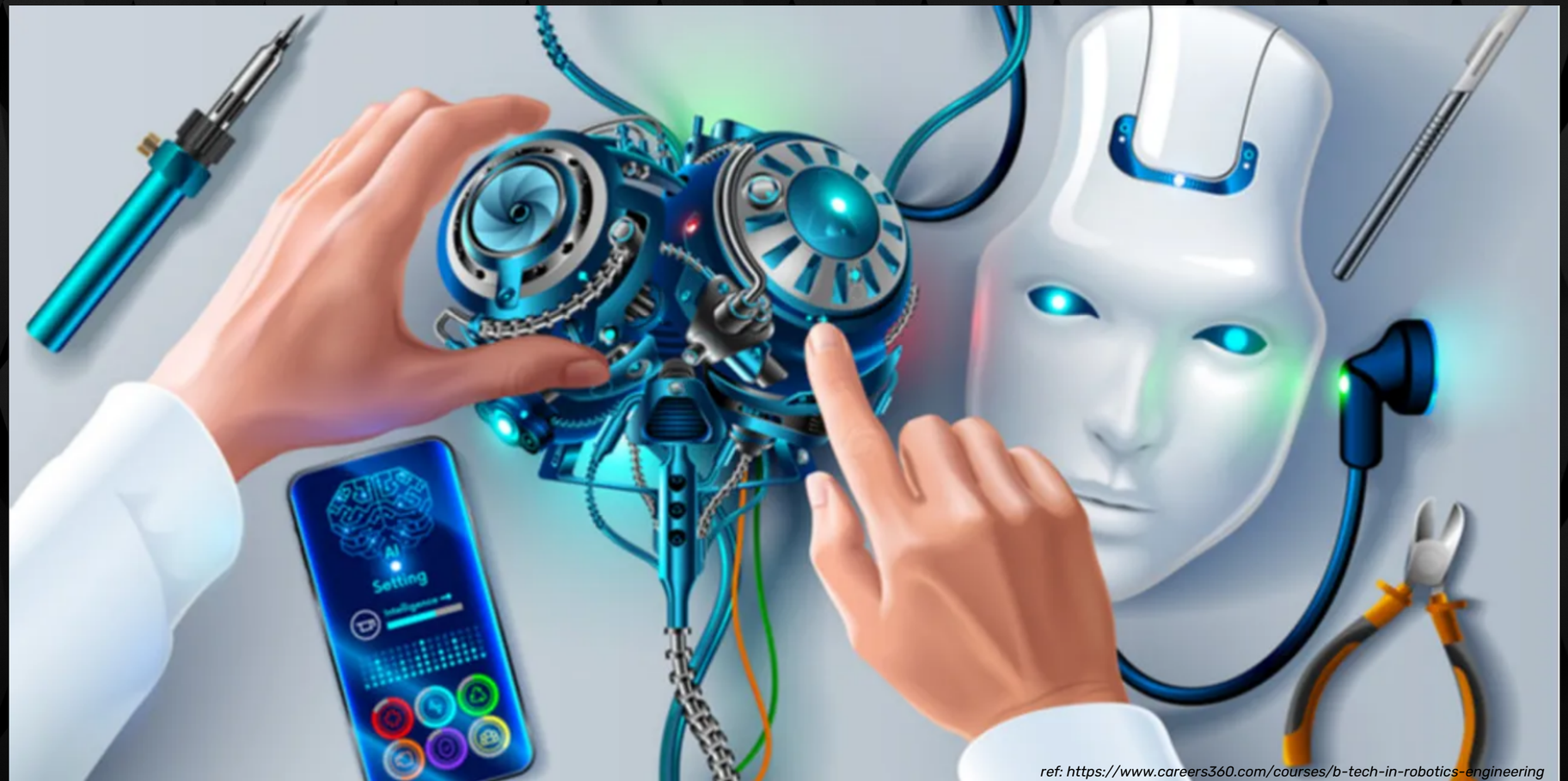
Week 2

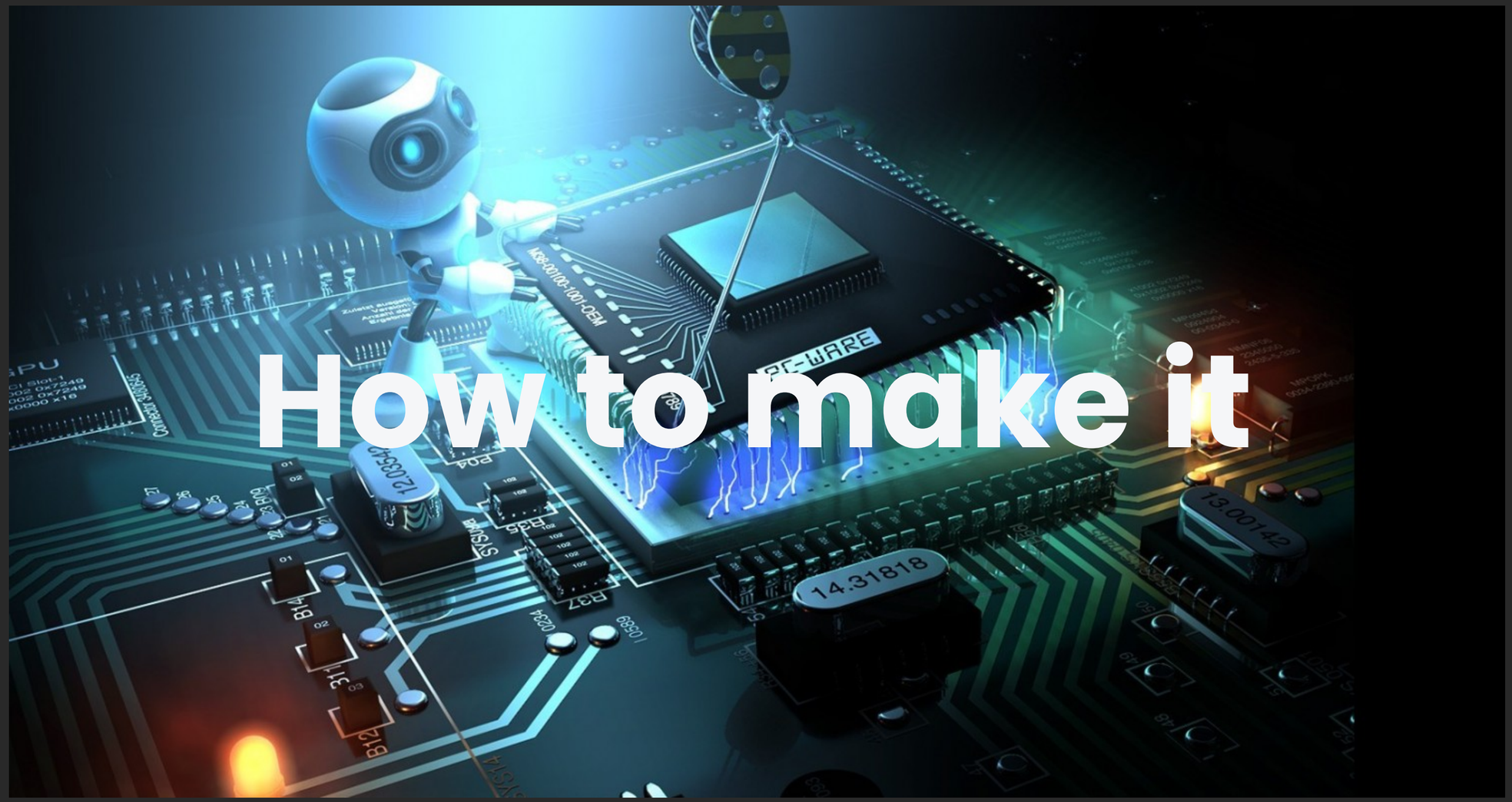
Basic Electronics

Aphirak Thitinaruemit

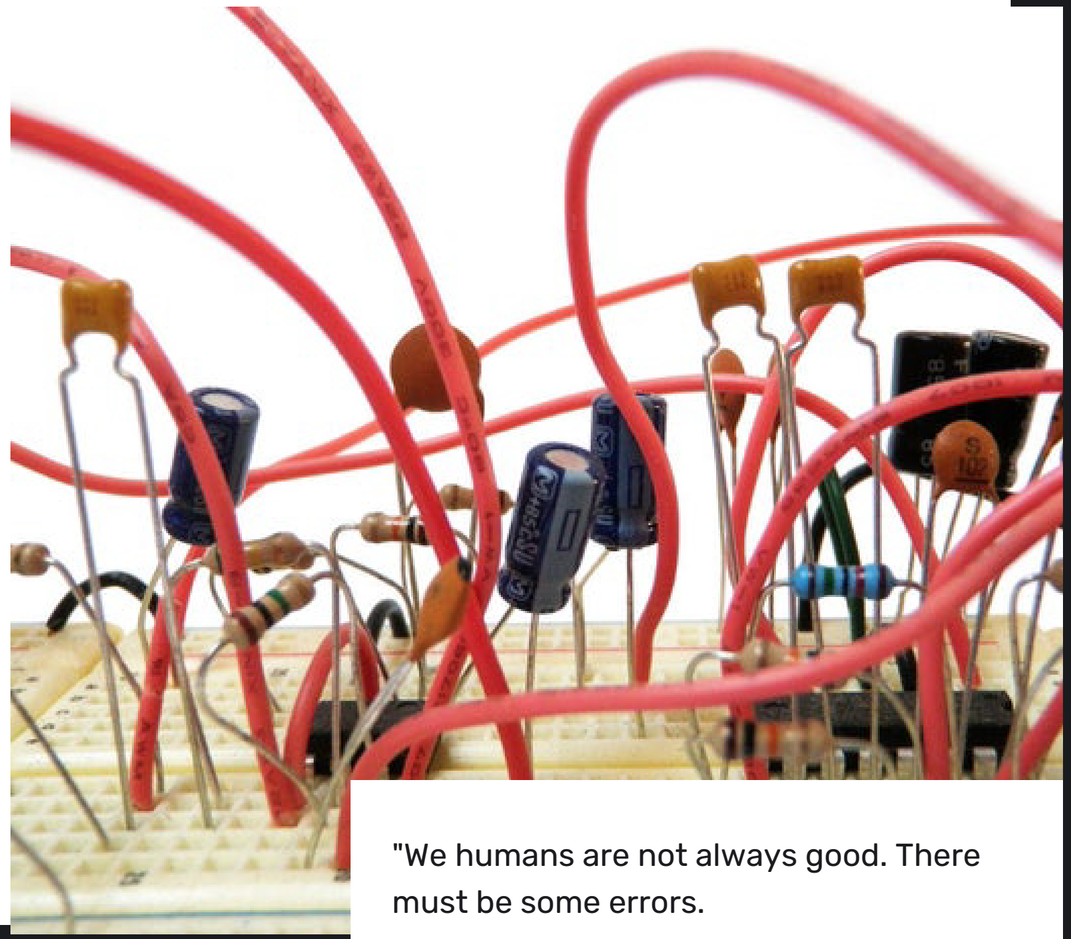


ref: https://www.careers360.com/courses/b-tech-in-robotics-engineering

Ref: https://www.jaycar.com.au/discover-robotics



How to make it



"We humans are not always good. There must be some errors.

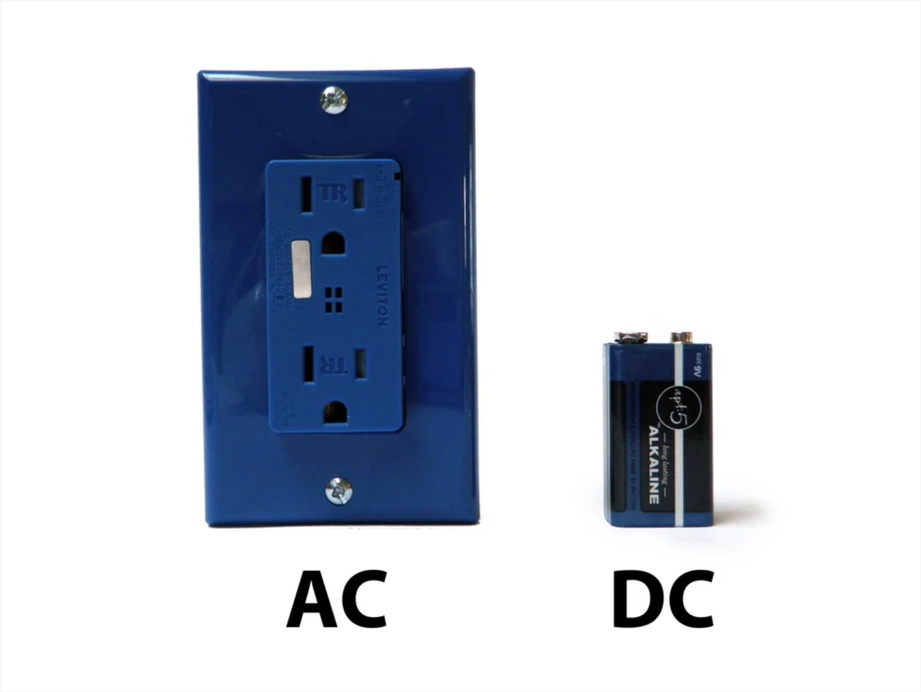
—— XXX

Students will review or learn about:

The basics of classical mechanics:

- Electricity, Resistance
- Series Vs. Parallel
- Basic Components
- Resistors
- Capacitors
- Diodes
- Transistors
- Integrated Circuits
- Potentiometers
- LEDs
- Switches
- Batteries
- Breadboards
- Wire
- Your First Circuit

Step 1: Electricity

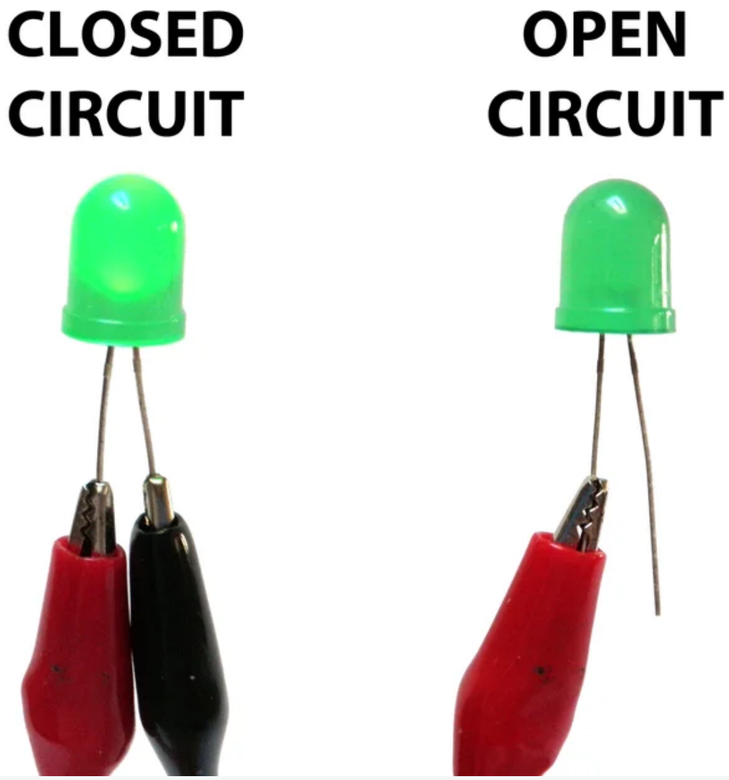


There are two types of electrical signals , those being alternating current (AC), and direct current (DC).

Most basic electronic circuits use DC electricity. As such, all further discussion of electricity will revolve around DC electricity.

Ref:https://www.instructables.com/Basic-Electronics/

Step 2: Circuits

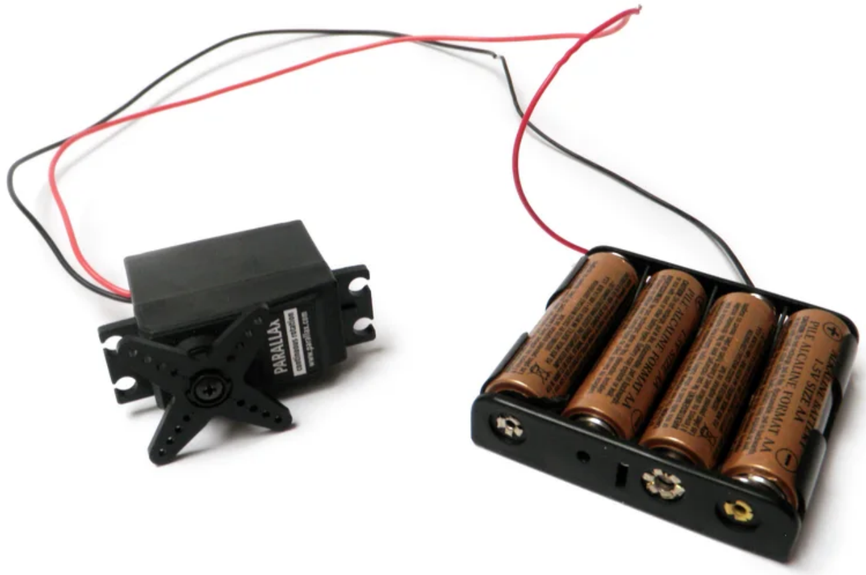


A circuit is a complete and closed path through which electric current can flow. In other words, a closed circuit would allow the flow of electricity between power and ground. An open circuit would break the flow of electricity between power and ground.

Anything that is part of this closed system and that allows electricity to flow between power and ground is considered to be part of the circuit.

Ref:https://www.instructables.com/Basic-Electronics/

Step 3: Resistance

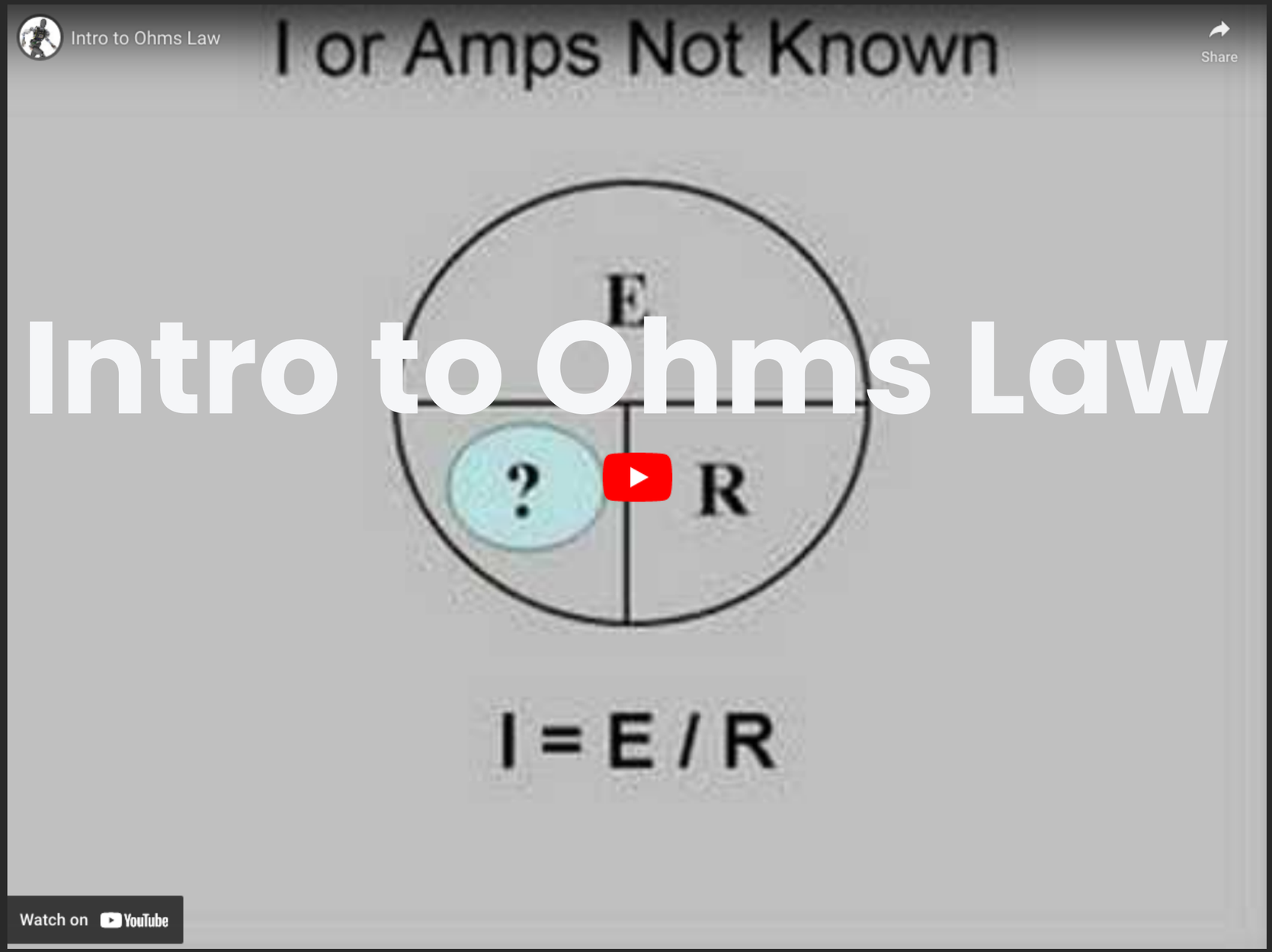


The next very important consideration to keep in mind is that electricity in a circuit must be used.

For instance, in the circuit above, the motor that electricity is flowing through is adding resistance to the flow of electricity. Thus, all of the electricity passing through the circuit is being put to use.

It is very important to prevent short circuits by making sure that the positive voltage is never wired directly to ground.

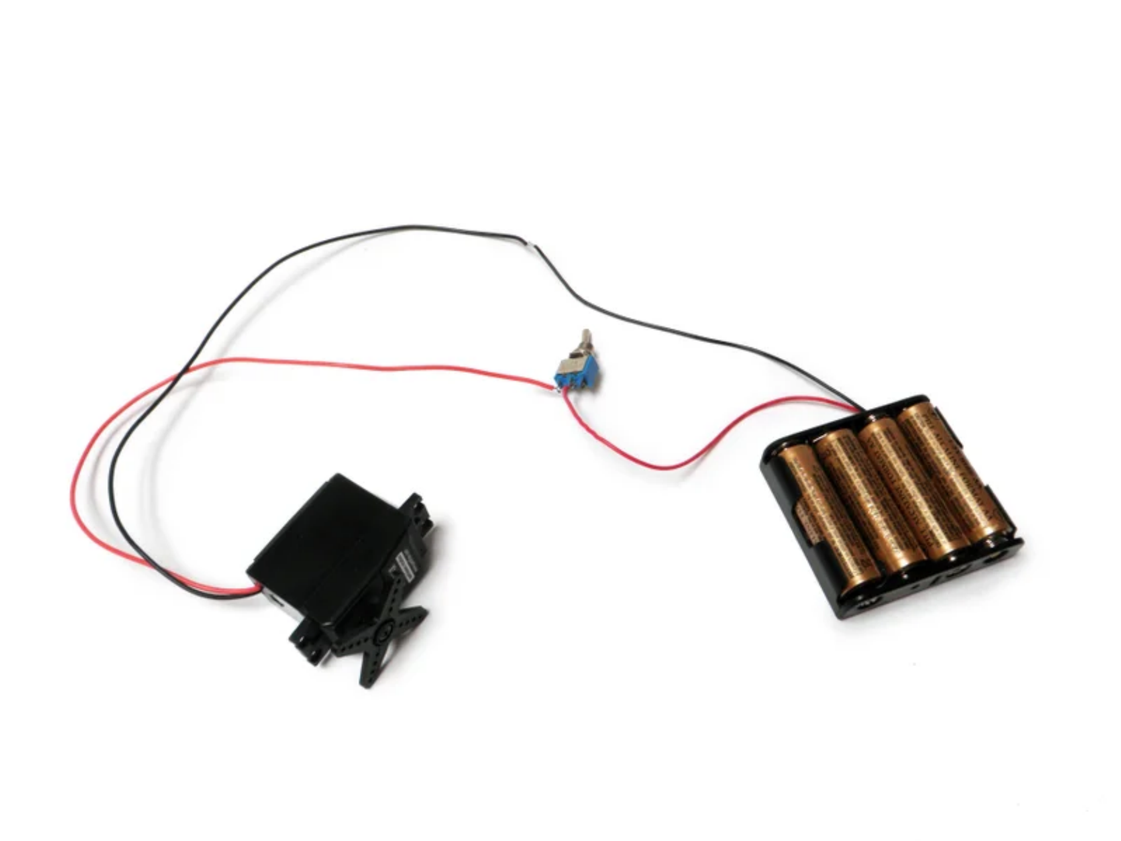
Ref:https://www.instructables.com/Basic-Electronics/



Intro to Ohms Law

Step 4: Series Vs. Parallel

There are two different ways in which you can wire things together called series and parallel.



Series

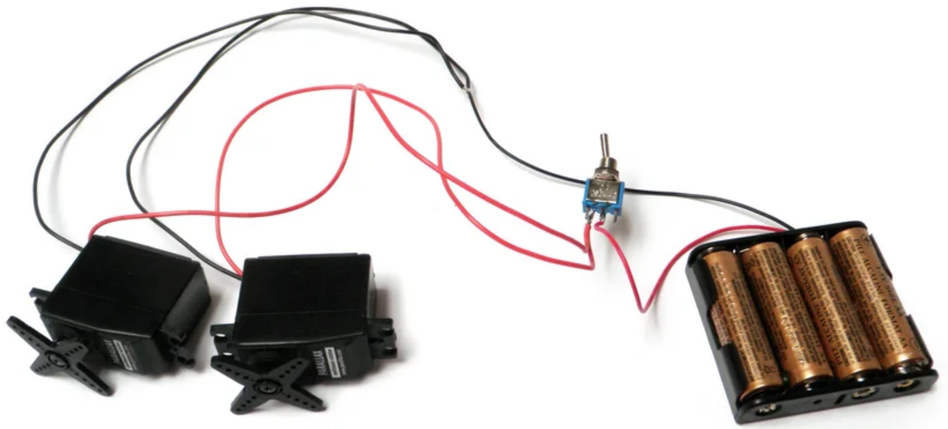
When things are wired in series, things are wired one after another, such that electricity has to pass through one thing, then the next thing, then the next, and so on.

In the first example, the motor, switch and battery are all wired in series because the only path for electricity to flow is from one, to the next, and to the next.

Ref:https://www.instructables.com/Basic-Electronics/

Step 4: Series Vs. Parallel

There are two different ways in which you can wire things together called series and parallel.



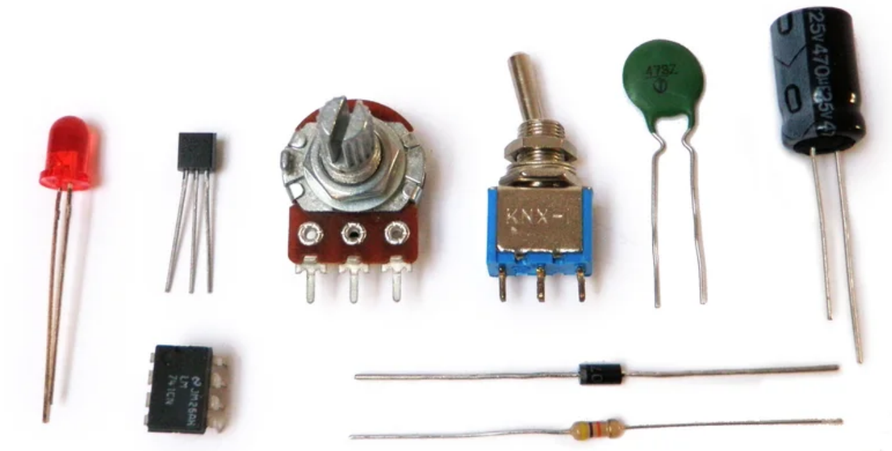
Parallel

When things are wired in parallel, they are wired side by side, such that electricity passes through all of them at the same time, from one common point to another common point

In the next example, the motors are wired in parallel because the electricity passes through both motors from one common point to another common point.

Ref:https://www.instructables.com/Basic-Electronics/

Step 5: Basic Components



In order to build circuits, you will need to become familiar with a few basic components. These components may seem simple, but are the bread and butter of most electronics projects.

Thus, by learning about these few basic parts, you will be able to go a long way.

Ref:https://www.instructables.com/Basic-Electronics/

Step 6: Resistors

As the name implies, resistors add resistance to the circuit and reduces the flow of electrical current. It is represented in a circuit diagram as a pointy squiggle with a value next to it.

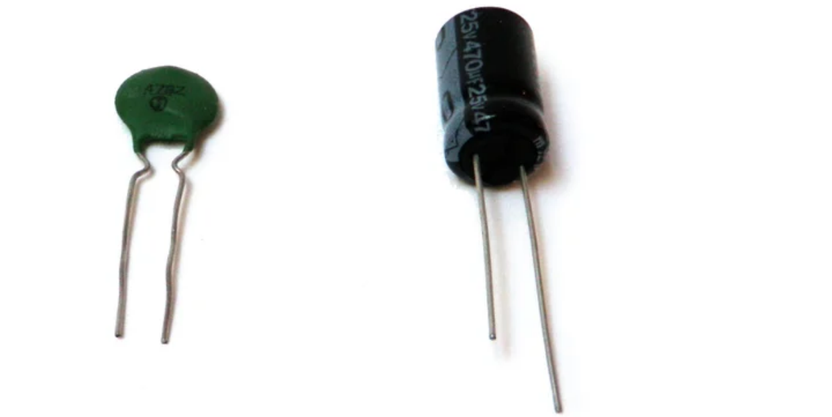
The different markings on the resistor represent different values of resistance. These values are measured in ohms.

Resistors also come with different wattage ratings. For most low-voltage DC circuits, 1/4 watt resistors should be suitable.

http://www.dannyg.com/examples/res2/resistor.htm

Ref:https://www.instructables.com/Basic-Electronics/

Step 7: Capacitors



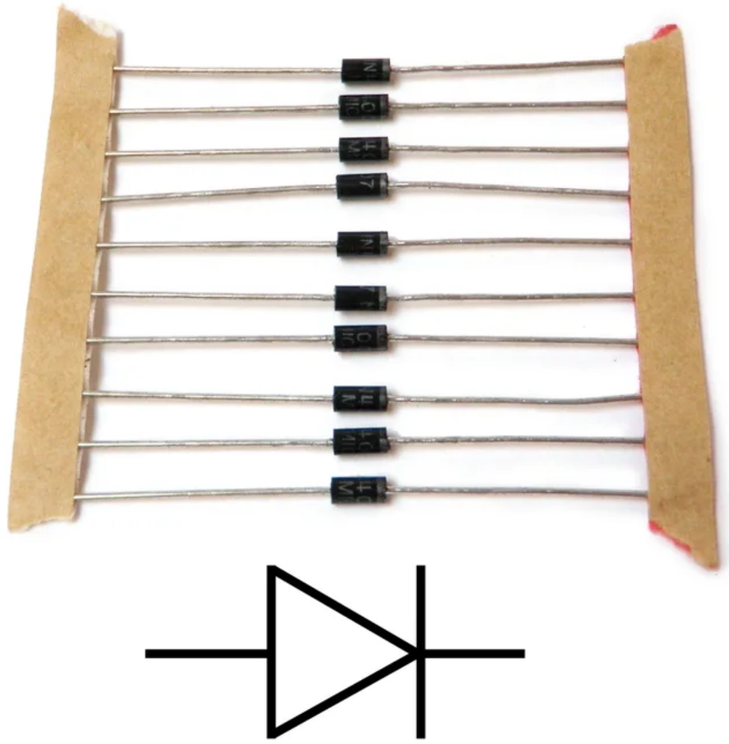
A capacitor is a component that stores electricity and then discharges it into the circuit when there is a drop in electricity. You can think of it as a water storage tank that releases water when there is a drought to ensure a steady stream.

Capacitors are measured in Farads. The values that you will typically encounter in most capacitors are measured in picofarad (pF), nanofarad (nF), and microfarad (uF). These are often used interchangeably and it helps to have a conversion chart at hand.

https://www.justradios.com/uFnFpF.html

Ref:https://www.instructables.com/Basic-Electronics/

Step 8: Diodes



Diodes are components which are polarized. They only allow electrical current to pass through them in one direction. This is useful in that it can be placed in a circuit to prevent electricity from flowing in the wrong direction.

Another thing to keep in mind is that it requires energy to pass through a diode and this results in a drop of voltage. This is typically a loss of about 0.7V. This is important to keep in mind for later when we talk about a special form of diodes called LEDs.

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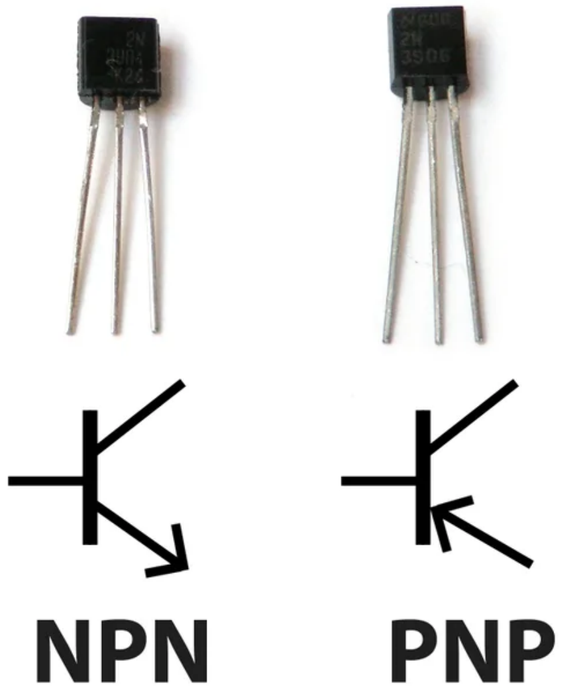
Step 9: Transistors

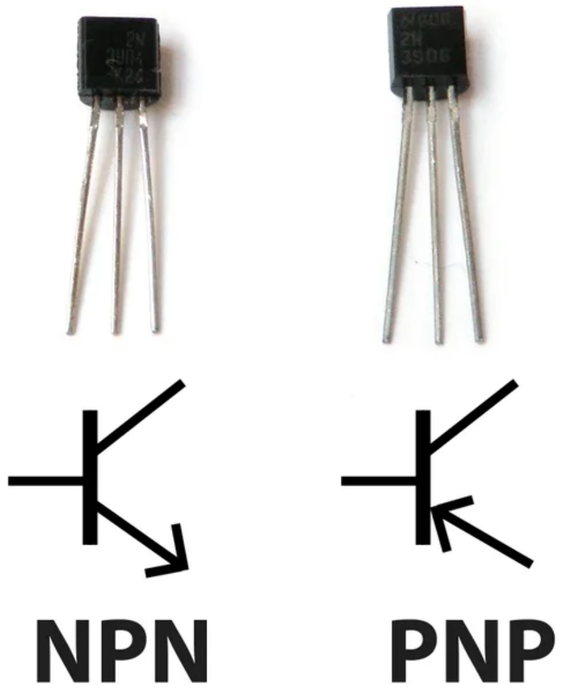


A transistor takes in a small electrical current at its base pin and amplifies it such that a much larger current can pass between its collector and emitter pins. The amount of current that passes between these two pins is proportional to the voltage being applied at the base pin.

There are two basic types of transistors, which are NPN and PNP. These transistors have opposite polarity between collector and emitter. For a very comprehensive intro to transistors check out

Ref:https://www.instructables.com/Basic-Electronics/

Step 9: Transistors (con.)



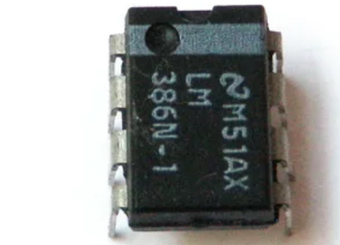
NPN transistors allow electricity to pass from the collector pin to the emitter pin. They are represented in a schematic with a line for a base, a diagonal line connecting to the base, and a diagonal arrow pointing away from the base.

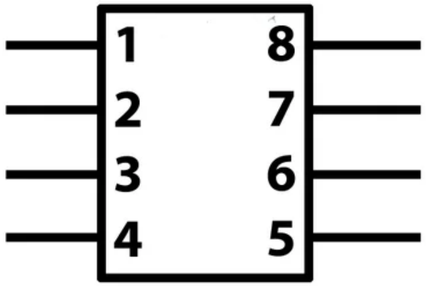
PNP transistors allow electricity to pass from the emitter pin to the collector pin. They are represented in a schematic with a line for a base, a diagonal line connecting to the base, and a diagonal arrow pointing towards the base.

https://www.talkingelectronics.com/projects/TheTransistorAmplifier/TheTransistorAmplifier-P1.html

Ref:https://www.instructables.com/Basic-Electronics/

Step 10: Integrated Circuits



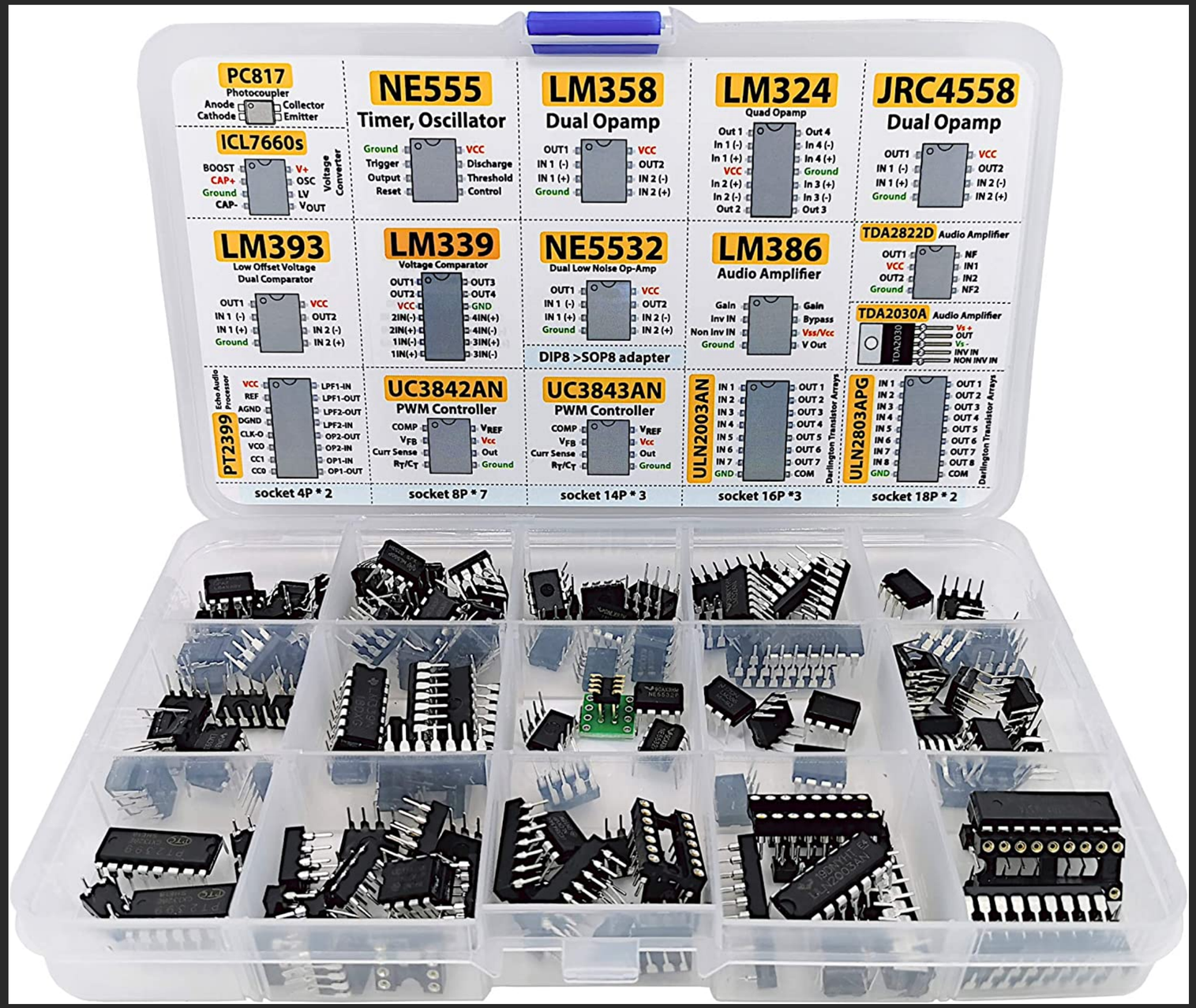


An integrated circuit is an entire specialized circuit that has been miniaturized and fit onto one small chip with each leg of the chip connecting to a point within the circuit. These miniaturized circuits typically consist of components such as transistors, resistors, and diodes.

For instance, the internal schematic for a 555 timer chip has over 40 components in it.

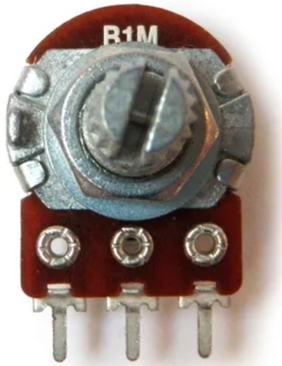
Ref:https://www.instructables.com/Basic-Electronics/

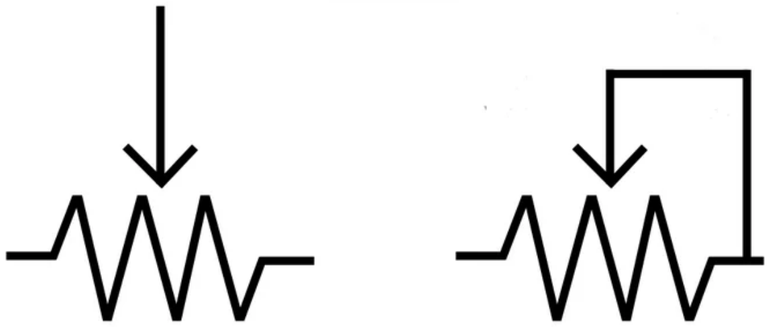
Week 2



w.amazon.com/Assortment-oscillator-JRC4558-TDA2030-TDA2822/dp/B07V1PKDZS/ref=as_li_ss_tl?dchild=1&keywords=integrated+circuits&qid=1585877763&sr=8-2&linkCode=sl1&tag=madeineuphori-20&linkId=4a6df8f33d862d4ace8a80c4d0faaa5b&language=en_US

Step 11: Potentiometers



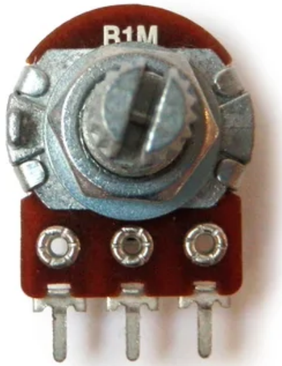


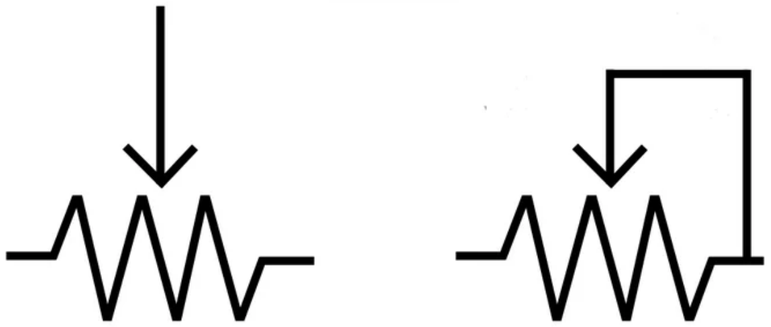
Potentiometers are variable resistors. In plain English, they have some sort of knob or slider that you turn or push to change resistance in a circuit. If you have ever used a volume knob on a stereo or a sliding light dimmer, then you have used a potentiometer.

Potentiometers are measured in ohms like resistors, but rather than having color bands, they have their value rating written directly on them (i.e. "1M"). They are also marked with an "A" or a "B, " which indicated the type of response curve it has.

Ref:https://www.instructables.com/Basic-Electronics/

Step 11: Potentiometers (Con.)





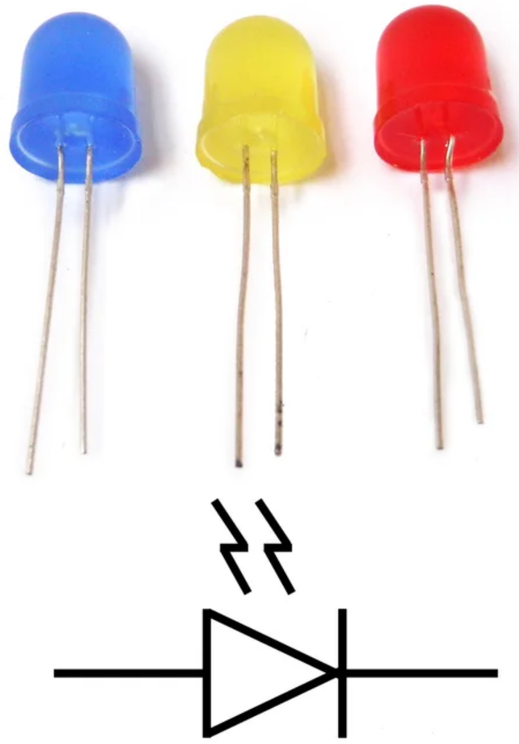
Potentiometers have three legs as to create a voltage divider, which is basically two resistors in series. When two resistors are put in series, the point between them is a voltage that is a value somewhere between the source value and ground.

For instance, if you have two 10K resistors in series between power (5V) and ground (0V), the point where these two resistors meet will be half the power supply (2.5V) because both of the resistors have identical values.

Ref:https://www.instructables.com/Basic-Electronics/

https://www.amazon.com/Seloky-Resistance-5K-100K-Knurled-Potentiometer/dp/B07MXJVYM9/ref=as_li_ss_tl?dchild=1&keywords=potentiometers&qid=1585877797&sr=8-3&linkCode=sl1&tag=madeineuphori-20&linkId=40f221a2e1ca7547b20dd3d48bd62538&language=en_US

Step 12: LEDs

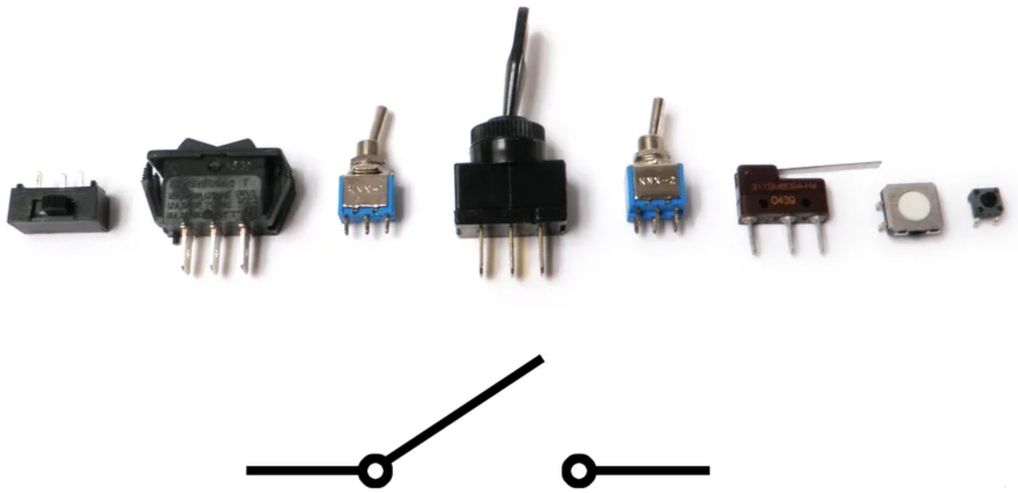


LED stands for light emitting diode. It is basically a special type of diode that lights up when electricity passes through it. Like all diodes, the LED is polarized and electricity is only intended to pass through in one direction.

There are typically two indicators to let you know what direction electricity will pass through and LED. The first indicator that the LED will have a longer positive lead (anode) and a shorter ground lead (cathode). The other indicator is a flat notch on the side of the LED to indicate the positive (anode) lead.

Ref:https://www.instructables.com/Basic-Electronics/

Step 13: Switches



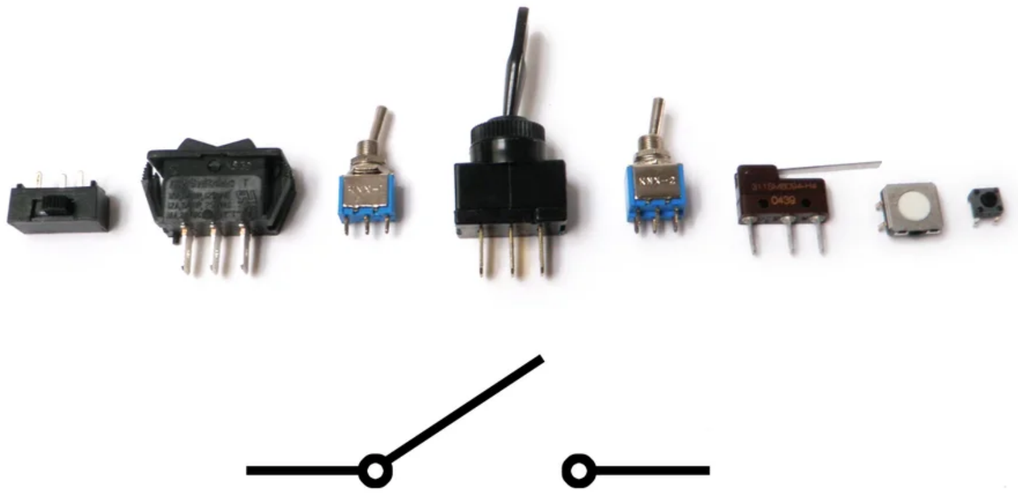
A switch is basically a mechanical device that creates a break in a circuit. When you activate the switch, it opens or closes the circuit. This is dependent on the type of switch it is.

Normally open (N.O.) switches close the circuit when activated.

Normally closed (N.C.) switches open the circuit when activated.

Ref:https://www.instructables.com/Basic-Electronics/

Step 13: Switches (Con.)



As switches get more complex they can both open one connection and close another when activated. This type of switch is a single-pole double-throw switch (SPDT).

If you were to combine two SPDT switches into one single switch, it would be called a double-pole double-throw switch (DPDT). This would break two separate circuits and open two other circuits, every time the switch was activated.

Ref:https://www.instructables.com/Basic-Electronics/

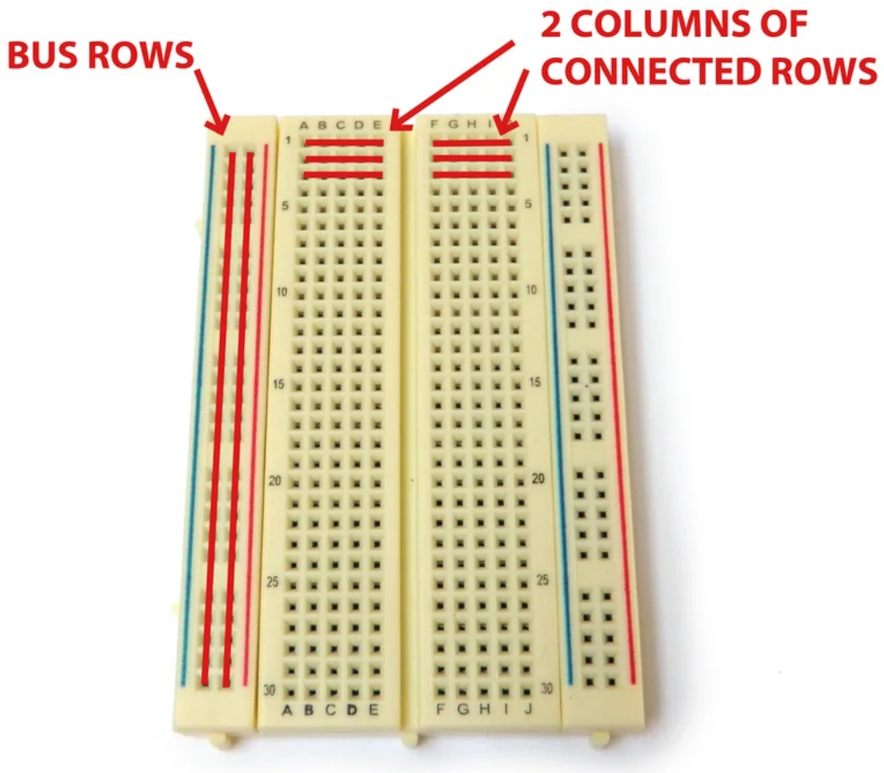
Step 14: Batteries

A battery is a container which converts chemical energy into electricity. To over-simplify the matter, you can say that it "stores power."

By placing batteries in series you are adding the voltage of each consecutive battery, but the current stays the same. For instance, a AA-battery is 1.5V. If you put 3 in series, it would add up to 4.5V. If you were to add a fourth in series, it would then become 6V.

Ref:https://www.instructables.com/Basic-Electronics/

Step 15: Breadboards



Breadboards are special boards for prototyping electronics. They are covered with a grid of holes, which are split into electrically continuous rows.

In the central part there are two columns of rows that are side-by-side. This is designed to allow you to be able to insert an integrated circuit into the center. After it is inserted, each pin of the integrated circuit will have a row of electrically continuous holes connected to it.

Ref:https://www.instructables.com/Basic-Electronics/

Step 16: Wire

In order to connect things together using a breadboard, you either need to use a component or a wire.

Wires are nice because they allow you to connect things without adding virtually no resistance to the circuit. This allows you to be flexible as to where you place parts because you can connect them together later with wire. It also allows you to connect a part to multiple other parts.

Ref:https://www.instructables.com/Basic-Electronics/

Step 16: Wire (Con.)

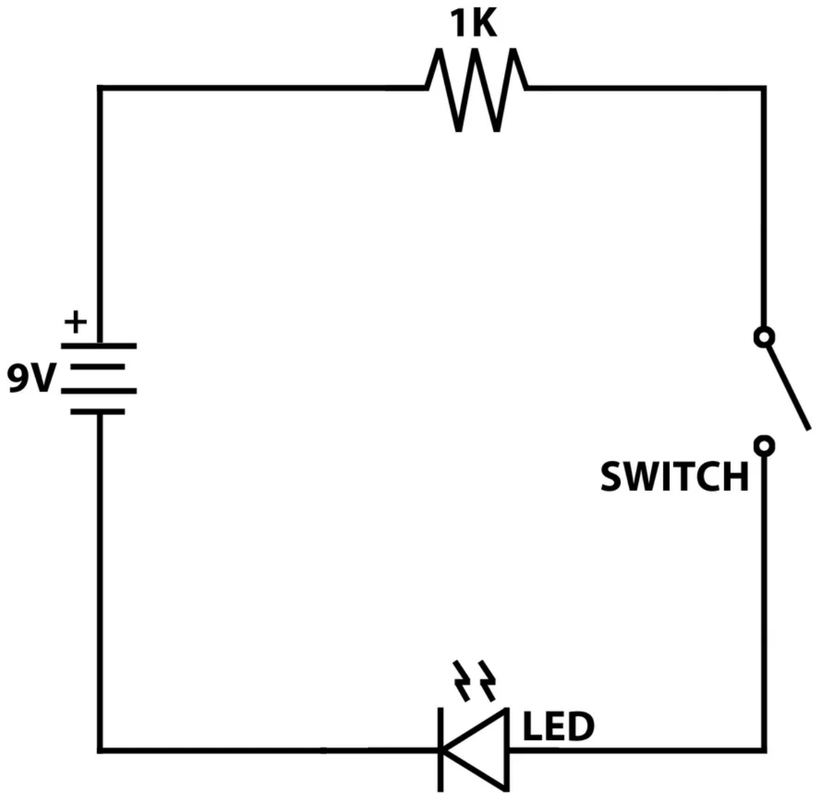
It is recommended that you use insulated 22awg (22 gauge) solid core wire for breadboards. You used to be able to find it at Radioshack, but instead could use the hookup wire linked to above. Red wire typically indicates a power connection and black wire represents a ground connection.

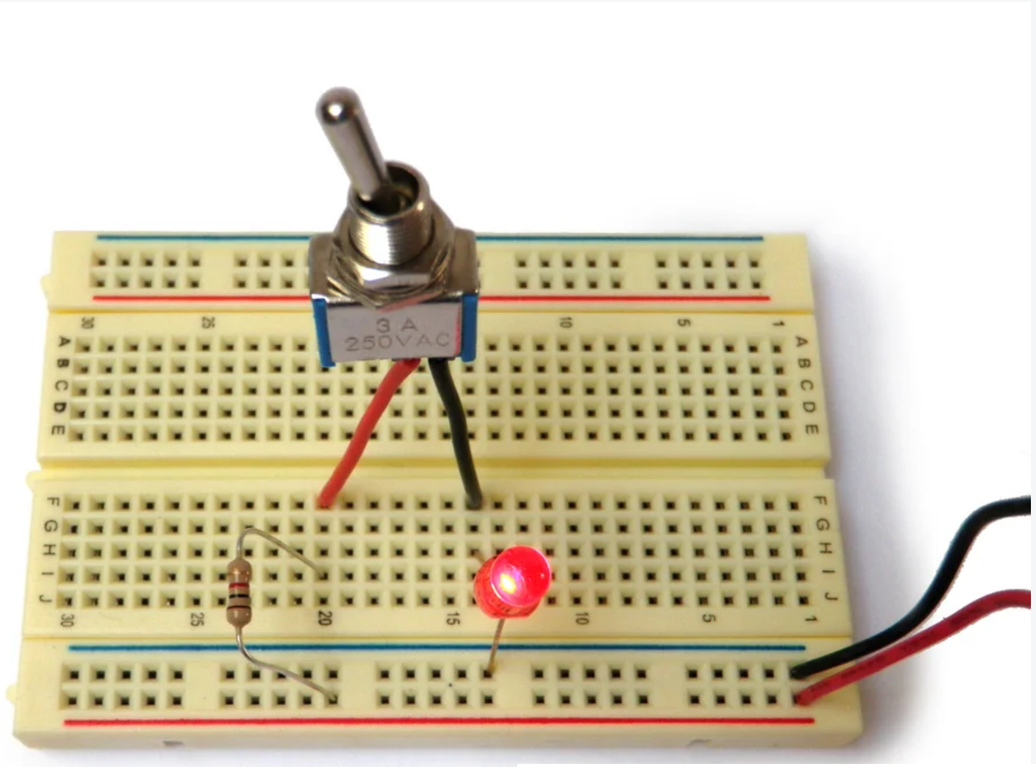
Ref:https://www.instructables.com/Basic-Electronics/

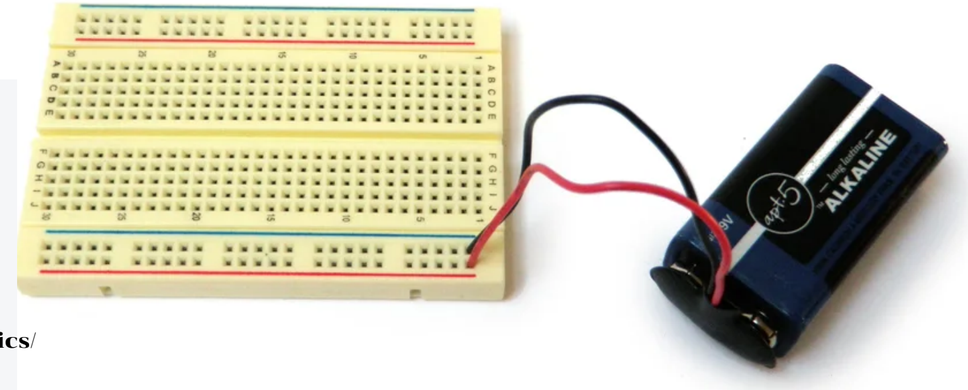
Step 16: Wire (Con.)

Ref:https://www.instructables.com/Basic-Electronics/

Step 17: Your First Circuit







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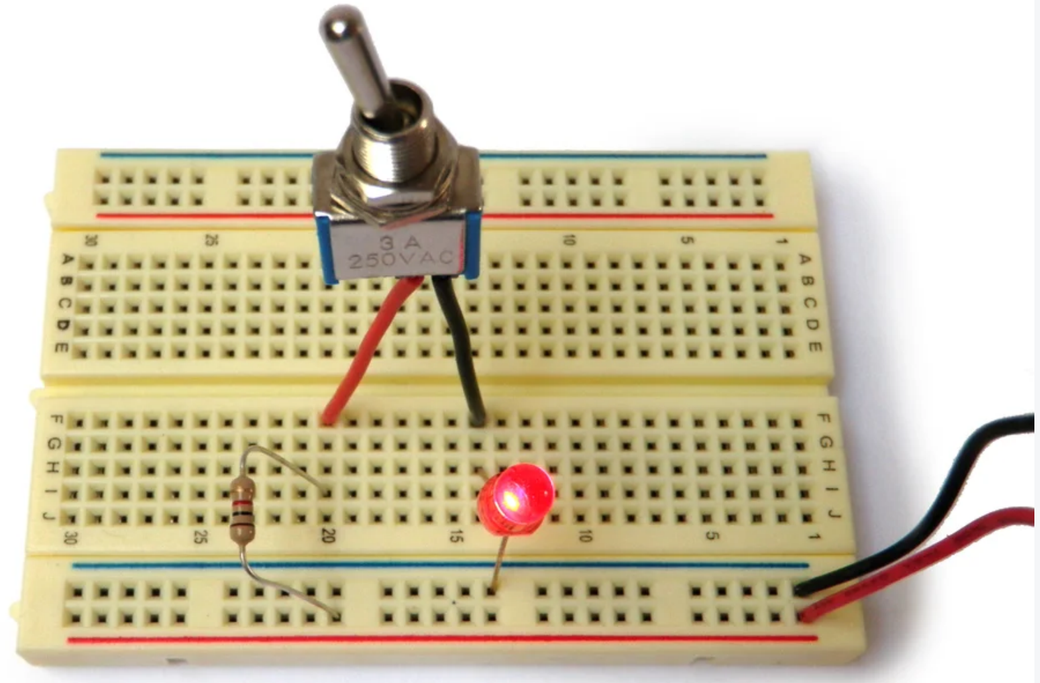
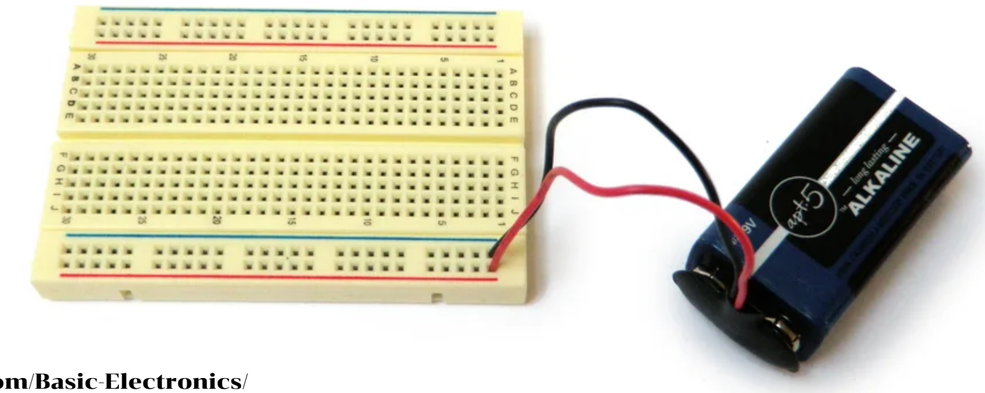
Step 17: Your First Circuit (Con.)



Parts List:
1K ohm - 1/4 Watt resistor
5mm red LED
SPST toggle switch
9V battery connector



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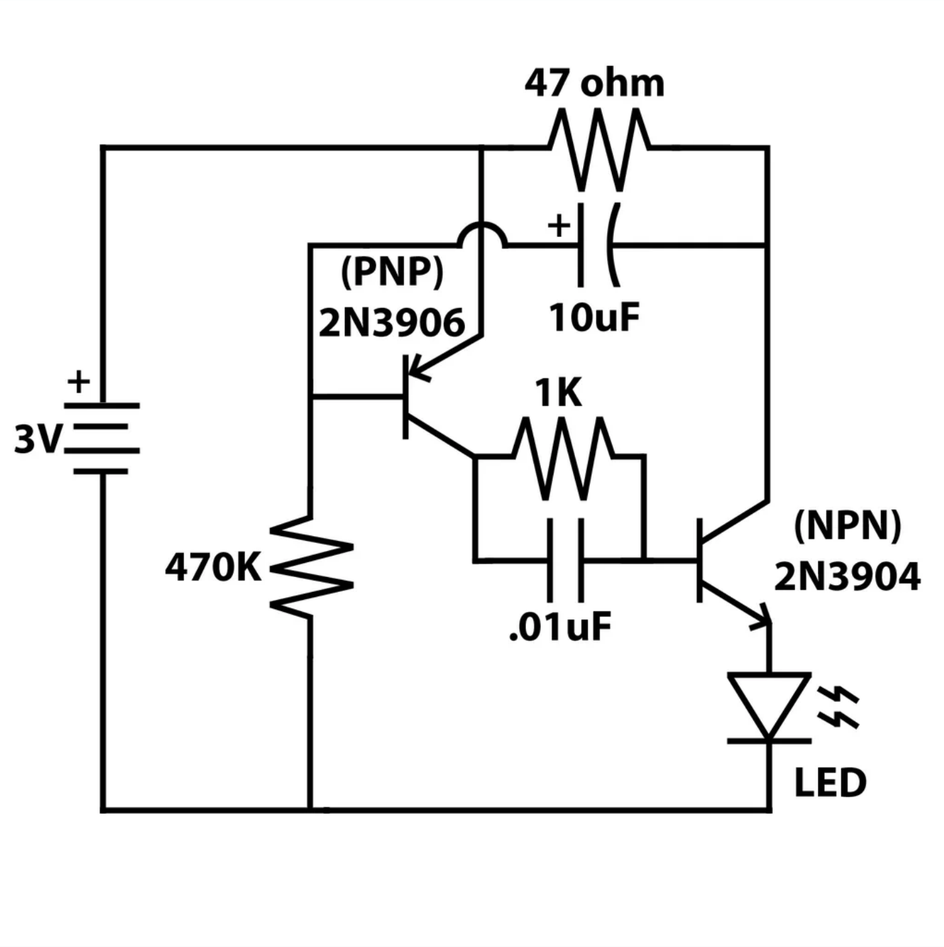
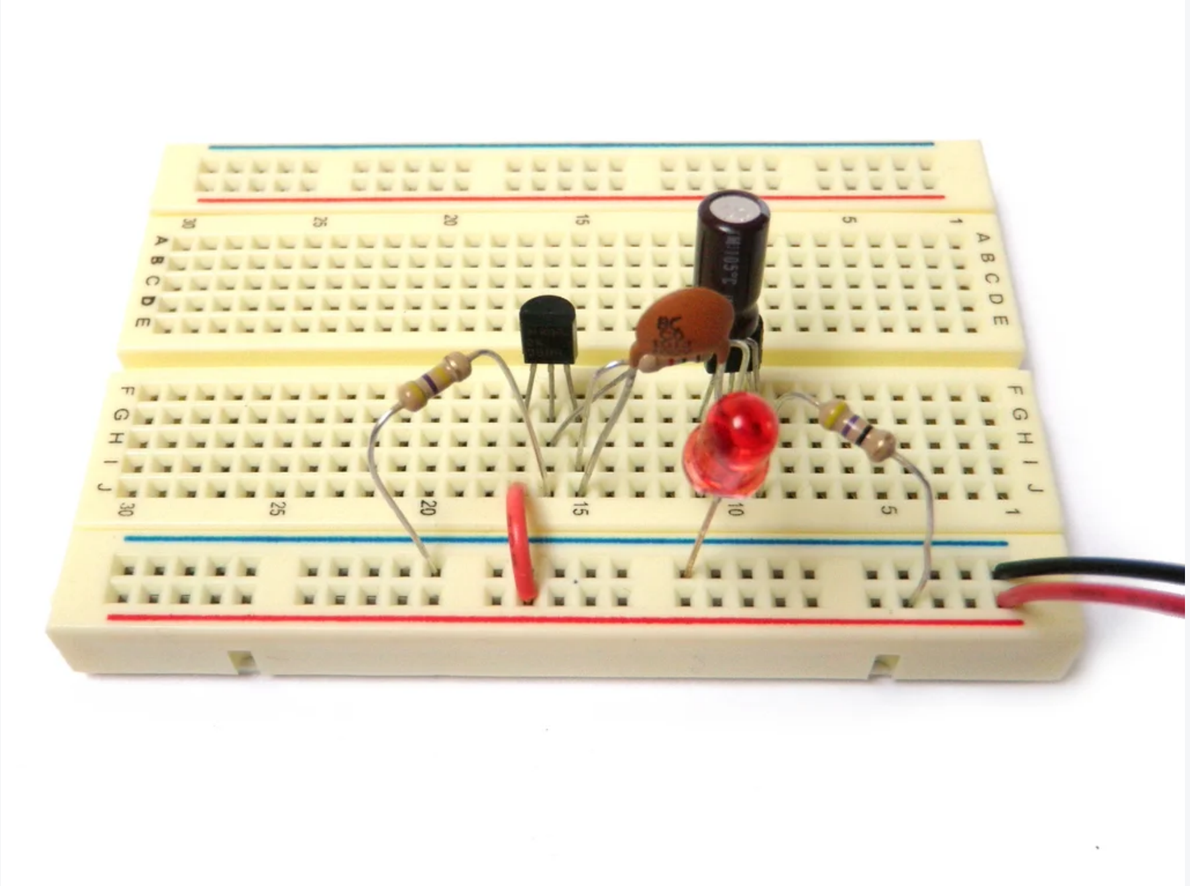
Step 18: Your Second Circuit





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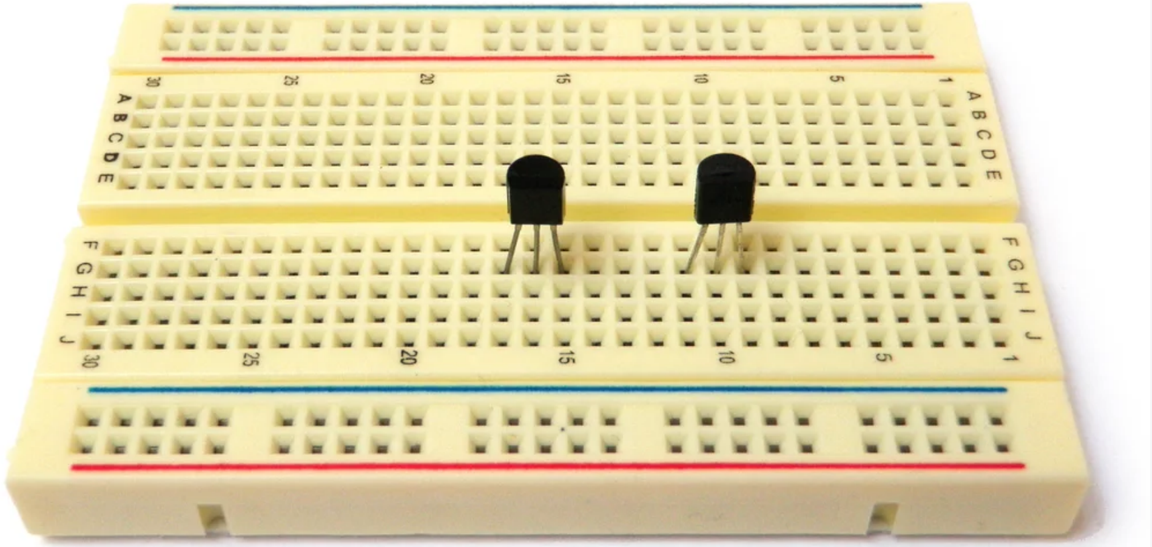
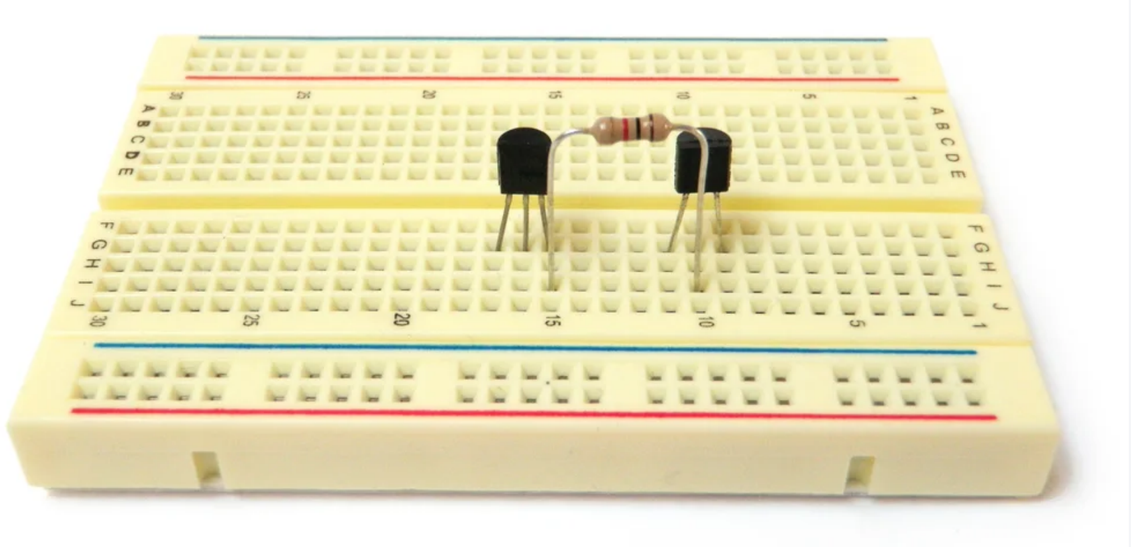
Step 18: Your Second Circuit (Con.)





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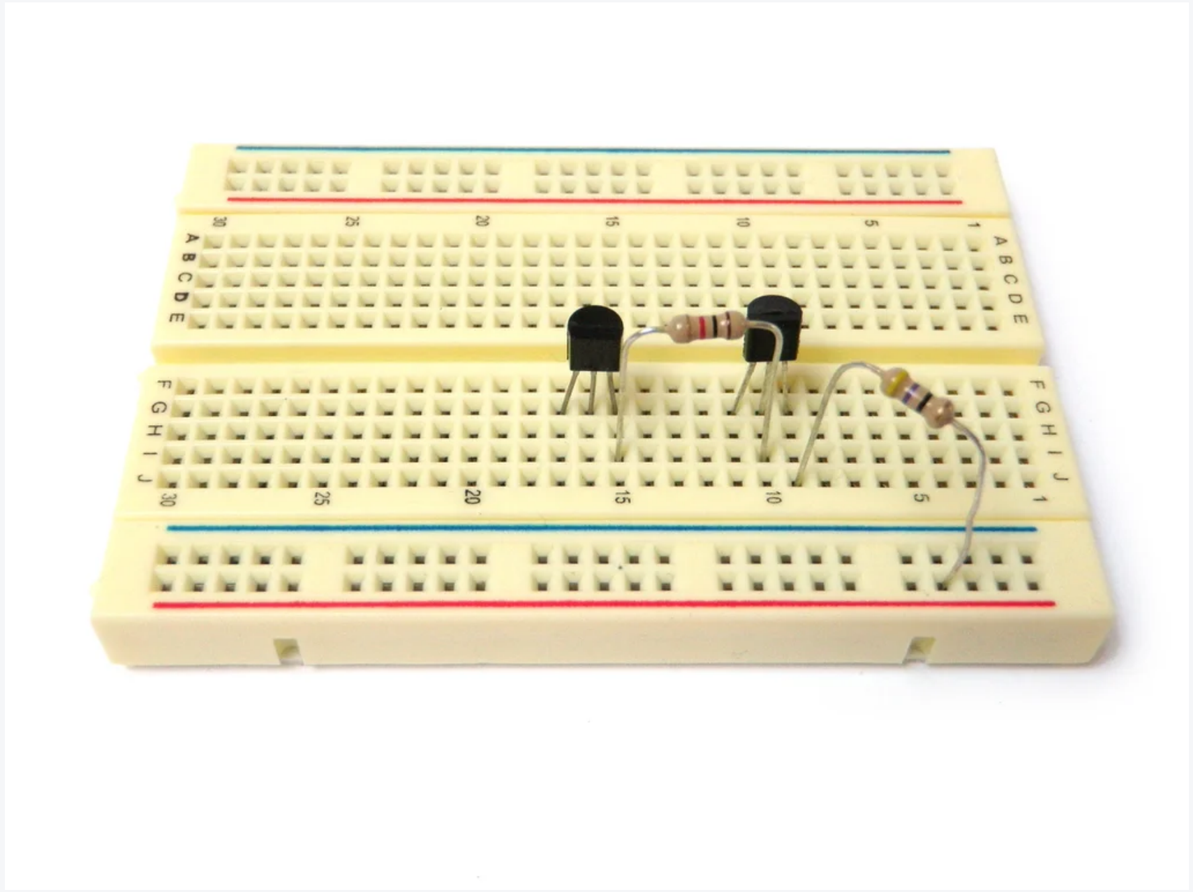
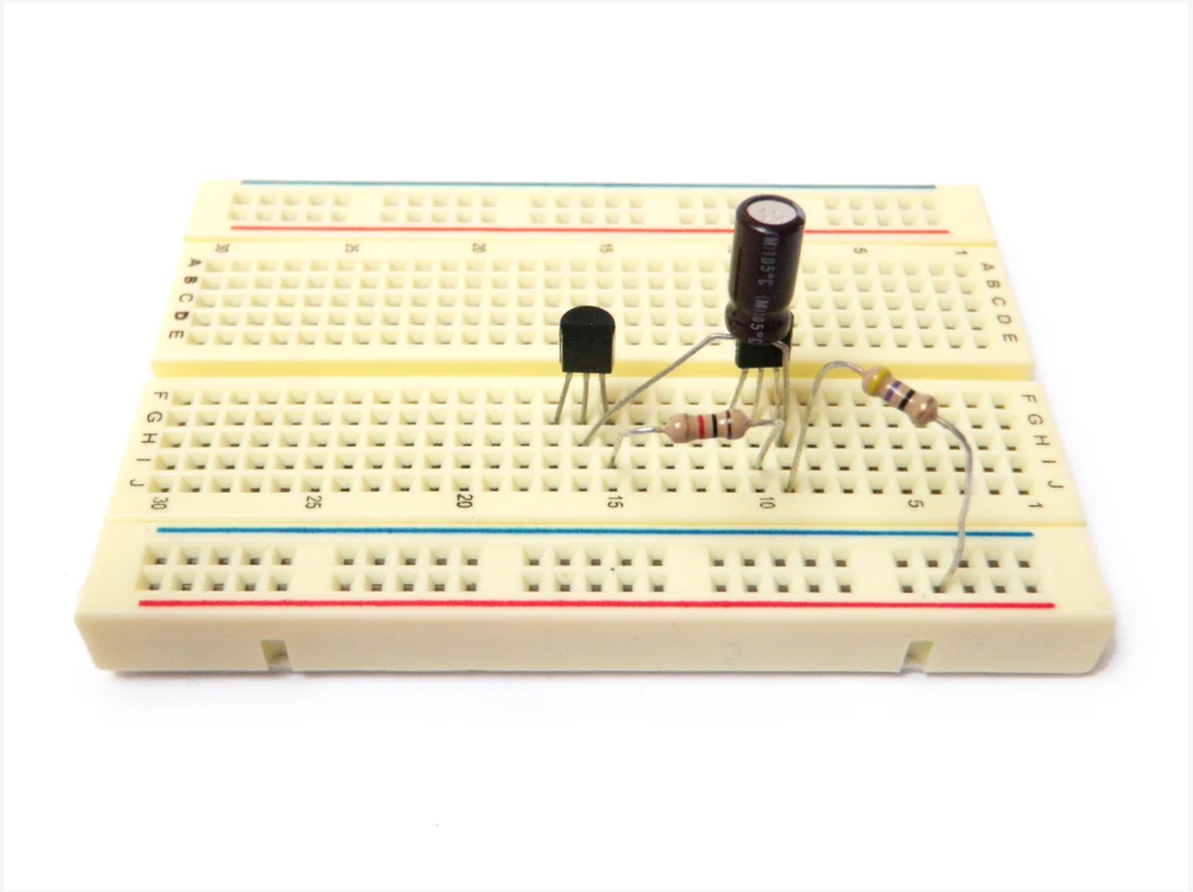
Step 18: Your Second Circuit (Con.)





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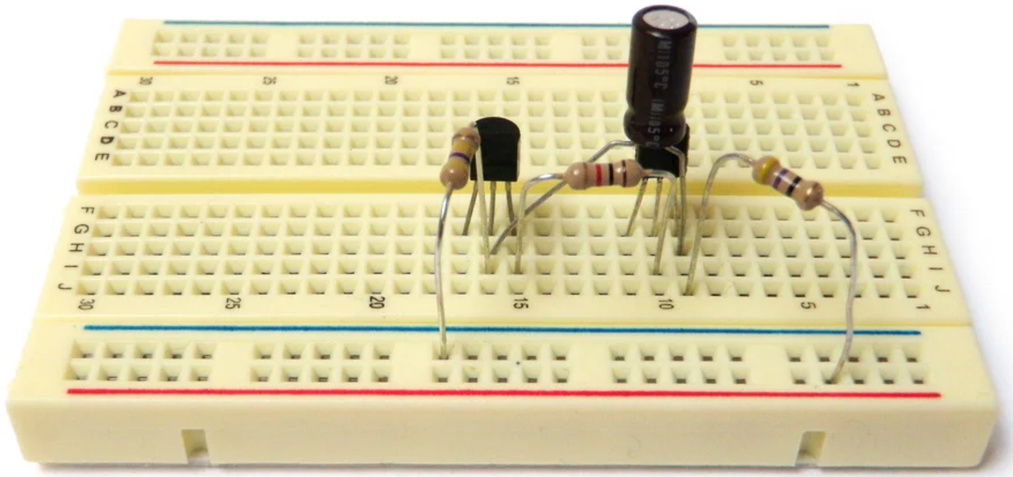
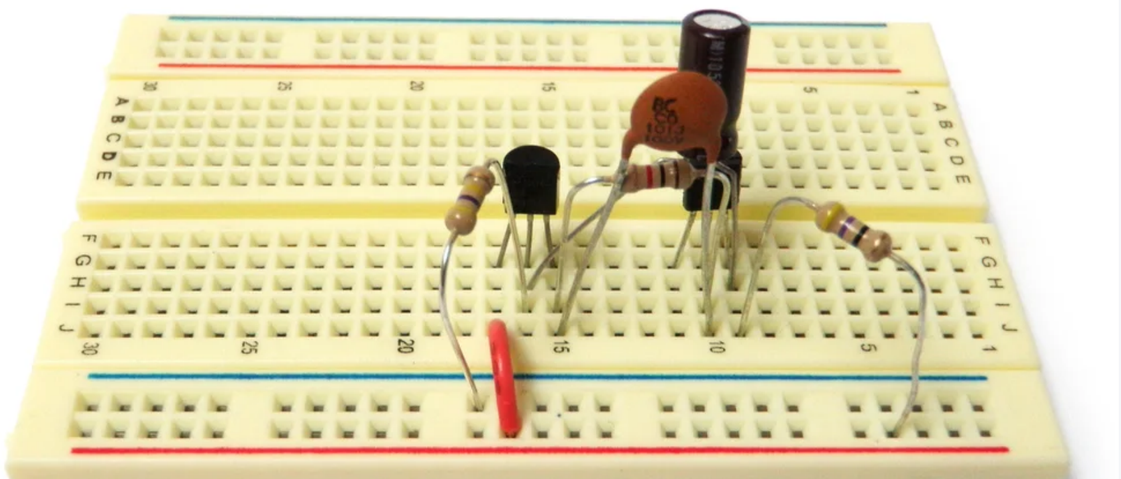
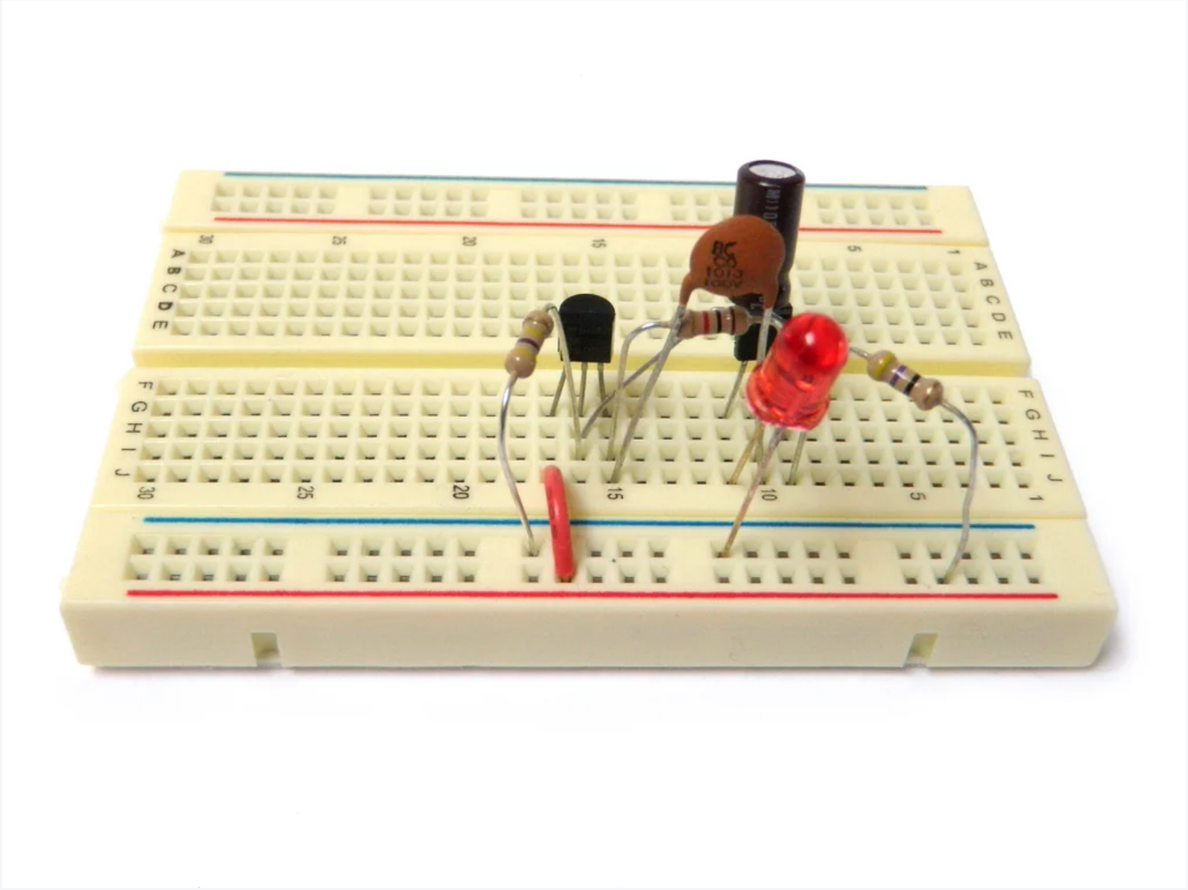




Ref:https://www.instructables.com/Basic-Electronics/

Step 18: Your Second Circuit (Con.)



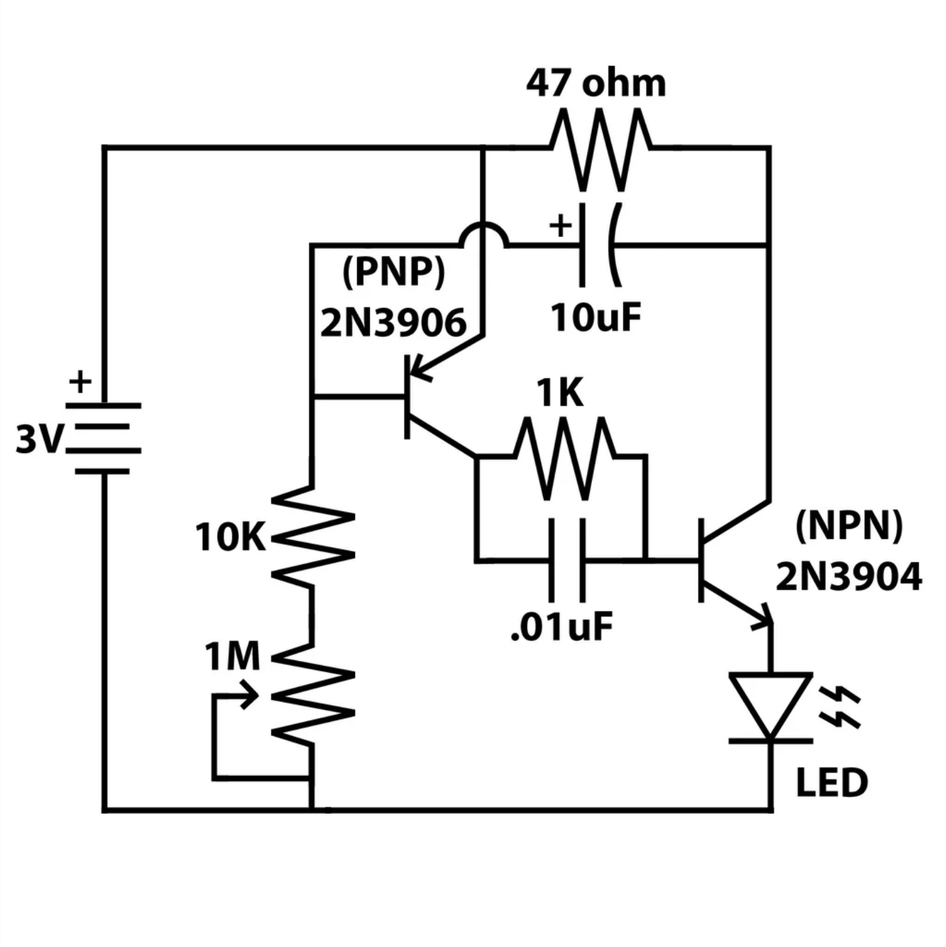
Automatically blink an LED.

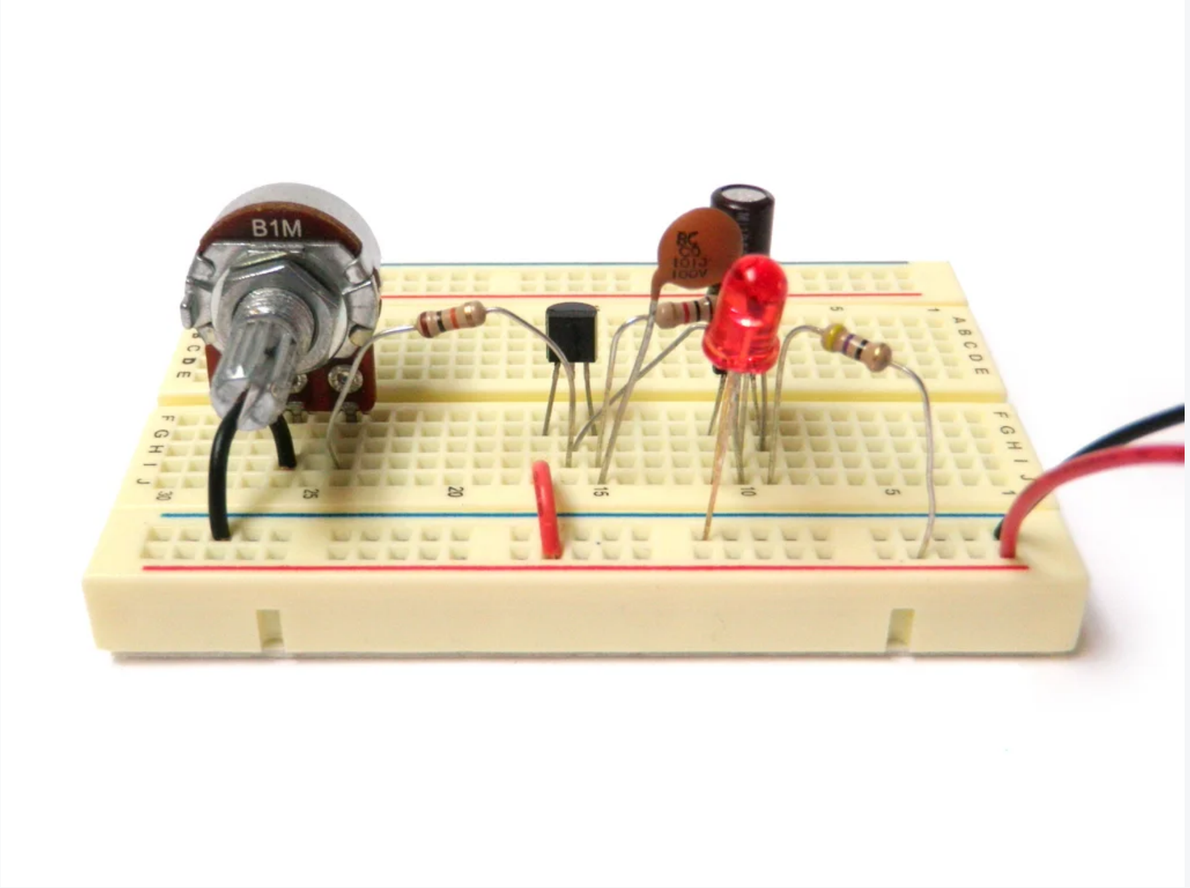
Parts List:
2N3904 PNP transistor
2N3906 NPN transistor
47 ohm - 1/4 Watt resistor
1K ohm - 1/4 Watt resistor
470K ohm - 1/4 Watt resistor
10uF electrolytic capacitor
0.01uF ceramic disc capacitor
5mm red LED
3V AA battery holder

Optional:
10K ohm - 1/4 Watt resistor
1M potentiometer

Ref:https://www.instructables.com/Basic-Electronics/

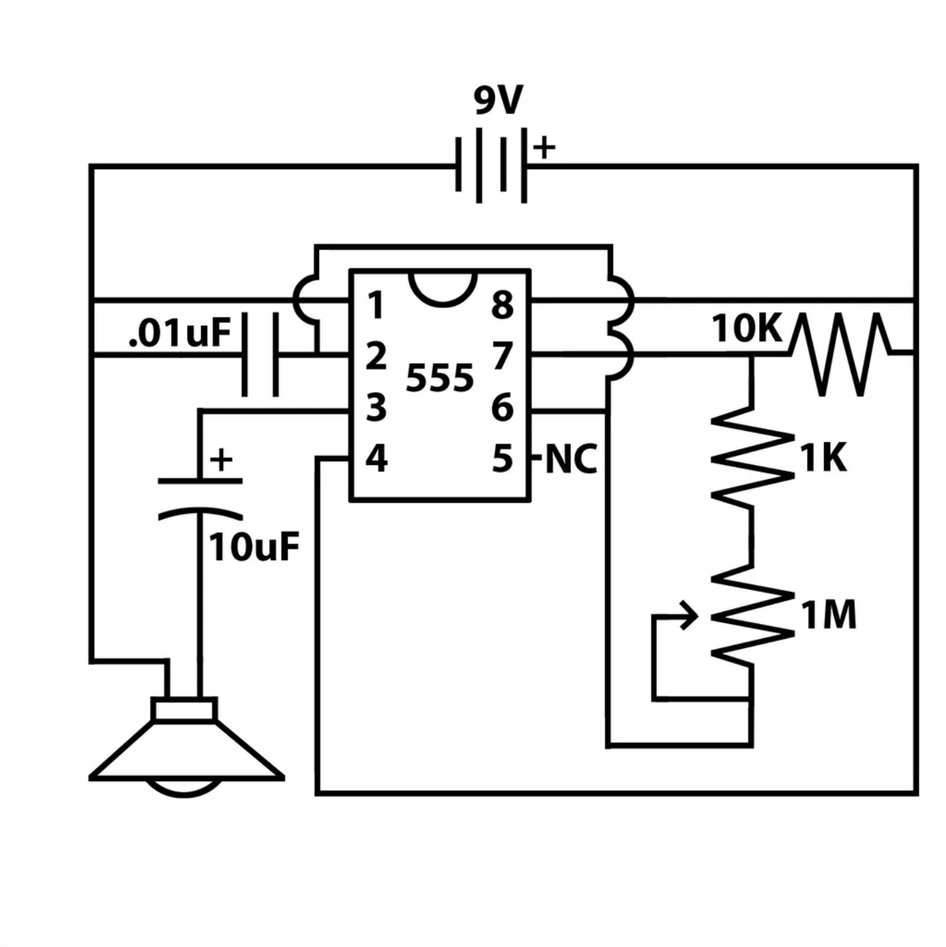
Step 18: Your Second Circuit (Con.)

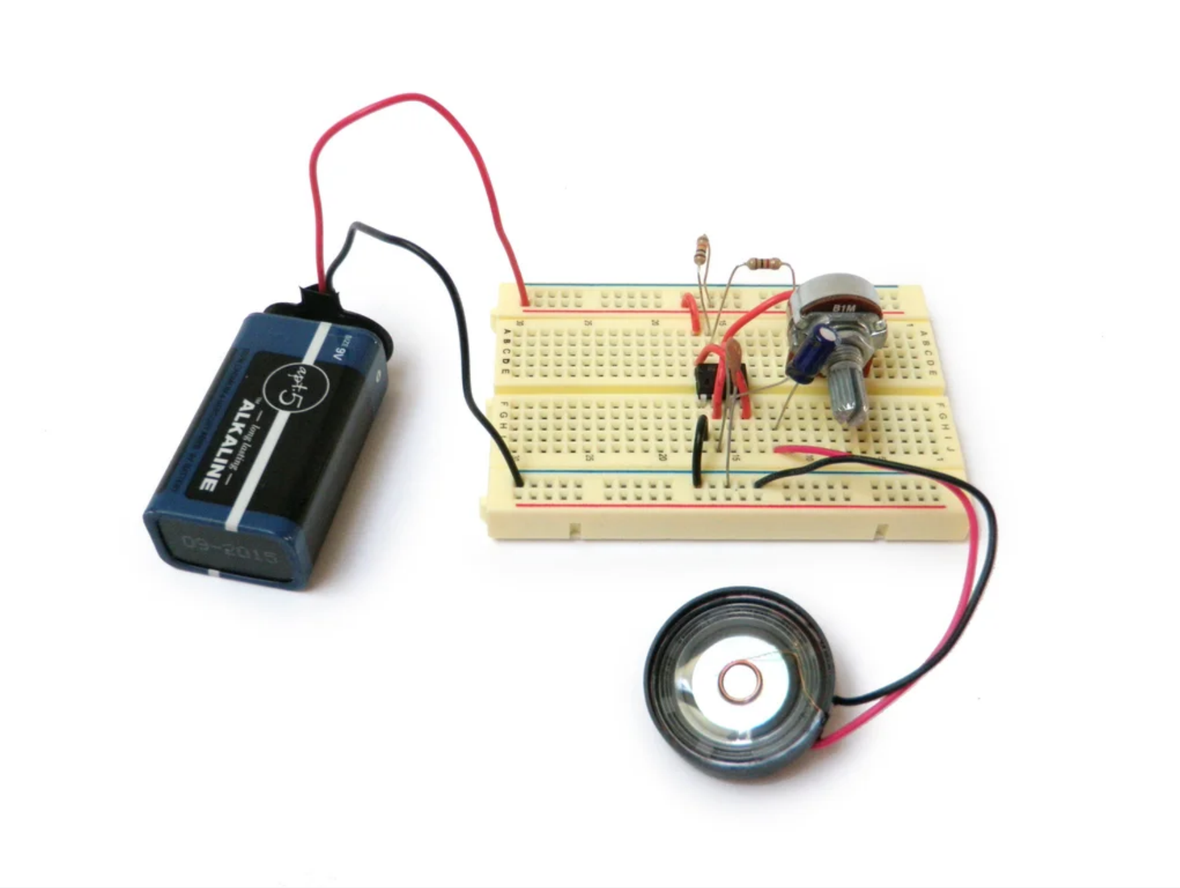




Ref:https://www.instructables.com/Basic-Electronics/

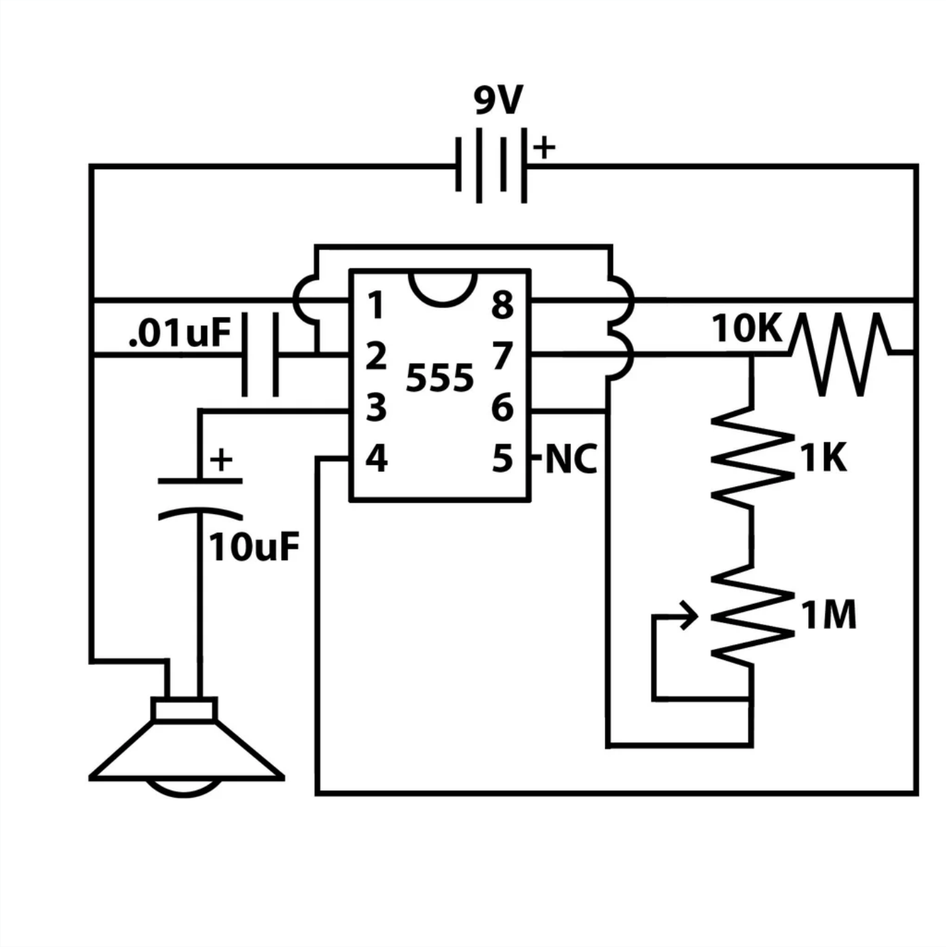
Step 19: Your Third Circuit





Ref:https://www.instructables.com/Basic-Electronics/

Step 19: Your Third Circuit



This last circuit is using a 555 timer chip to make noise using a speaker.

Parts List:

555 Timer IC
1K ohm - 1/4 Watt resistor
10K ohm - 1/4 Watt resistor
1M ohm - 1/4 Watt resistor
10uF electrolytic capacitor
0.01uF ceramic disc capacitor
Small Speaker
9V battery connector

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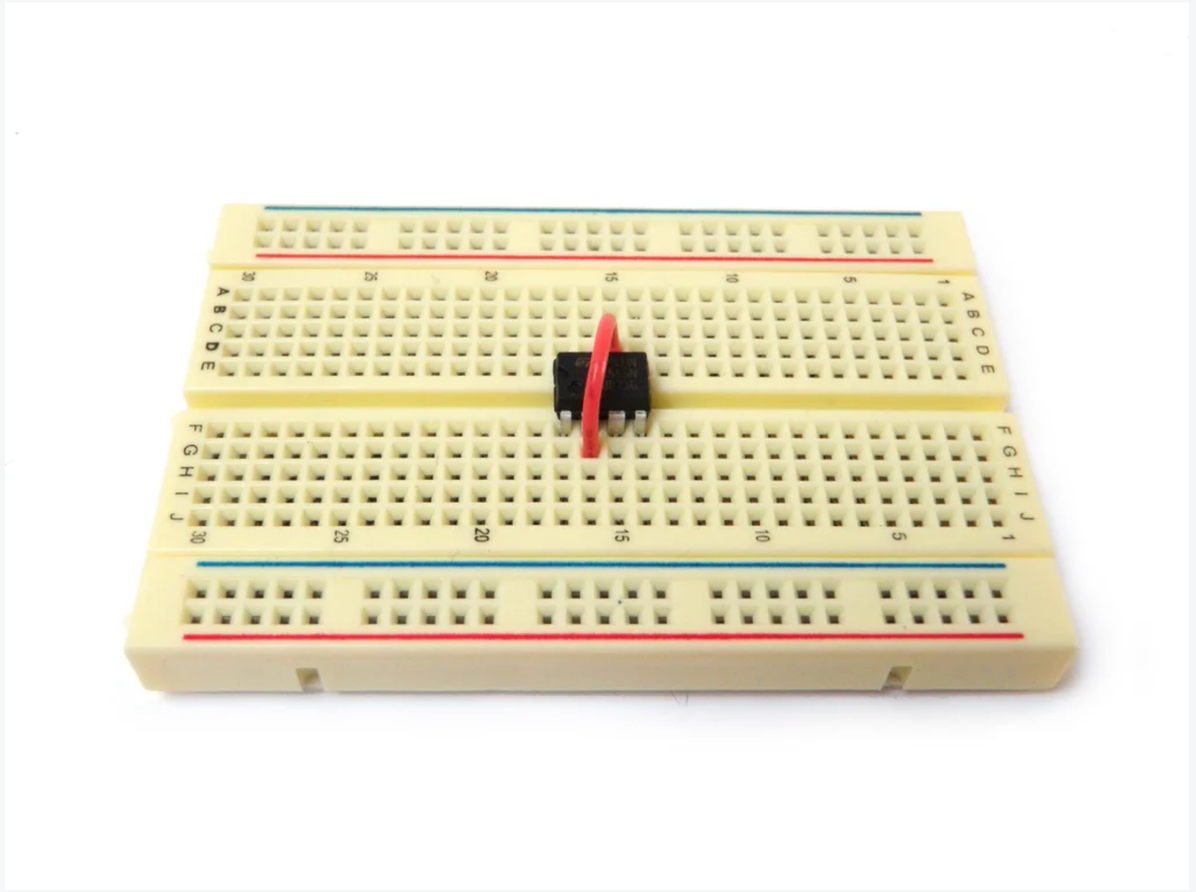
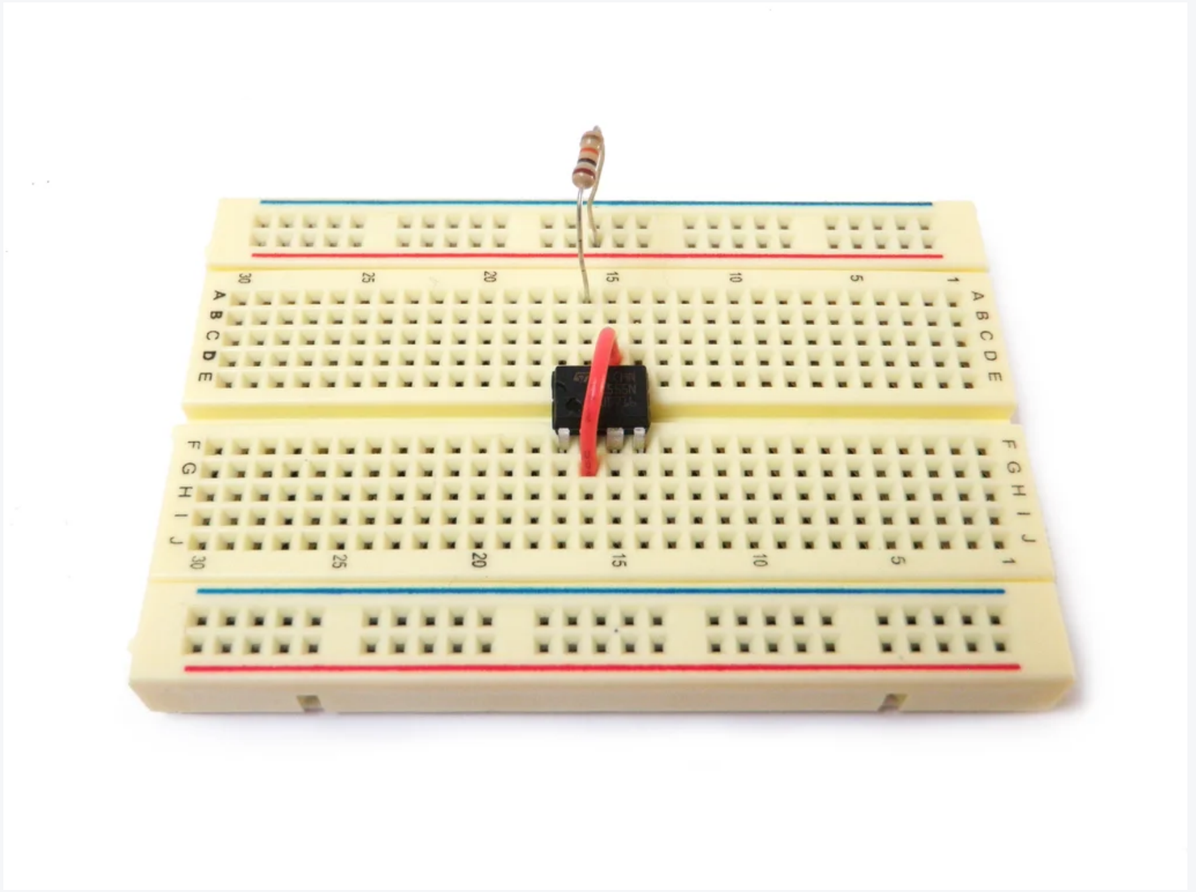
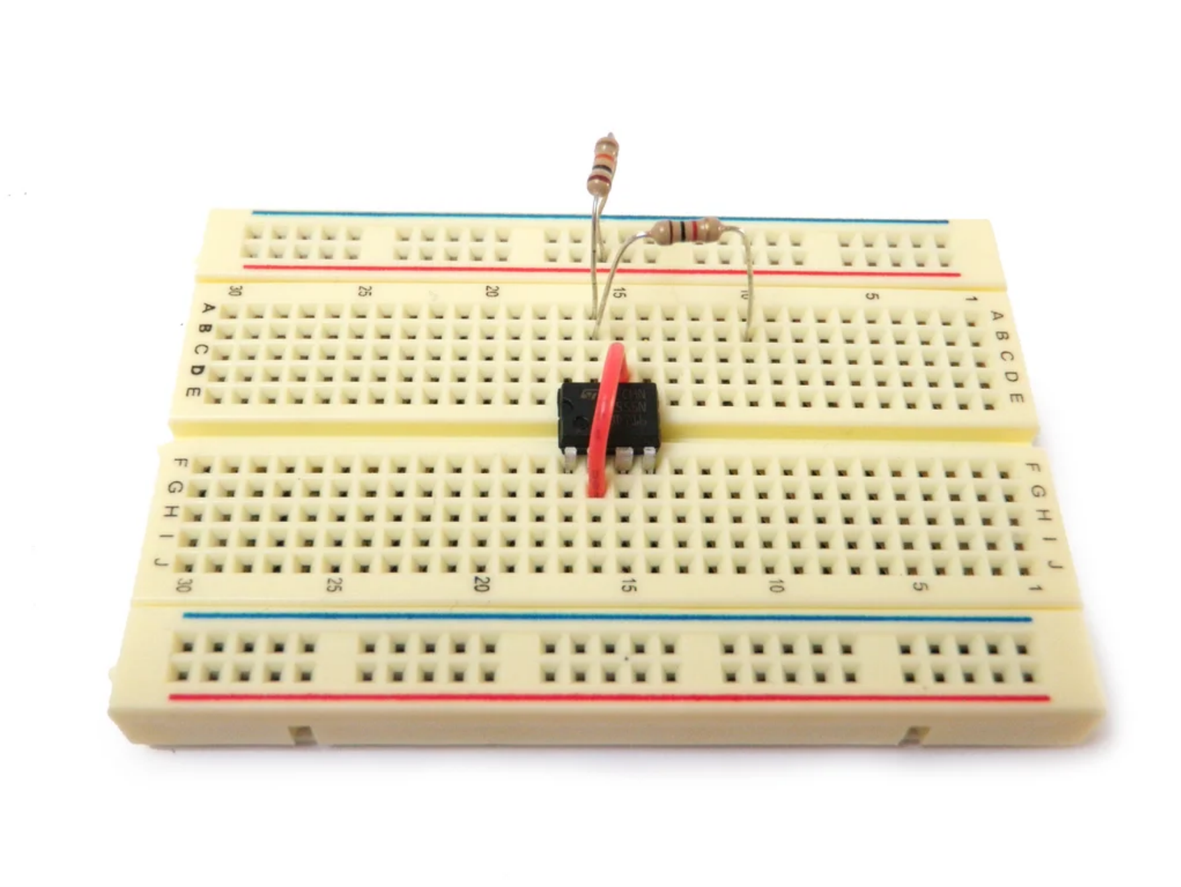
Step 19: Your Third Circuit (Con.)

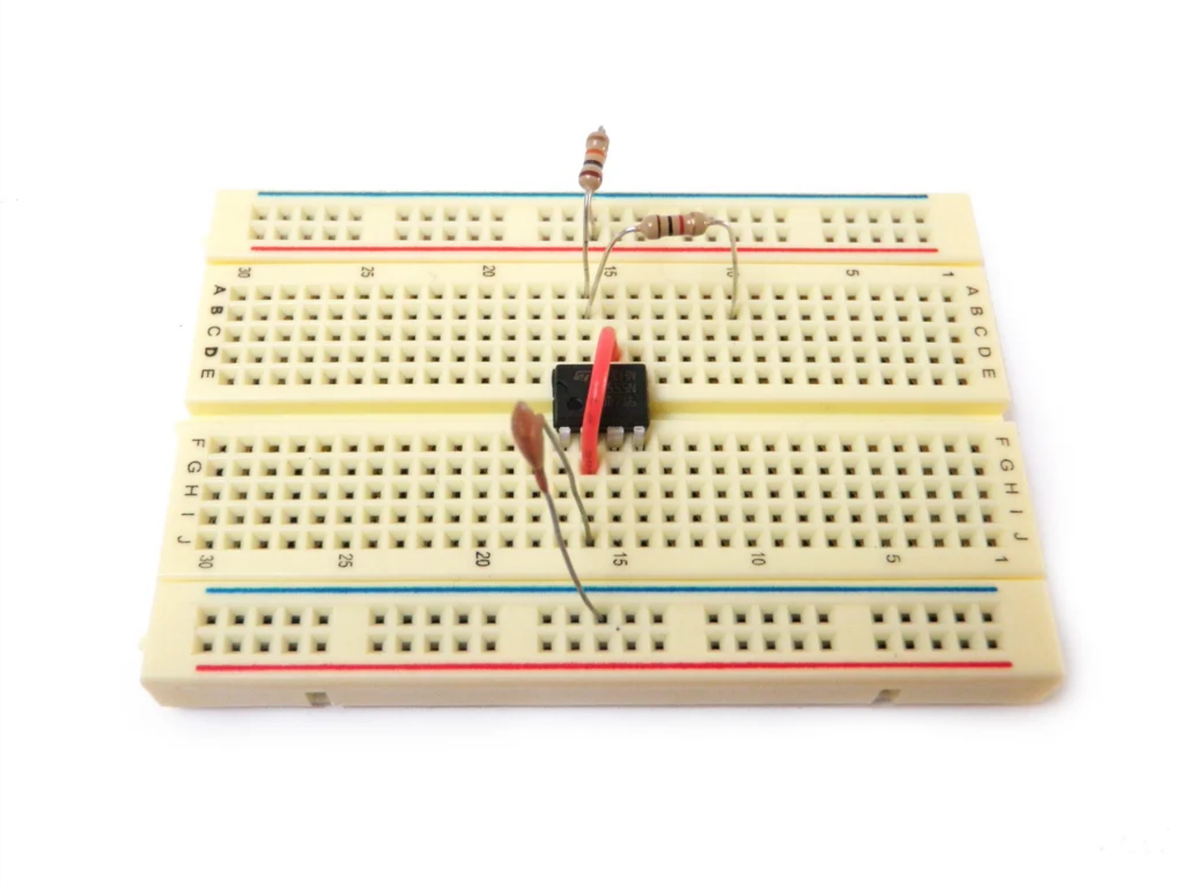




Ref:https://www.instructables.com/Basic-Electronics/

Step 19: Your Third Circuit (Con.)





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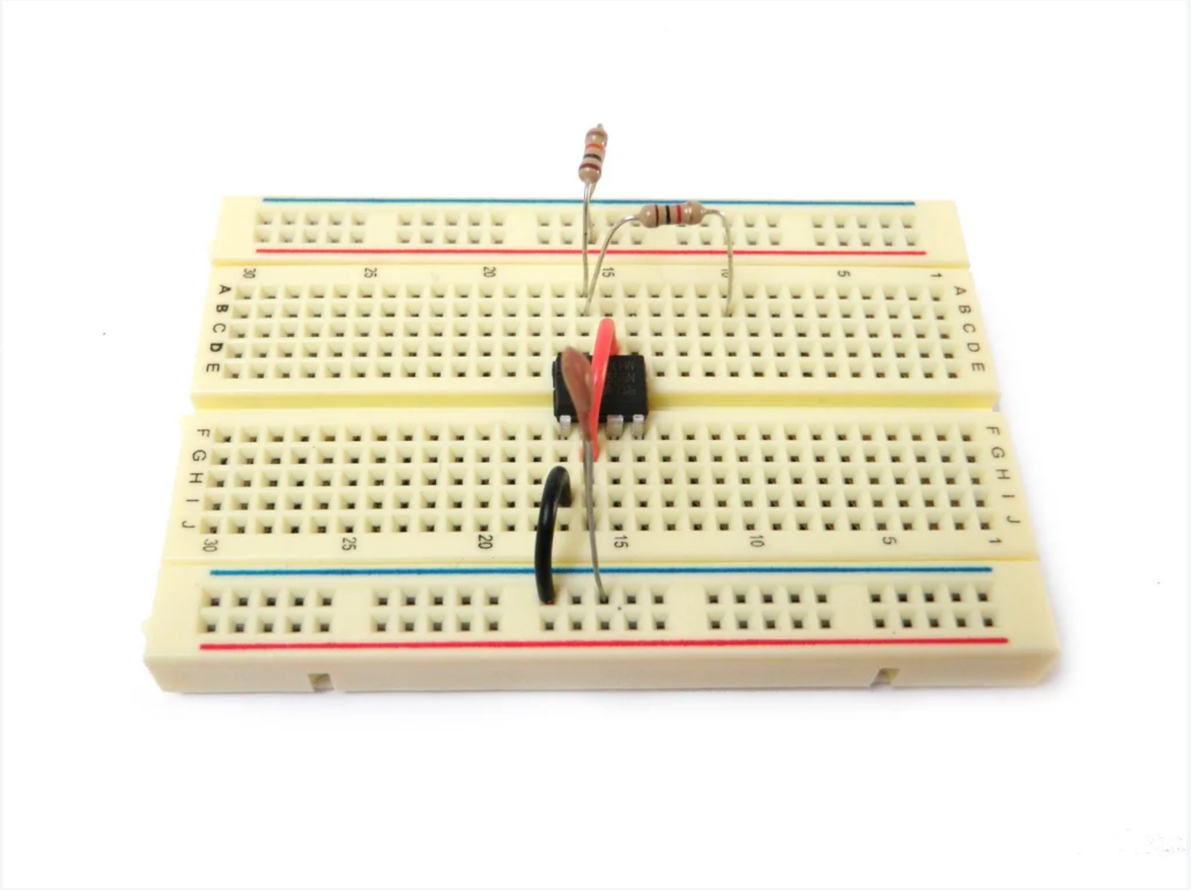
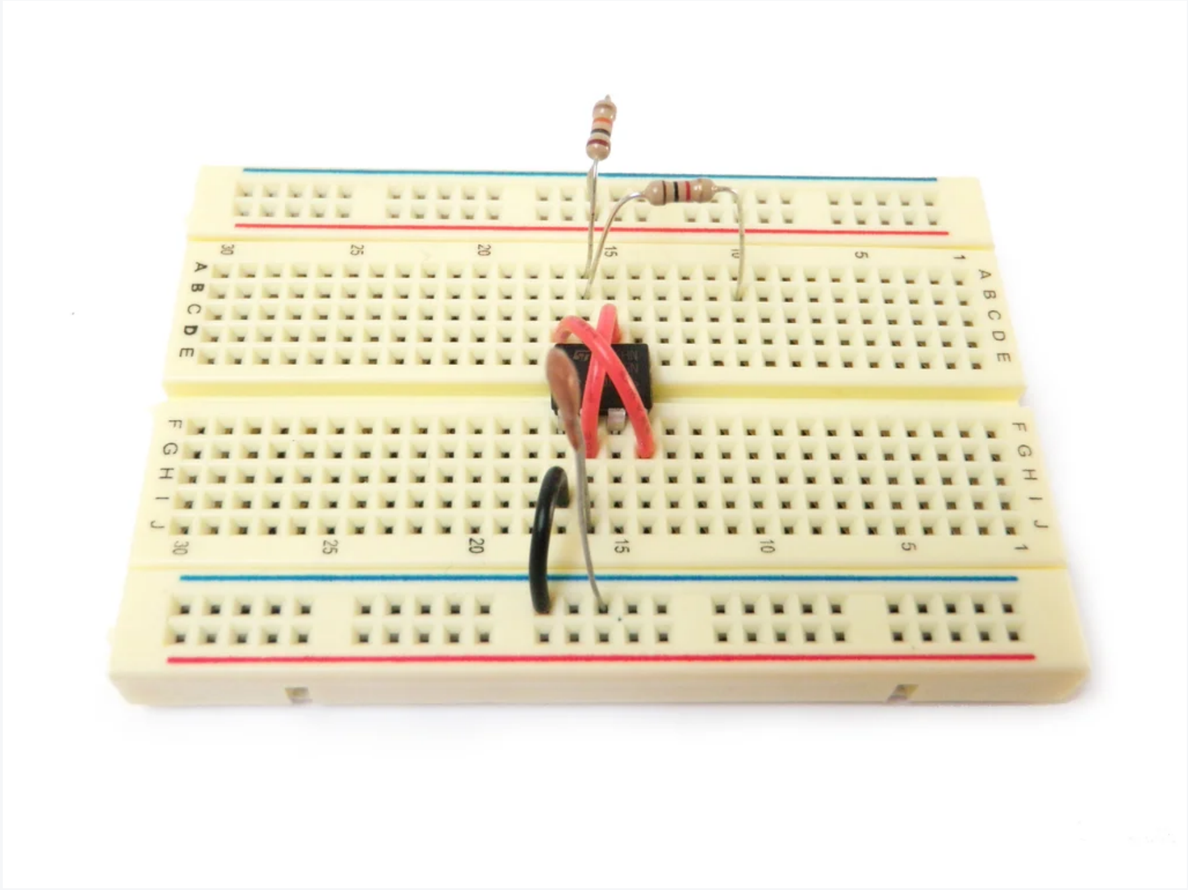
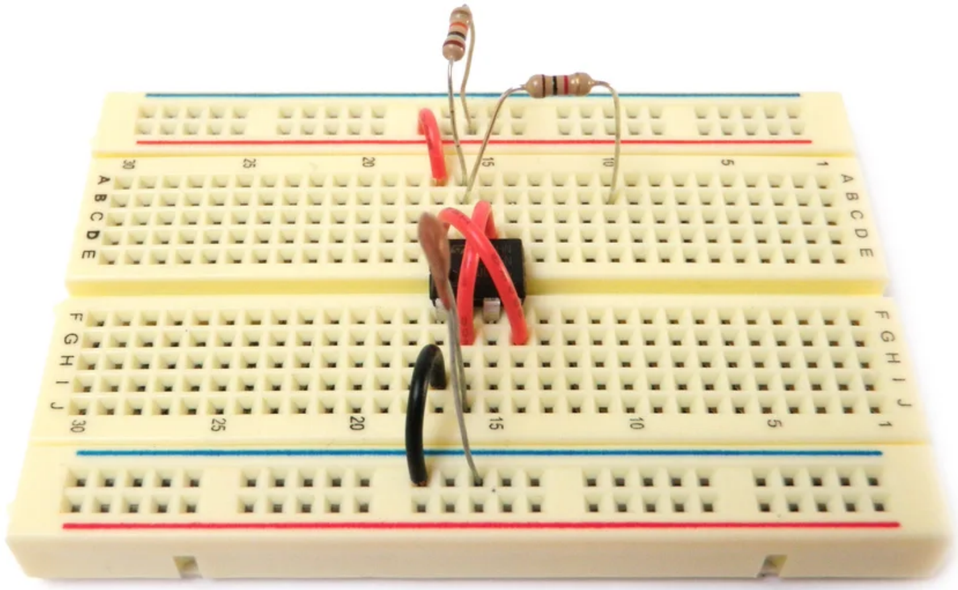
Step 19: Your Third Circuit (Con.)

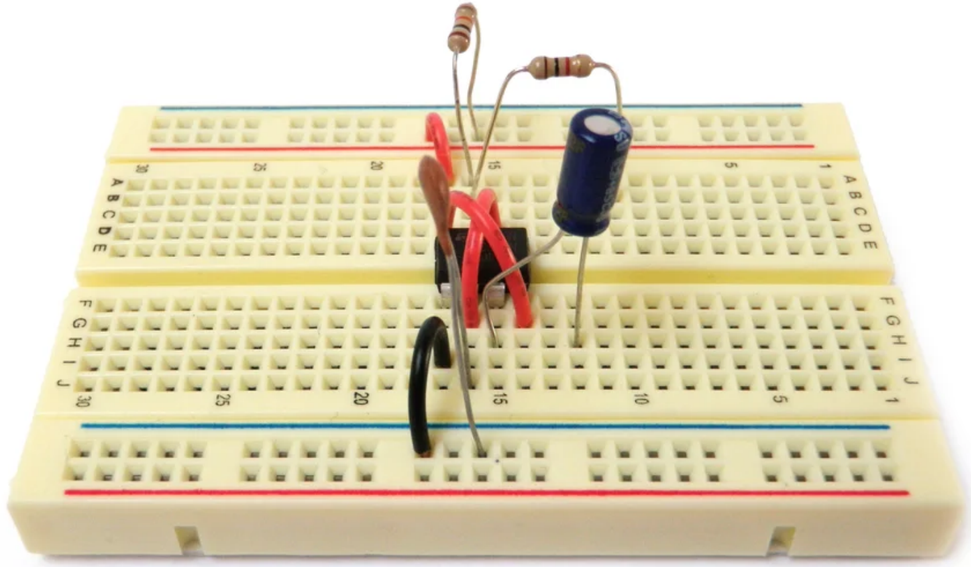




Ref:https://www.instructables.com/Basic-Electronics/

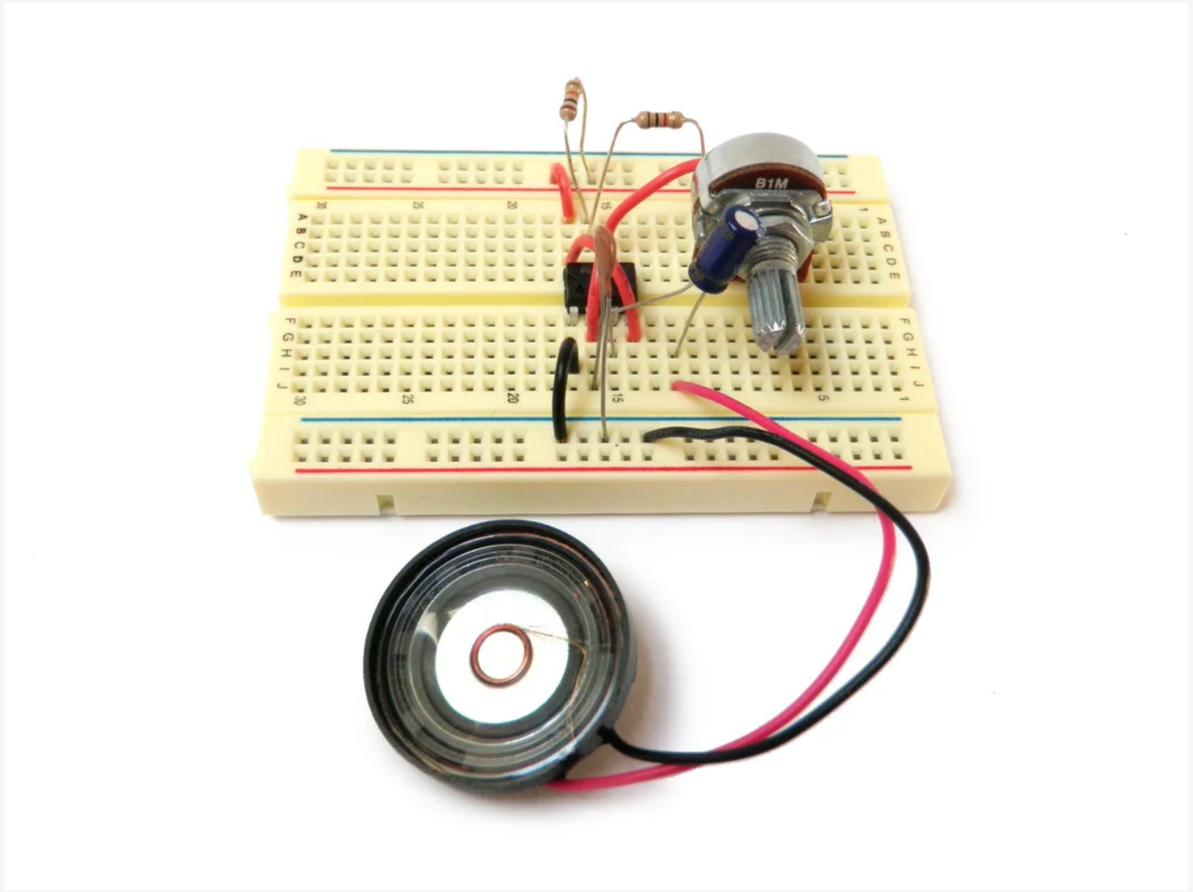
Step 19: Your Third Circuit (Con.)

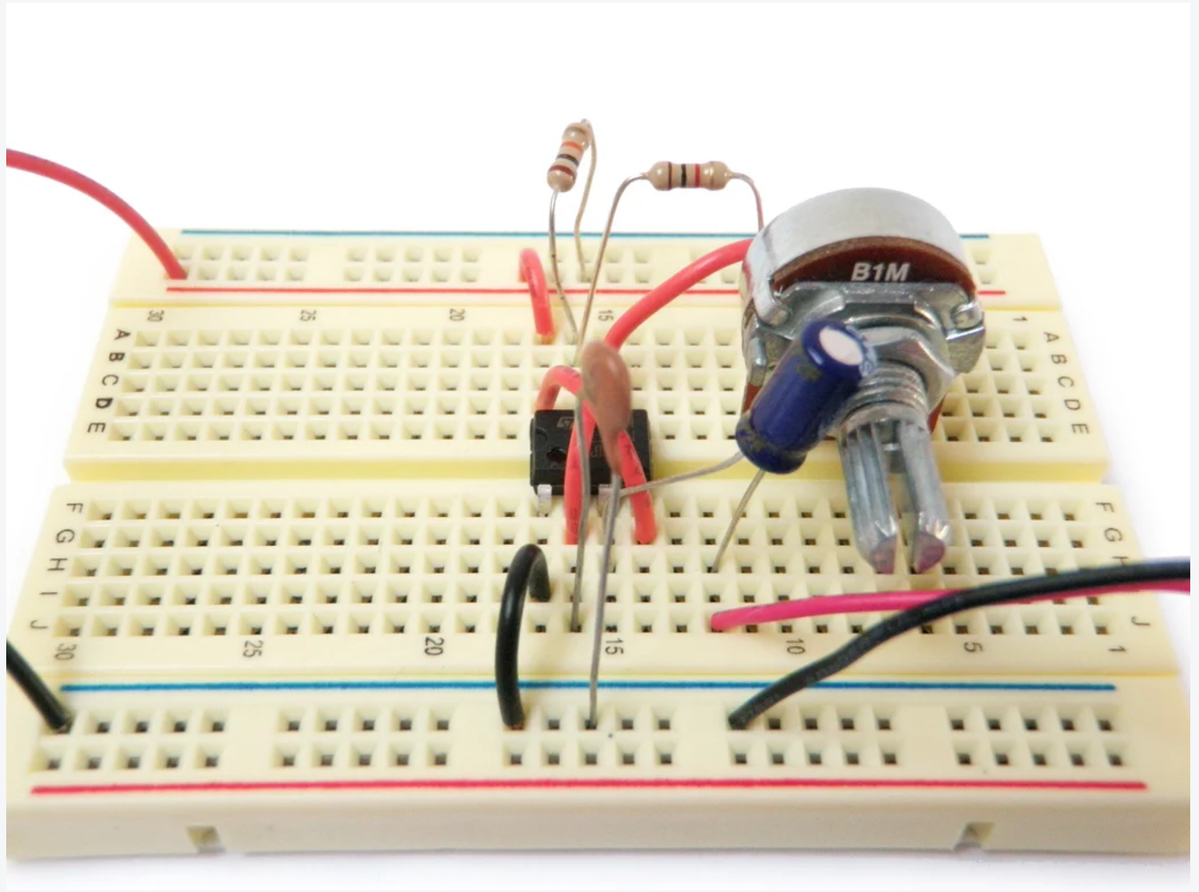




Ref:https://www.instructables.com/Basic-Electronics/

Step 19: Your Third Circuit (Con.)





Ref:https://www.instructables.com/Basic-Electronics/

Step 19: Your Third Circuit

This last circuit is using a 555 timer chip to make noise using a speaker.

What is happening is that the configuration of components and connections on the 555 chip is causing pin 3 to oscillate rapidly between high and low. If you were to graph these oscillations, it would look like a square wave (a wave the alternates between two power levels). This wave then rapidly pulses the speaker, which displaces air at such a high frequency that we hear this as a steady tone of that frequency.

https://www.electronics-tutorials.ws/waveforms/555_oscillator.html

Step 20: You're on Your Own

Make Your Circuit

http://www.discovercircuits.com/list.htm

Ref:https://www.instructables.com/Basic-Electronics/