Learning About Symbols 1

File: 00-Symbols-1.kicad_sch

Learning About Symbols 2

File: 00-Symbols-2.kicad_sch

Learning About Schematics

File: 00-Schematics.kicad_sch

Light the LED

File: 01-LED.kicad_sch

LEDs and Resistors

File: 02-LED.kicad_sch

RGB Color Mixing

File: 03-RGB.kicad_sch

Storage Tank

File: 04-StorageTank.kicad_sch

Diodes

File: 05-Diodes.kicad_sch

Resistors in Series and Parallel

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Microcontroller ADC

File: 30-MicroADC.kicad_sch

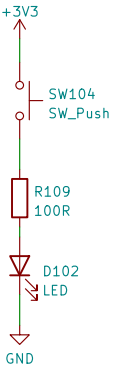
DCZia

Sheet: /

File: thirtyinone-circuits.kicad_sch

Title: 30-IN-One Circuits

Size: A	Date: 2022-06-24	**Rev: 1.0**
KiCad E.D.A. kicad (6.0.5)		Id: 1/34

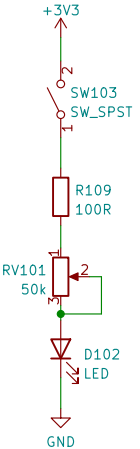


What happens when you press the switch?

Sheet: /Light the LED/
File: 01-LED.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 2/34

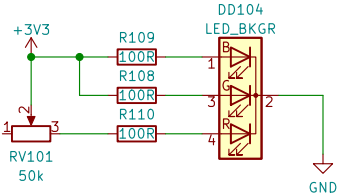


Why do we need a resistor for an LED?

Sheet: /LEDs and Resistors/
File: 02-LED.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 3/34

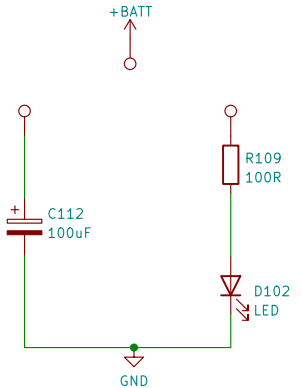


Why does the color change when you rotate RV101?

Sheet: /RGB Color Mixing/
File: 03-RGB.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 4/34

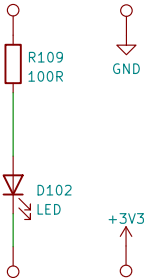


Connect C112 to BATT for a few seconds, and then connect C112 to R109. What happens?

Sheet: /Storage Tank/
File: 04-StorageTank.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 5/34

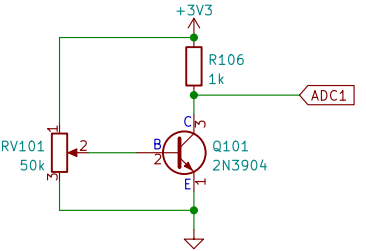


Connect BATT to D102 and GND to R109. Now swap them.
Why does the LED only light in one direction?

Sheet: /Diodes/
File: 05-Diodes.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 6/34

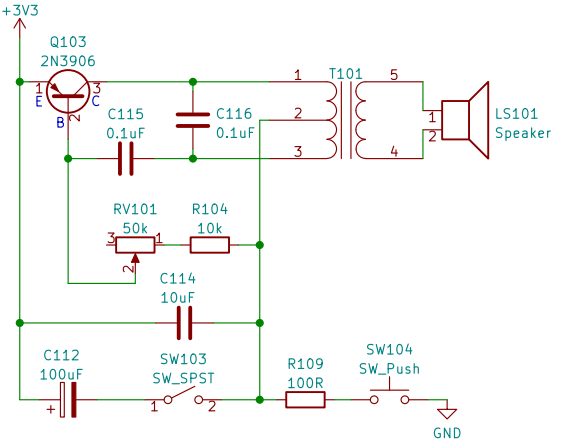


Adjust RV101 until ADC1 measures about 3V. Now press your finger against Q101.
What happens to the voltage?
Why does this happen?

Sheet: /Temperature Sensor/
File: 07-TempSensor.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 7/34



Can you make this circuit meow?

Sheet: /Electronic Cat/
File: 09-ElectronicCat.kicad_sch

Title:

Size: User	Date:	**Rev:**
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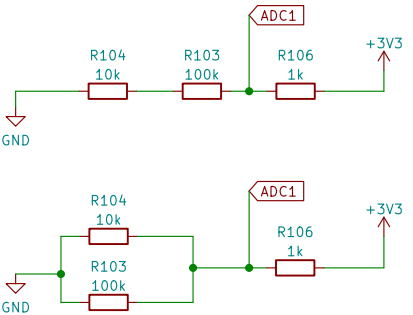

Use ADC1 to measure the voltage in circuit 1 at the test point.
Now build circuit 2 and measure at the same point.
Why are the voltages different?

Sheet: /Resistors in Series and Parallel/
File: 06-Resistors.kicad_sch

Title:

Size: User	Date:	**Rev:**
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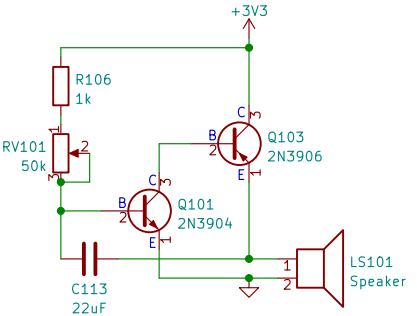
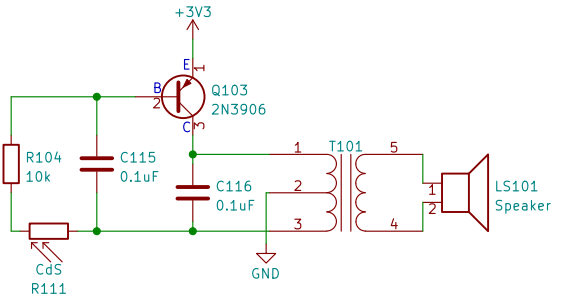


How do these two transistors make noise?

Sheet: /Metronone/
File: 08-Metronome.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 10/34

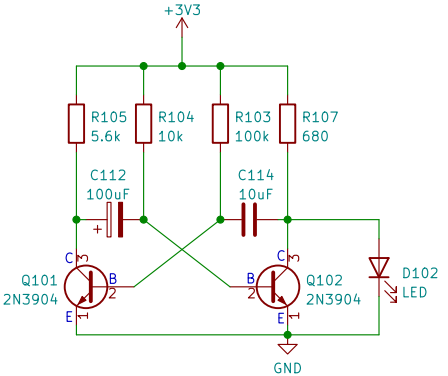


Can you rev the motorcycle?

Sheet: /Electronic Motorcycle/
File: 10-ElectronicMotorcycle.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 11/34

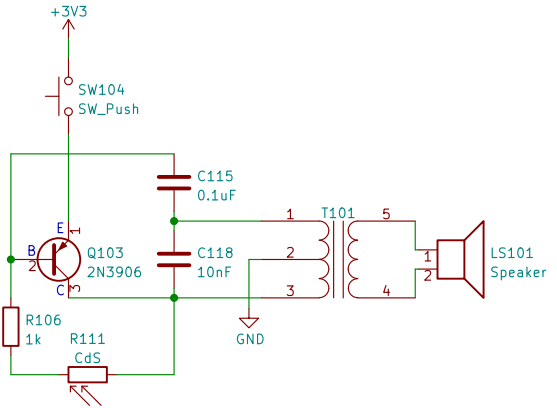


The transistors take turns conducting, making the LED blink

Sheet: /The Blinker/
File: 15-TheBlinker.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 12/34

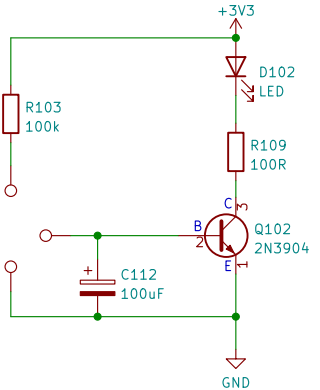


Can you use light to play a song?

Sheet: /Light Theremin/
File: 12-LightTheremin.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 13/34

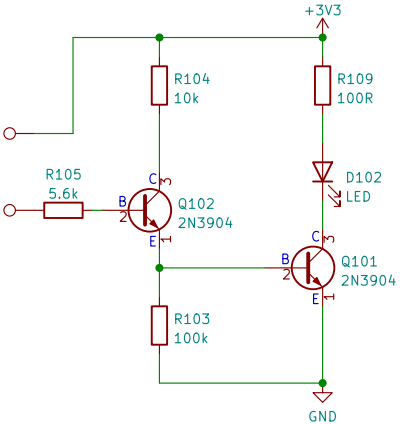


Connect Q102 to R103 with a wire. D102 will slowly light.
Now remove the wire. D102 will slowly turn off.
Touch the wire to ground to quickly turn off the light.

Sheet: /Sunrise – Sunset/
File: 13–SunriseSunset.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 14/34

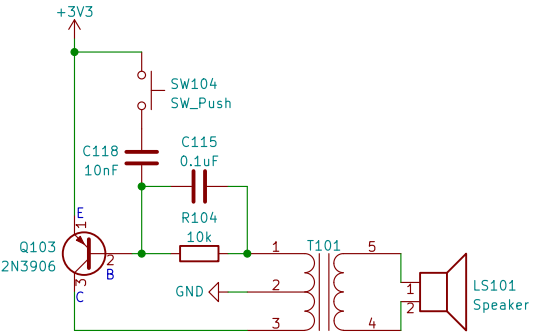


Don't touch the two wires together, but hold them tightly in your hands. Can you turn on the light?

Sheet: /Touch Circuit/
File: 14-TouchCircuit.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 15/34

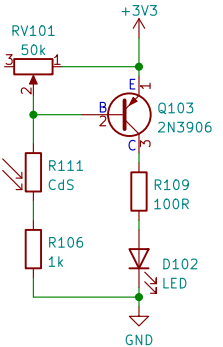


Is this an illegal circuit?

Sheet: /Patrol Car Siren/
File: 11-PatrolCarSiren.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 16/34

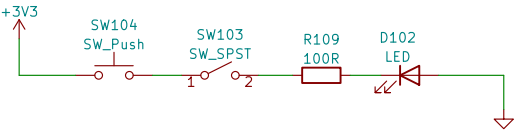


Can you toggle the LED with light?

Sheet: /Light Controlled Switch/
File: 20-LightSwitch.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 17/34

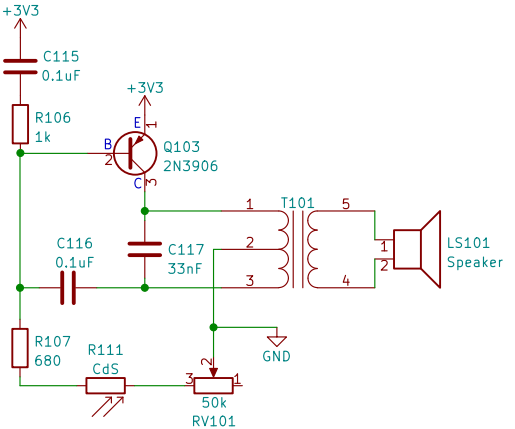


AND – SW104 AND SW103 need to be closed to light D102

Sheet: /Logic AND/
File: 21-AND.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 18/34

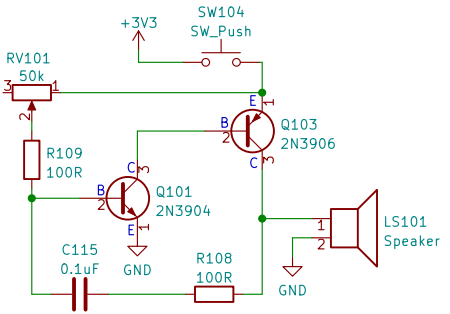


What happens when the sun comes up?

Sheet: /Early Bird/
File: 16-EarlyBird.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 19/34

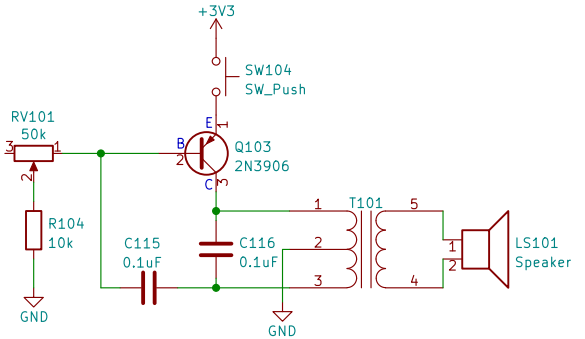


Can you make some music with this circuit?

Sheet: /Audio Osc/
File: 17-AudioOsc.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 20/34

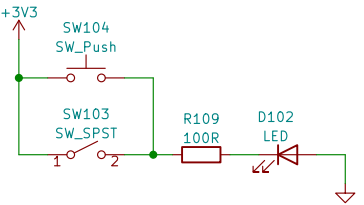


What happens as you adjust RV101?

Sheet: /Pulse Osc/
File: 19-PulseOsc.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 21/34

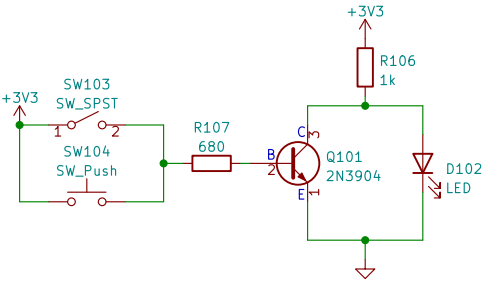


OR – SW104 OR SW103 need to be closed to light D102

Sheet: /Logic OR/
File: 22-OR.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 22/34

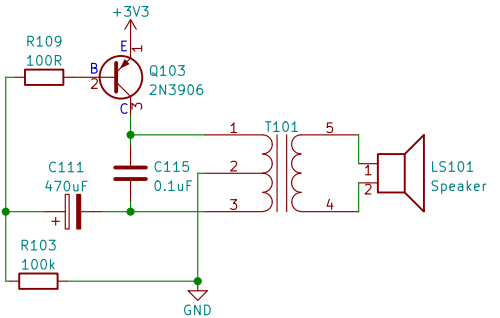


NOR – D102 is only on when SW103 NOR SW104 is switched

Sheet: /Logic NOR/
File: 23-NOR.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 23/34

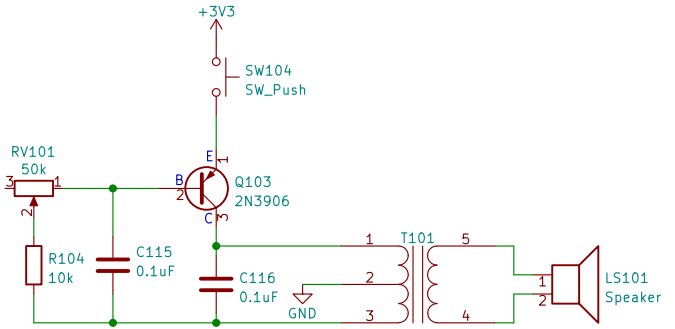


What happens to the tick rate if you change R103?

Sheet: /Grandfather Clock/
File: 18-GrandfatherClock.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 24/34



Time to practise some Morse code!

Sheet: /Code Practice/
File: 24-CodePractice.kicad_sch

Title:

Size: User	Date:	**Rev:**
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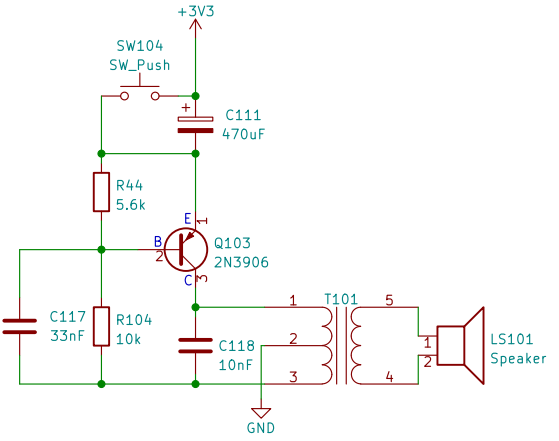
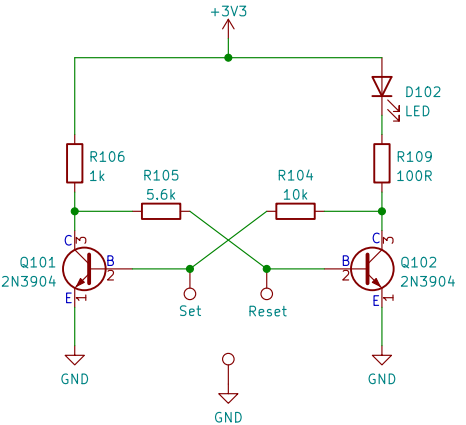


Press SW104, and then release. Why does the speaker remain on?

Sheet: /Turn Off Delay Osc/
File: 25-TurnOffOsc.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 26/34

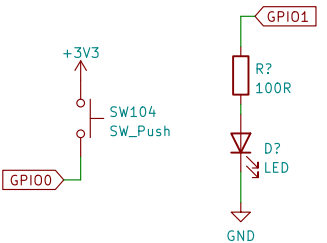


A flip-flop is the cornerstone of computer memory

Sheet: /RS Flip Flop/
File: 26-RSFlipFlop.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 27/34

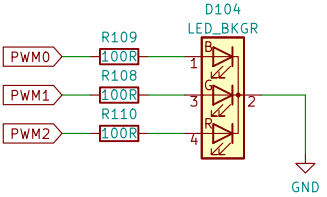


What happens when you press the switch?

Sheet: /Microcontroller GPIO/
File: 27-MicroGPIO.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 28/34

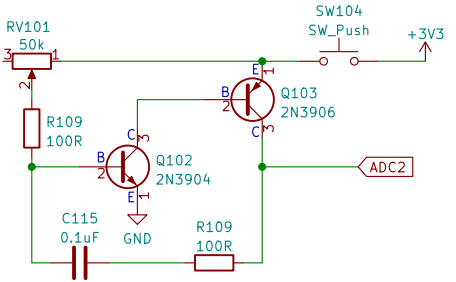


Why is the color cycling?

Sheet: /Microcontroller RGB/
File: 28-MicroRGB.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 29/34

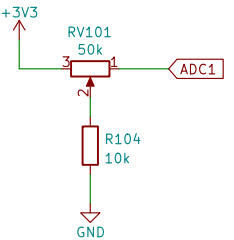


This is the circuit from 17. Can you measure the frequency?

Sheet: /Microcontroller Frequency Counter/
File: 29-MicroFreqCounter.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 30/34



How does an ADC work?

Sheet: /Microcontroller ADC/
File: 30-MicroADC.kicad_sch

Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 31/34

These are power symbols.
3.3v is plus, or positive.
GND is ground, or negative.

Note that the symbols have a letter and a number.
The letter is the type of component. This is a Resistor.
The number is uniquely identify the part on the schematic.
Together, this is called the 'Reference Designator' or 'RefDes'.
Sometimes a component value is present as well.

This is a resistor. A resistor impedes the flow of electricity
They are measured in 'ohms'.
Values less than 1000 usually have an R at the end to help denote less than 1000.

This is a special resistor that is variable. You twist a knob to change the value.
Terminals 1 and 3 measure 50k ohms on this one, and are constant.
Terminal 2 is a wiper that moves along the fixed part.
As you twist the knob, resistance at 1–2 goes in one direction,
and resistance at 2–3 goes to the other direction.

This special resistor is also variable.
However, the resistance across it varies as the amount of light it 'sees' changes.
Shine more light, and the resistance goes down.

These are capacitors. A capacitor stores energy and smooths changes in voltage.
Some capacitors have a polarity. They are 'polarized'.
Connecting a polarized capacitor backwards can damage them.

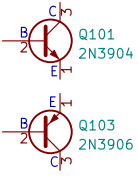
What happens when you press the switch?

Sheet: /Learning About Symbols 1/
File: 00–Symbols–1.kicad_sch

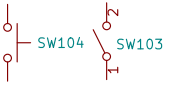
Title:

Size: User	Date:	**Rev:**
KiCad E.D.A. kicad (6.0.5)		Id: 32/34

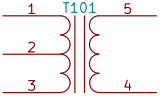
This is a LED, or Light Emitting Diode.
It converts electricity into light.
Note that has a polarity and will only light in one direction.



This is a transistor. It allows a very small current to 'switch' a much larger current.
The transistor is the cornerstone of our modern electronics.
These bi-polar transistors are two different kinds, NPN and PNP
The 2N3904 is a NPN. An easy way to remember this is 'Not Pointing In'
The 2N3906 is a PNP.
The P and N refer to the layers inside the transitor. An N is negatively doped.
A P is positively doped.
The 3 terminals of a transistor are the Base, Collector and Emitter.



These are switches. A switch interrupts the flow of current.
The one on the left is a 'push button', it will open when you let go.
This is called 'Normally Open' or 'NO'
The other switch latches closed or open. It has a single 'pole'.
It is a 'Single Pole, Single Throw', SPST.



This is a transformer. It transforms the magnitude of the signal from the
'primary' to the 'secondary' winding.
The voltages at the two sides are magnetically coupled. They are not directly coupled.
This is called 'galvantic isolation'.

This is a speaker. It converts an alternating voltage into sound.
A thin membrane is wrapped with a magnetic coil, and the magnetic field moves the coil.
The moving membrane pushes air to make sound.

What happens when you press the switch?

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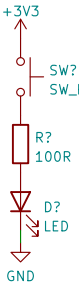

Let's look at a schematic. It is a visual diagram that shows how a circuit is wired.
To wire this circuit up, you simply use wires to replicate the lines.

Lines that have a dot indicate they are tied together.

Lines that cross without a dot are not connected. Be careful of this!

What happens when you press the switch?

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