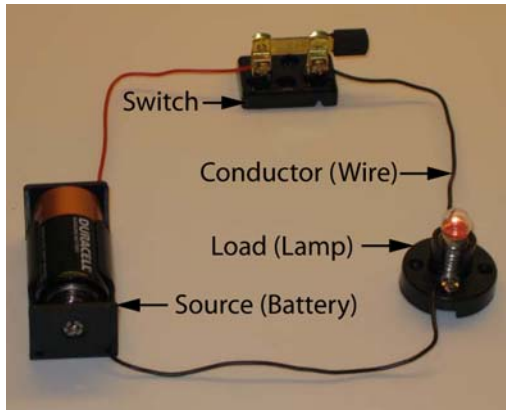
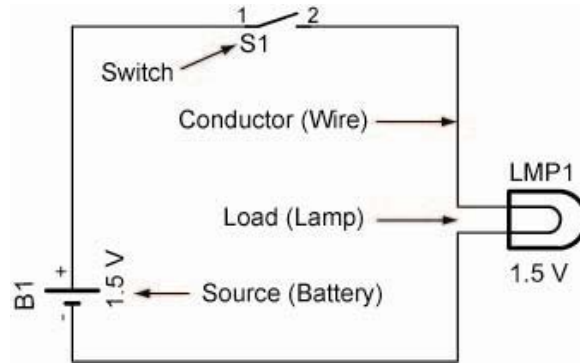
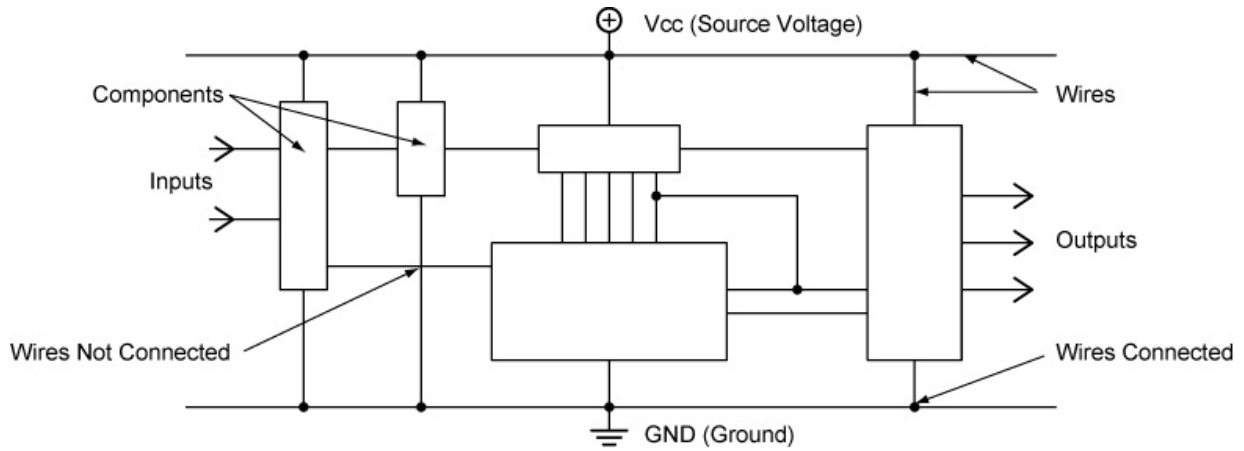


Photo of Circuit



Schematic Diagram of Circuit

- Note that each component has its individual designation, i.e., B1, S1, and LMP1.
- Also note that the value of the component is given where applicable.
- In a schematic drawing, the distance between components does not represent the actual distance when wiring the components.
- Show polarity (+ and -) for components that have polarity. This will be covered more in later lessons.
- Current must loop back to power supply or loop through a common ground symbol.
- General Rules and Hints for Schematics:
(From: <http://opencircuitdesign.com/xcircuit/goodschem/goodschem.html>)
 - Wires connecting are indicated by a heavy black dot; wires crossing, but not connecting, have no dot.
 - Wires and components are aligned horizontally or vertically, unless there's a good reason to do otherwise.
 - Label pin numbers on the outside of a symbol, signal names on the inside.
 - All parts should have values or types indicated; it's best to give all parts a label, too, e.g., R7 or IC3.
 - In general, signals go from left to right
 - Put positive supply voltages at the top of the page, negative at the bottom.
 - Don't attempt to bring all wires around to the supply rails, or to a common ground wire. Instead, use the ground symbol(s) and labels like +Vcc to indicate those voltages where needed.
 - It is helpful to label signals and functional blocks and show waveforms; in logic diagrams it is especially important to label signal lines, e.g., RESET' or CLK.
 - It is helpful to bring leads away from components a short distance before making connections or jogs.
 - Leave some space around circuit symbols



General Layout of a Schematic Drawing

- Another way to show voltage source and ground:
 - In order to make schematics cleaner and easier to read, the battery symbol is left out all together from the schematic and voltage source and ground symbols are substituted. This really cleans up a large schematic where lots of parts are connected to the voltage source and ground.
 - A voltage source may be drawn as shown in the following examples:

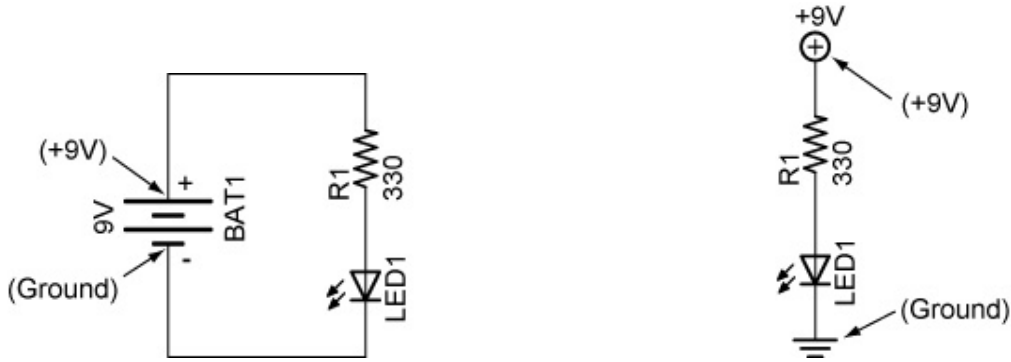


- A earth ground may be represented by the following symbol:



This symbol may also be used to indicate a point in a circuit that is the common reference voltage (0V) from which all other voltages are measured.

- Example of a schematic using a voltage source and ground:



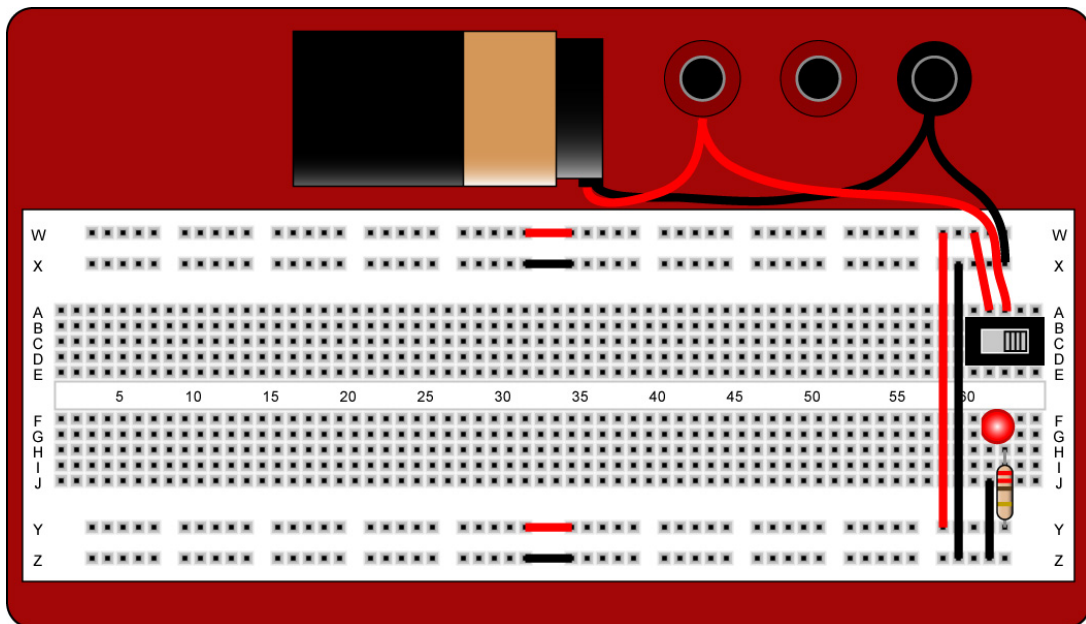
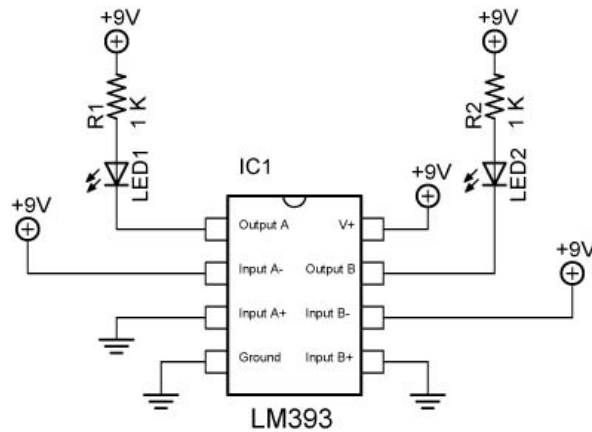
Schematic with Battery Symbol

Equivalent Schematic Using +9V Supply and Ground Symbols

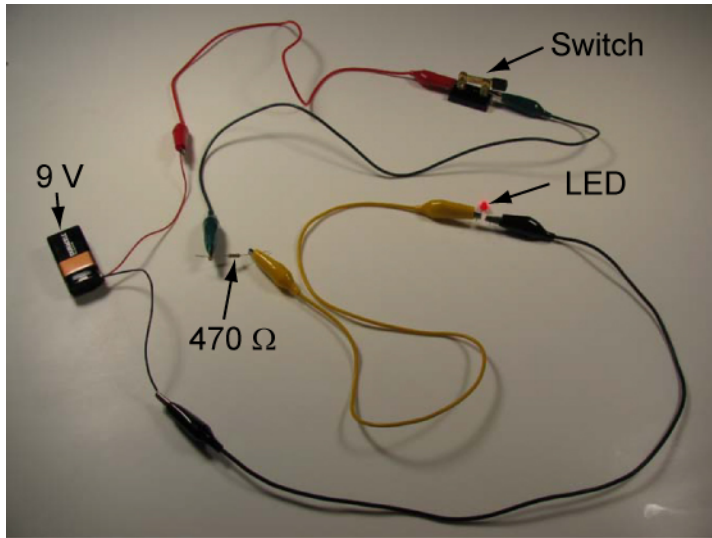
The equivalent schematic serves the same function as the schematic with a battery. In both schematics, the 330 ohm resistor is connected to the positive terminal of the battery and the cathode of the LED is connected to the negative terminal. The LED will light in both circuits.

- In Class Examples:

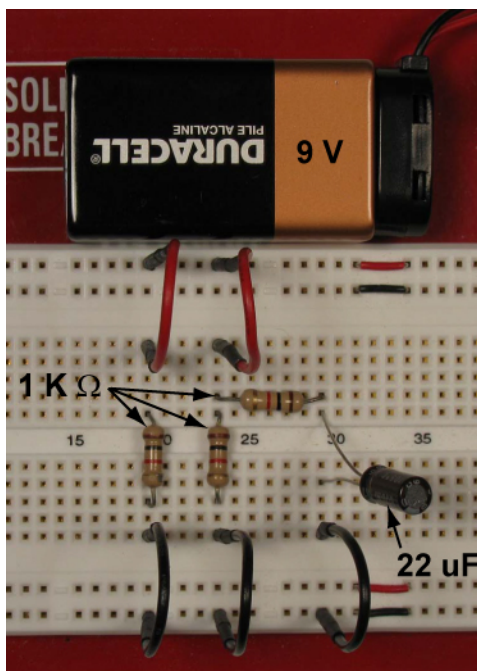
- Example 1: From the schematic below, draw in the components on the solderless breadboard.



- Example 2: From the photo, draw the schematic.



- Example 3: From the photo, draw the schematic.



- Student Activity Sheet 2-6, Meter Loading
- Perform Schematics Lab 1 – Drawing Schematics.
- Start Student Activity Sheet 1-5.
- Start Student Activity Sheet 1-7.
- Perform Schematics Lab 2 – Bounce1.
- Internet References:
 - http://www.efundies.com/guides/fundamentals/intro/how_to_read_schematics/how_to_read_schematics_page_1.htm
 - http://www.efundies.com/guides/fundamentals/intro/common_schematic_symbols/common_schematic_symbols_page_1.htm
 - <http://opencircuitdesign.com/xcircuit/goodschem/goodschem.html>

Electronics Technology and Robotics I Week 5 Schematics Lab 1 – Drawing Schematics

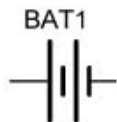
- **Purpose:** The purpose of this lab is to have the student practice drawing schematics.
- **Apparatus and Materials:**
 - 1 – Digital Multimeter
 - 7 Circuits Provided by the Instructor
- **Procedure:**
 - Draw schematics for the 7 circuits displayed.
 - In Circuit 6, measure the voltage between Point A and ground. Compare it to the source voltage.

Source Voltage = _____

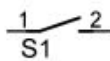
Point A to GND = _____

- Use the integrated circuit (IC1) below when drawing Circuit 4, the electronic cricket.

- Component Symbols Needed:



Battery



Switch



Fixed Resistor



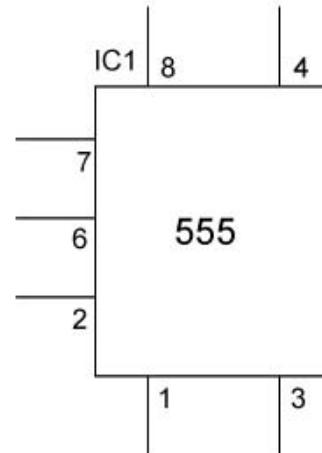
Lamp



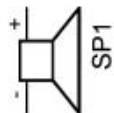
LED



Capacitor



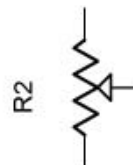
555 Timer Integrated Circuit



Speaker



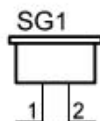
Ground



Potentiometer



+9 V Source

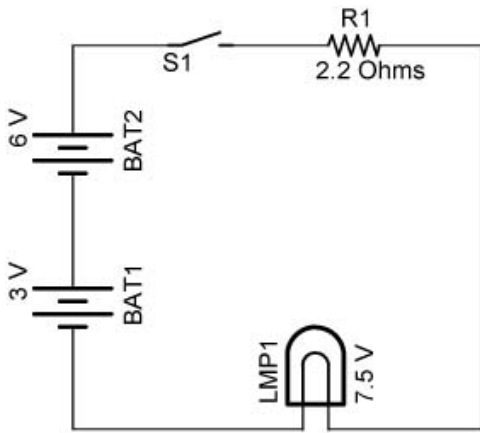


Buzzer

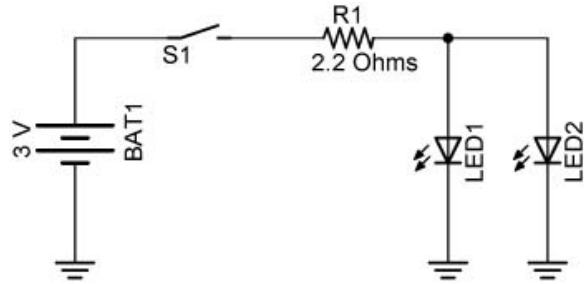


Output Point

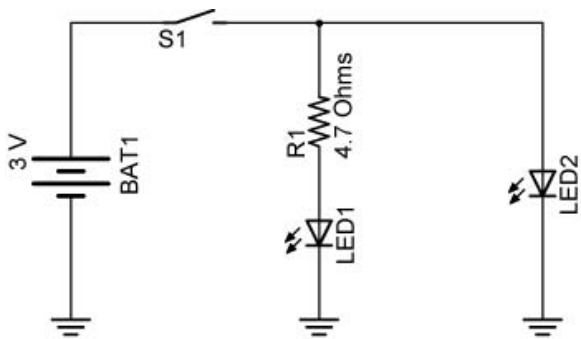
Seven Circuit Schematics



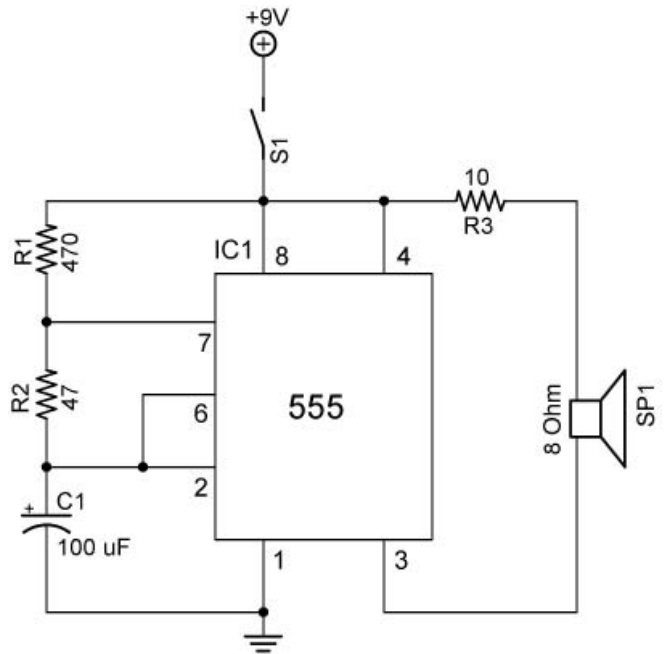
Circuit 1



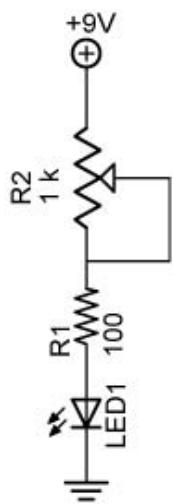
Circuit 2



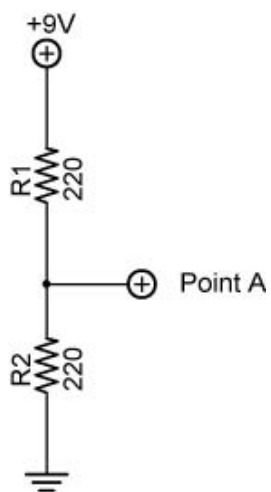
Circuit 3



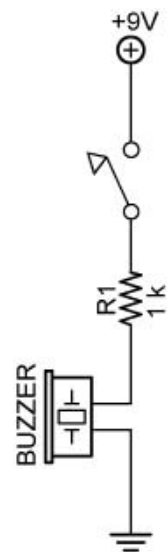
Circuit 4



Circuit 5



Circuit 6



Circuit 7

Electronics Technology and Robotics I Week 5 Schematics Lab 2 – Bounce1.pbp

- **Purpose:** The purpose of this lab is to have the student practice wiring a circuit from a schematic drawing.
- **Apparatus and Materials:**
 - 1 – Breadboard with +5 V Power Source
 - 1 – PIC16F88 with PicBasic Pro Program:
<http://www.cornerstonerobotics.org/code/bounce1.pbp>
 - 1 – 4.7 K Resistor DIP
 - 8 – LEDs
 - 8 – 100 Ω Resistors
- **Procedure:**
 - Wire the circuit Bounce1:

