

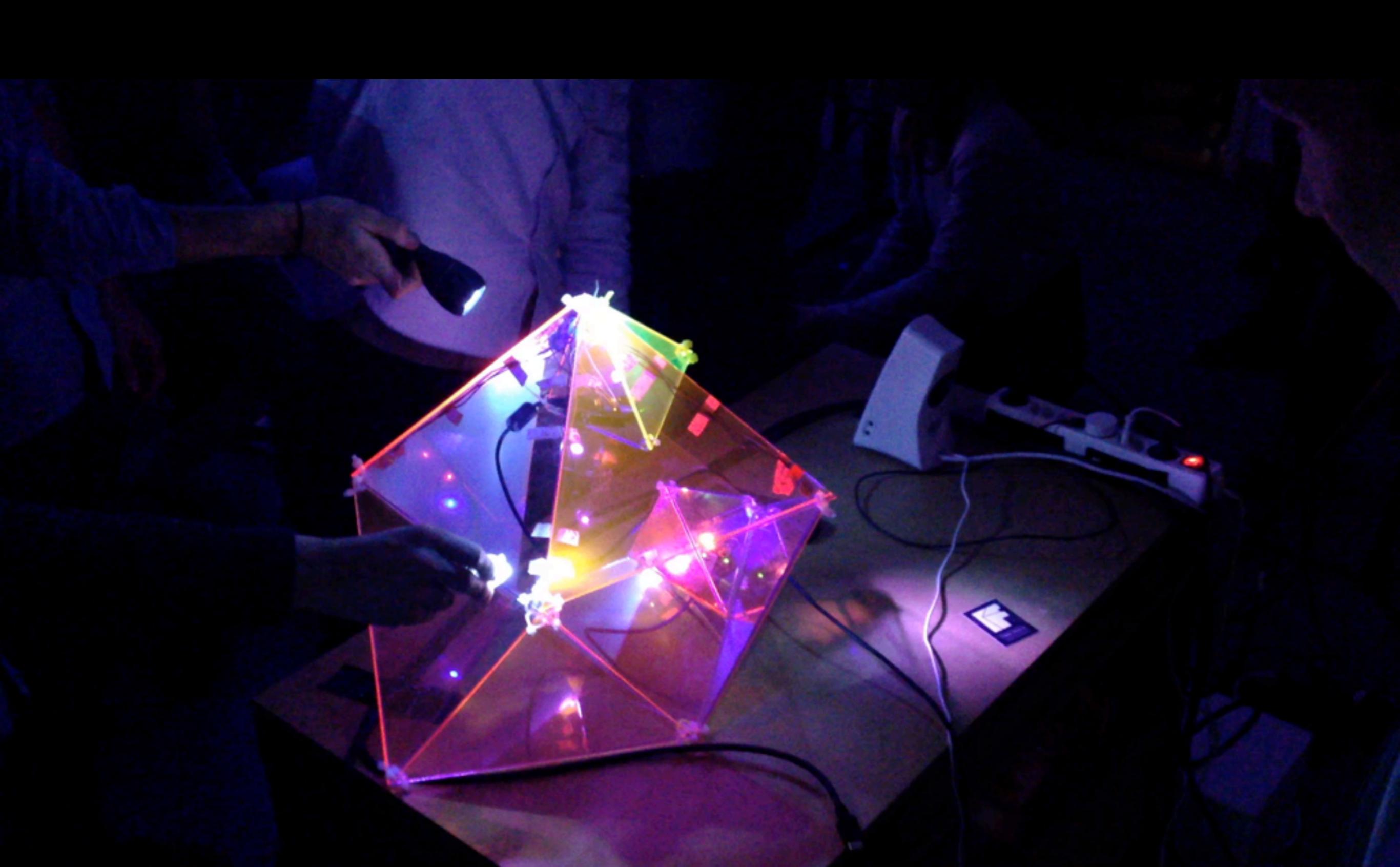
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Goldsmiths
UNIVERSITY OF LONDON









CODE LIBERATION
FOUNDATION



EXIT



BOSSED UP JAM



HIGH SCHOOL CLASSES



CLF x BLACK GIRLS CODE



GAME DEVELOPMENT CLASSES



CIBELLE

PRISM SHELL

プリズムシェール

TAP to play





SLAM CITY ORACLES

STELLAR
SMOOCH

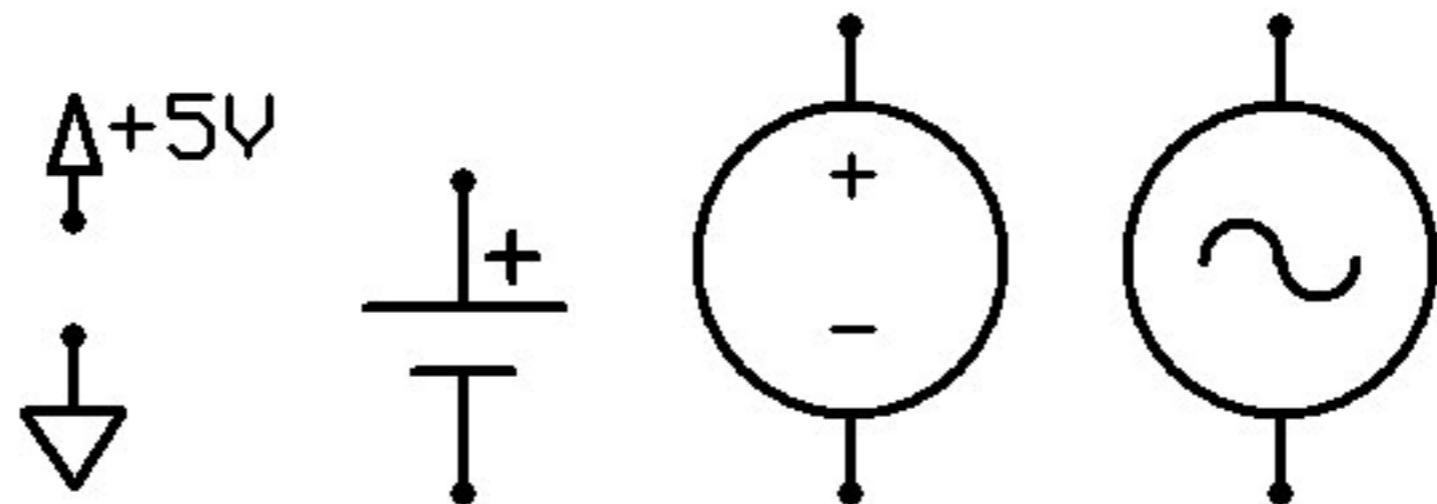




NYCRESISTOR

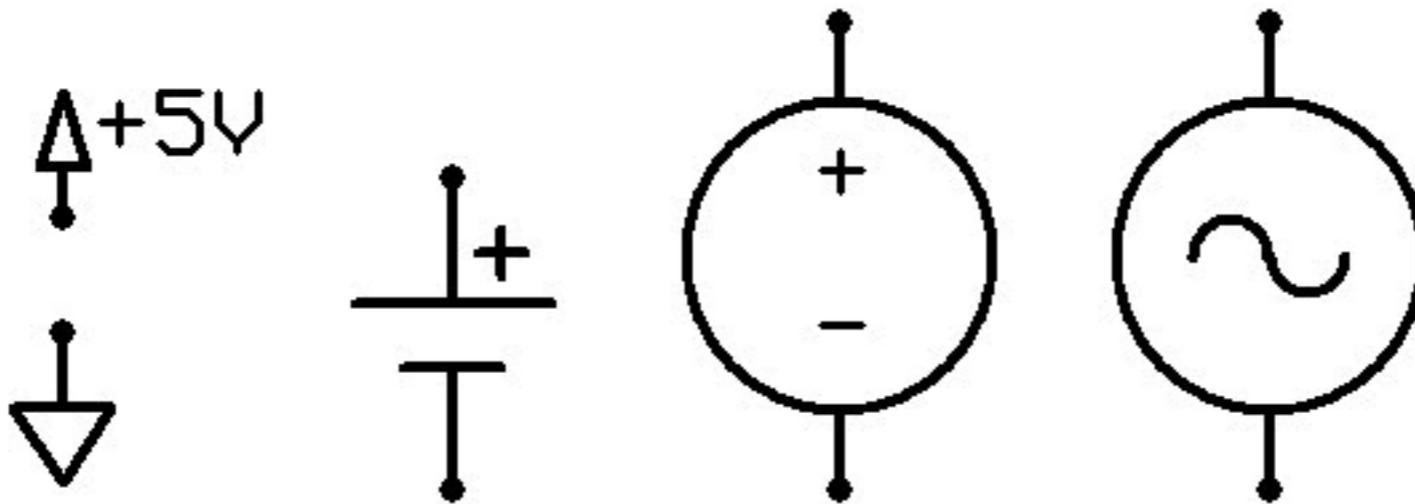


from: cats on synthesizers in space

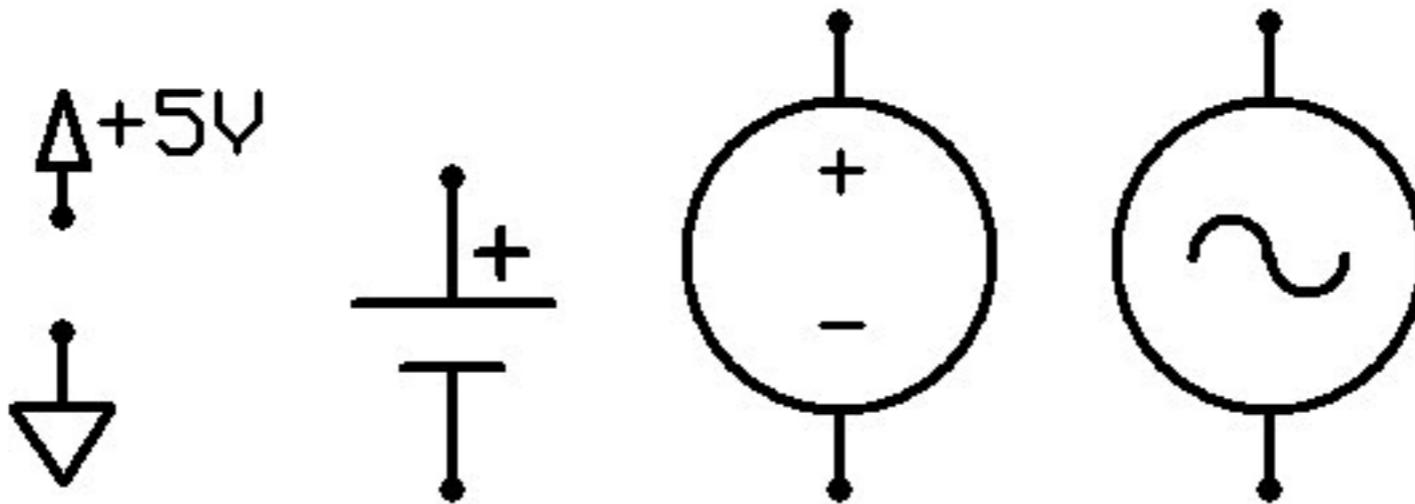


All electronics use
Power





and balance a relationship between
voltage (V), current(I) and resistance(R).

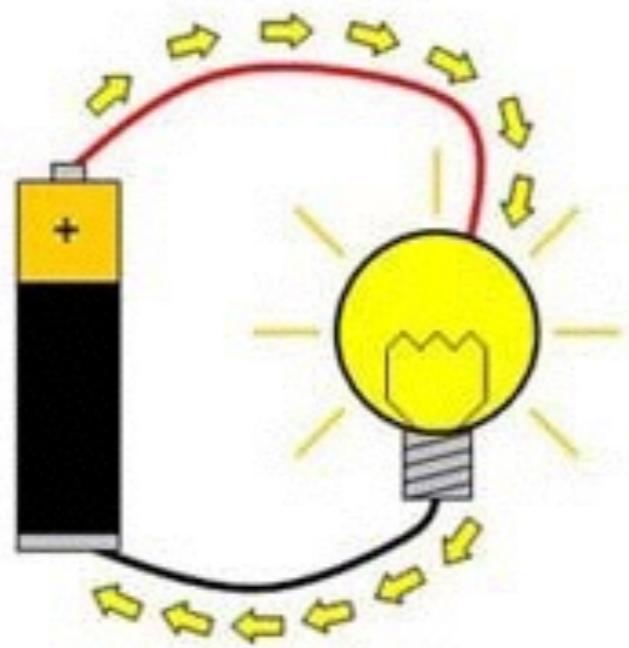


voltage = how much possible power we have to use

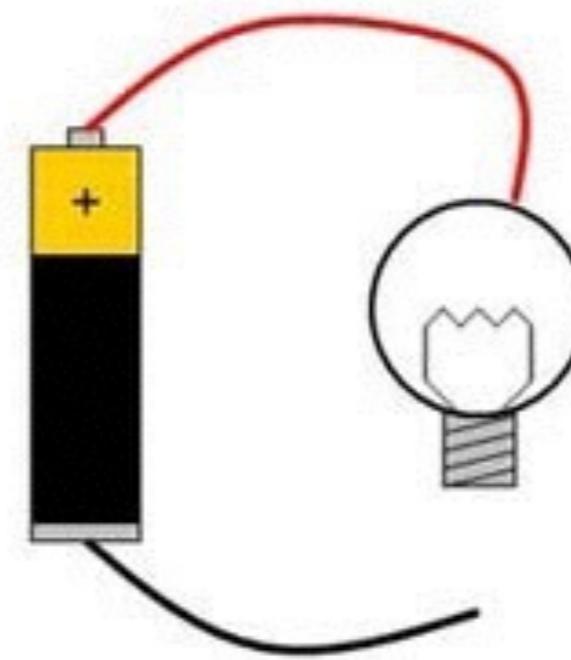
current = how fast we use it

resistance = how much power is burned up as we go around our circuit.

Closed circuit



Open circuit

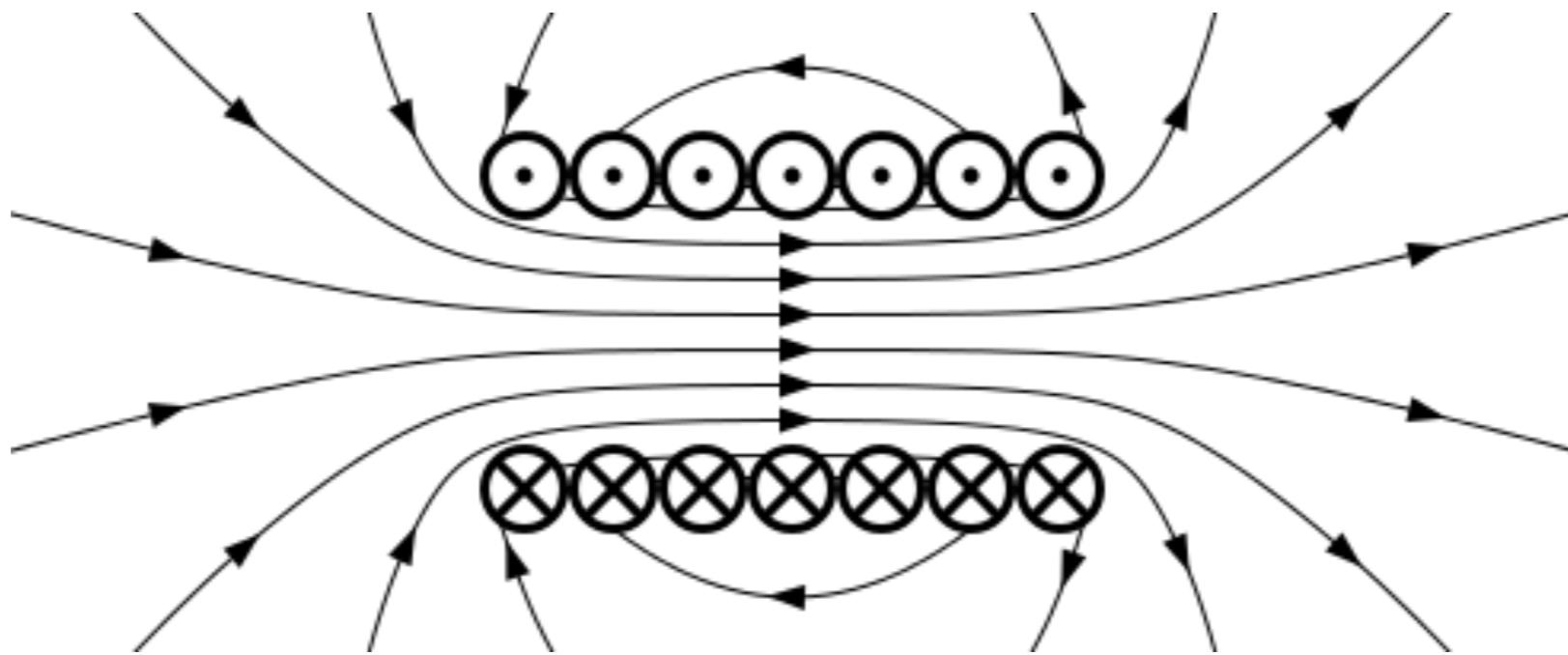


Voltage flows around a **circuit**.

Circuits are open or closed and are the loop from the positive side of your power source through your electronics to the ground side of the power source.

In an closed battery powered circuit, the **voltage** will flow from + to - sides of the battery. It gets used up.

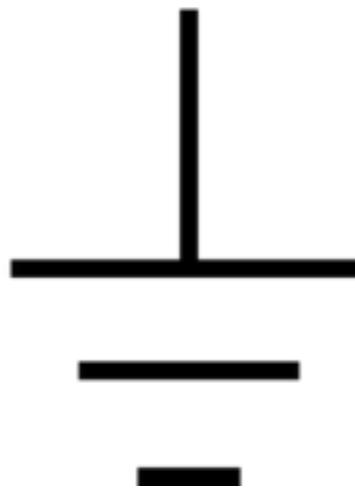
Voltage is measured in **Volts**.



Voltage

difference in electric potential energy between two points per unit electric charge.





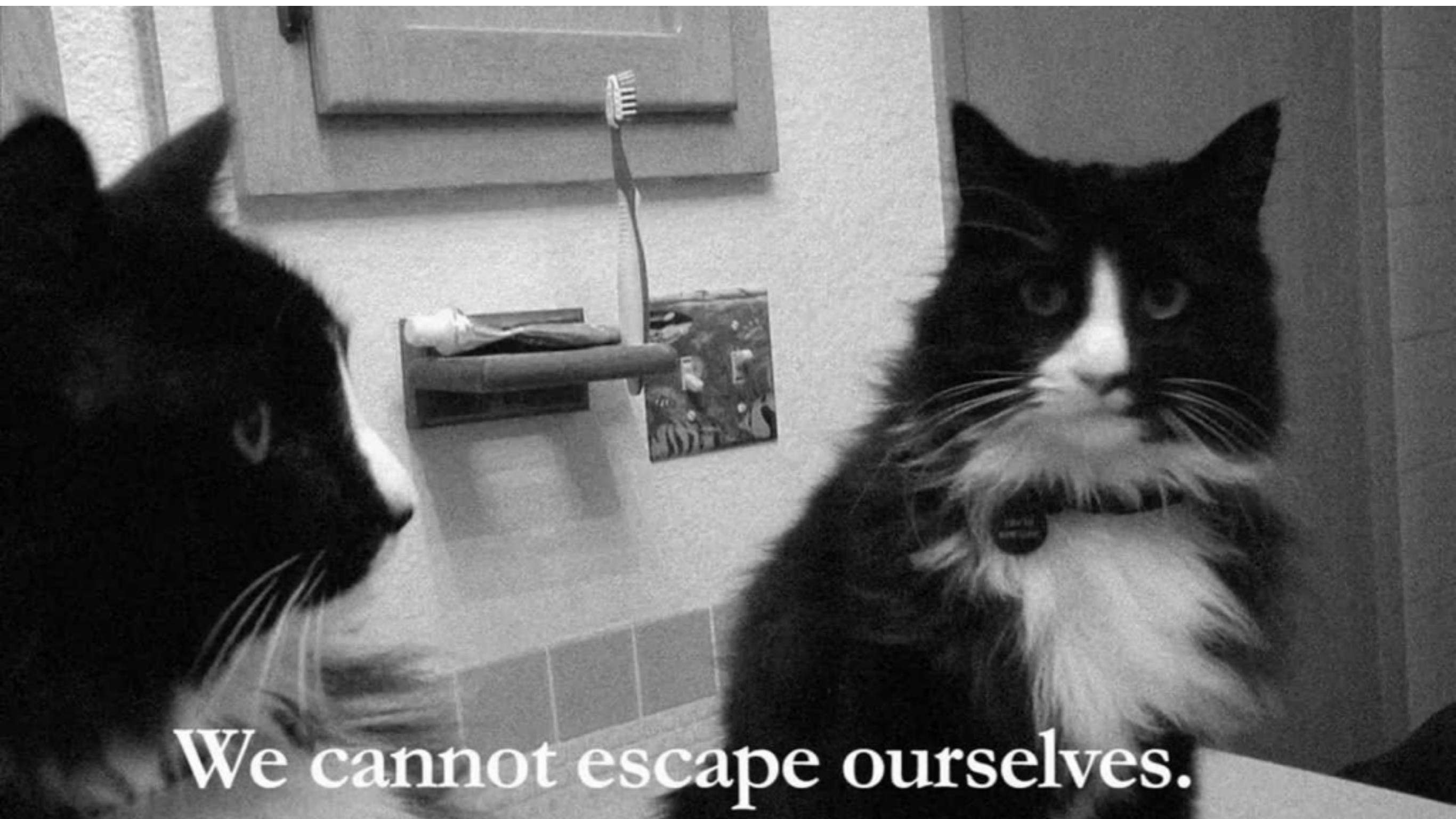
Ground

In electrical engineering, ground or earth is the reference point in an electrical circuit from which voltages are measured, a common return path for electric current, or a direct physical connection to the Earth.

Ω

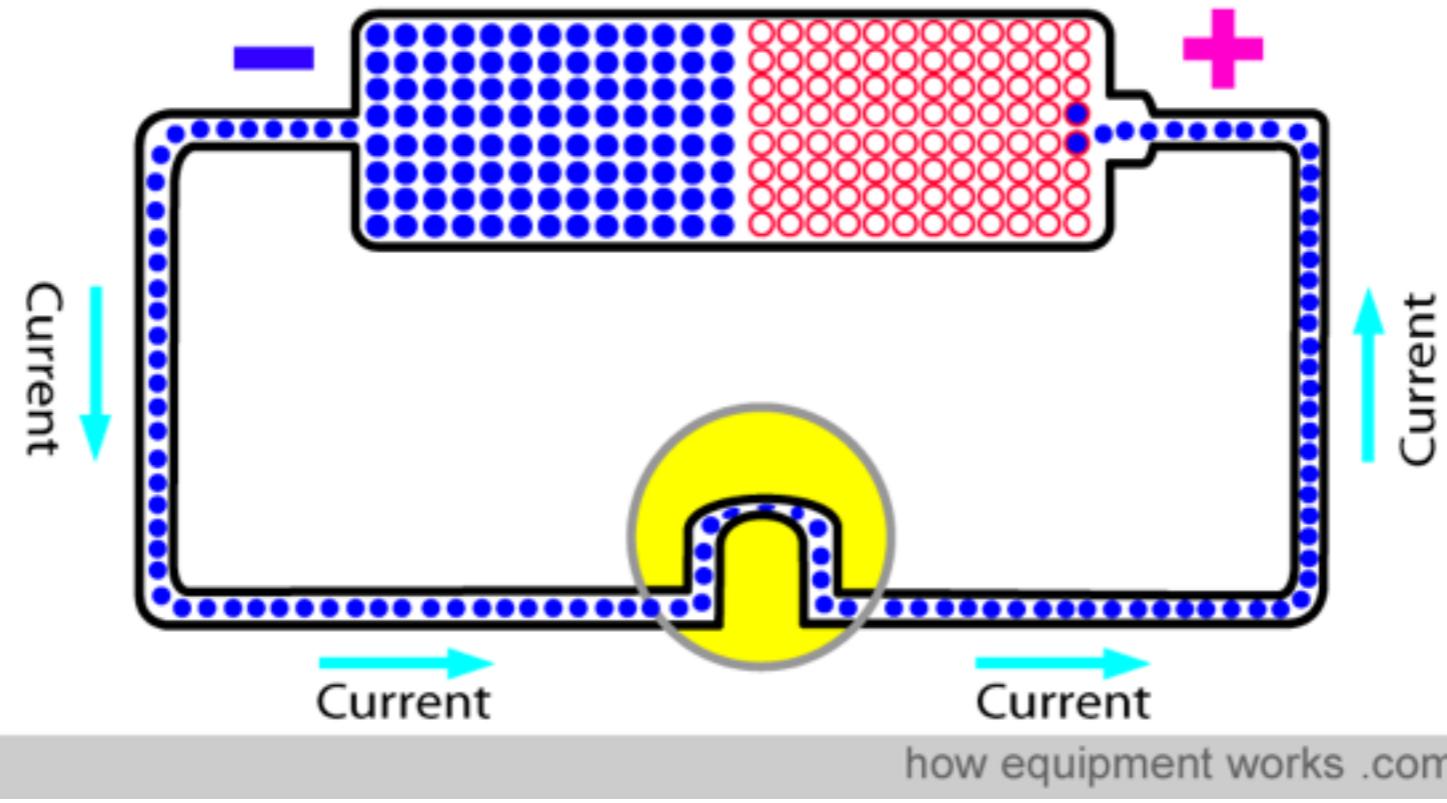
Current (I)

How fast is the voltage flowing
intensité de courant (I)



We cannot escape ourselves.

<https://www.youtube.com/watch?v=Q34z5dCmC4M>



Electronic Components need the voltage to be going at a specific speed, or **current** to be strong enough to power it.

Current is measured in **Amps**. One amp is a good deal of current so often you'll see it measures in mA or milliamps
amp = milliamp / 1000

(this is similar to bytes and megabytes in a computer)



Resistance (R)

How easily can the current flow?



Ohm's law

- Ohm's law says *that the tension is equal to the product of the intensity and the resistance*

$$V = R \cdot I$$

- This is equivalent to:

$$I = V/R \leftrightarrow R = V/I$$



Index

Each component will use a certain amount of voltage and current

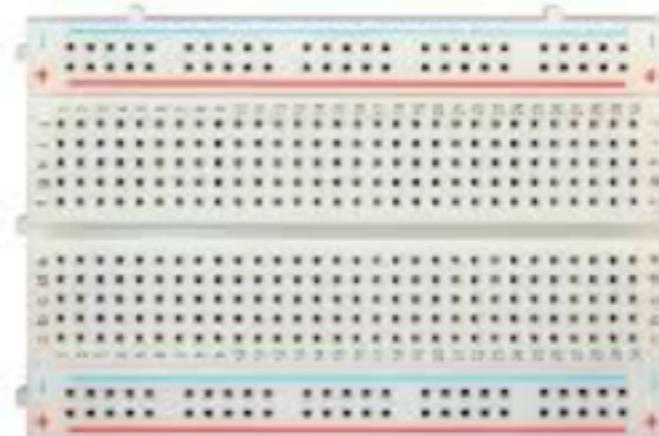
You can find out a part's needs in its ***datasheet***

Google the name of the part, the part number written on it, and datasheet

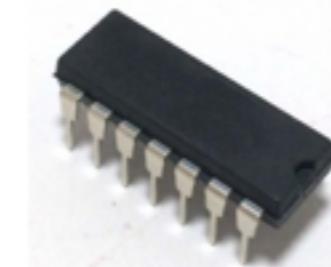
For example: transistor 2n2222 datasheet



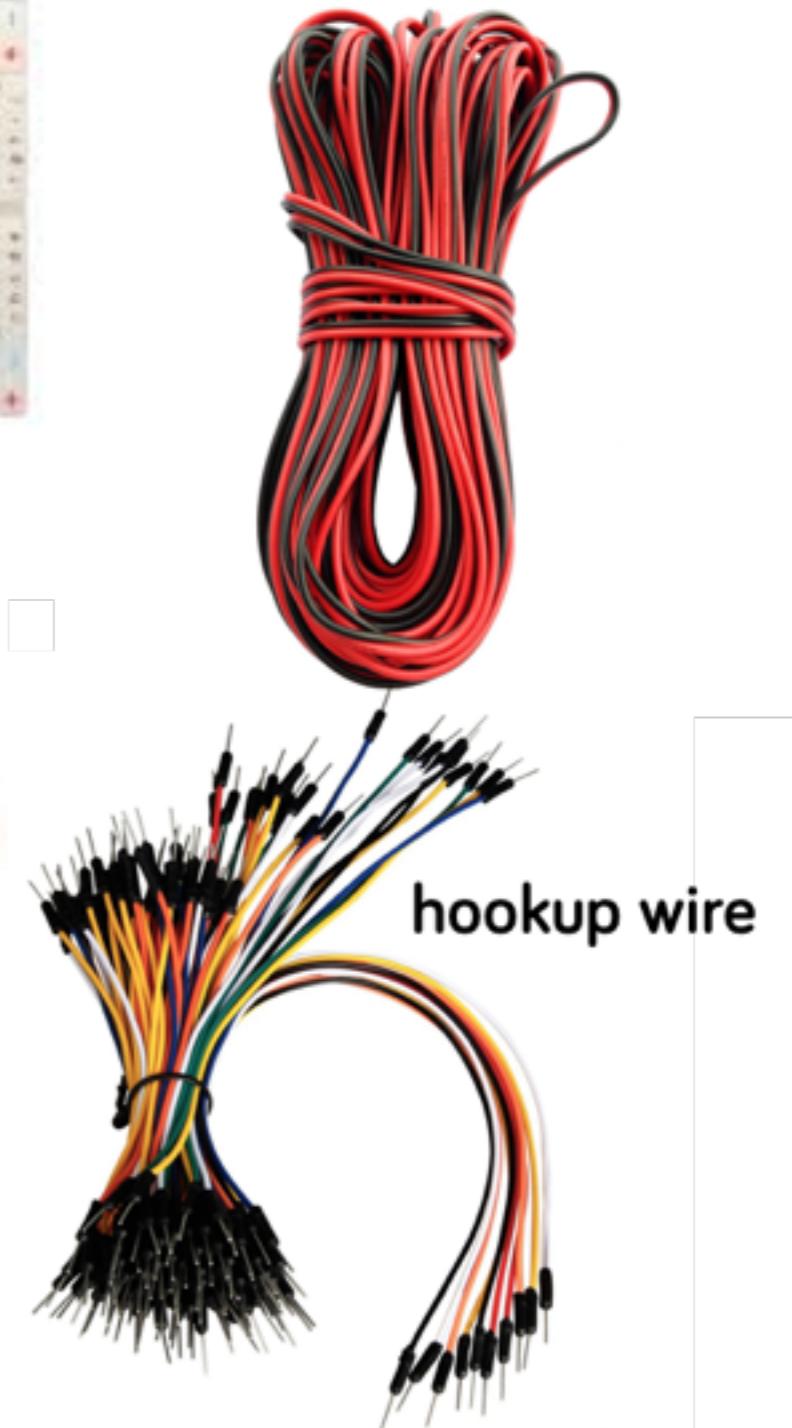
capacitor



resistor



Schmitt trigger



1/4" jack

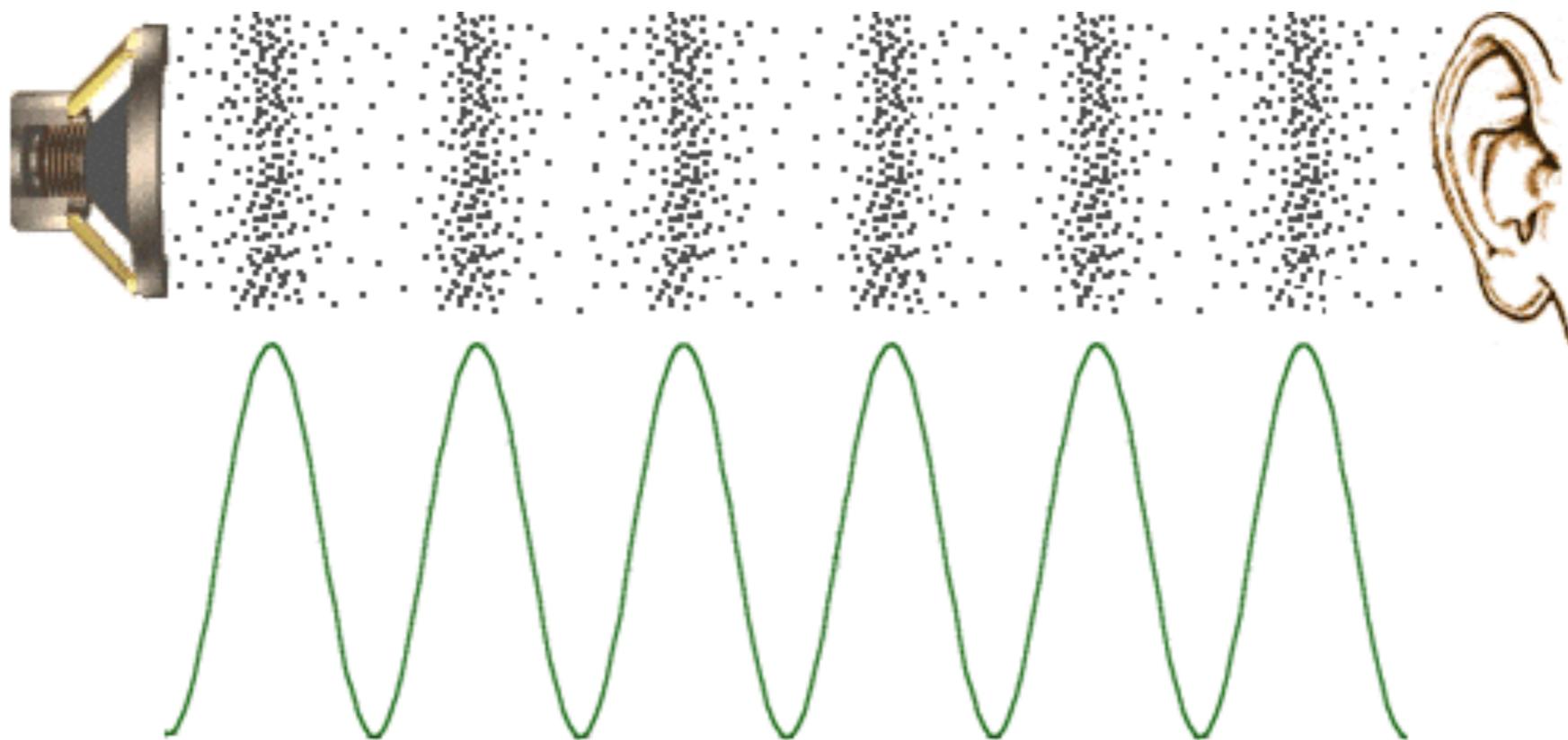
If you add electricity to a copper coil, you create a magnet field. (this is how we make motors)



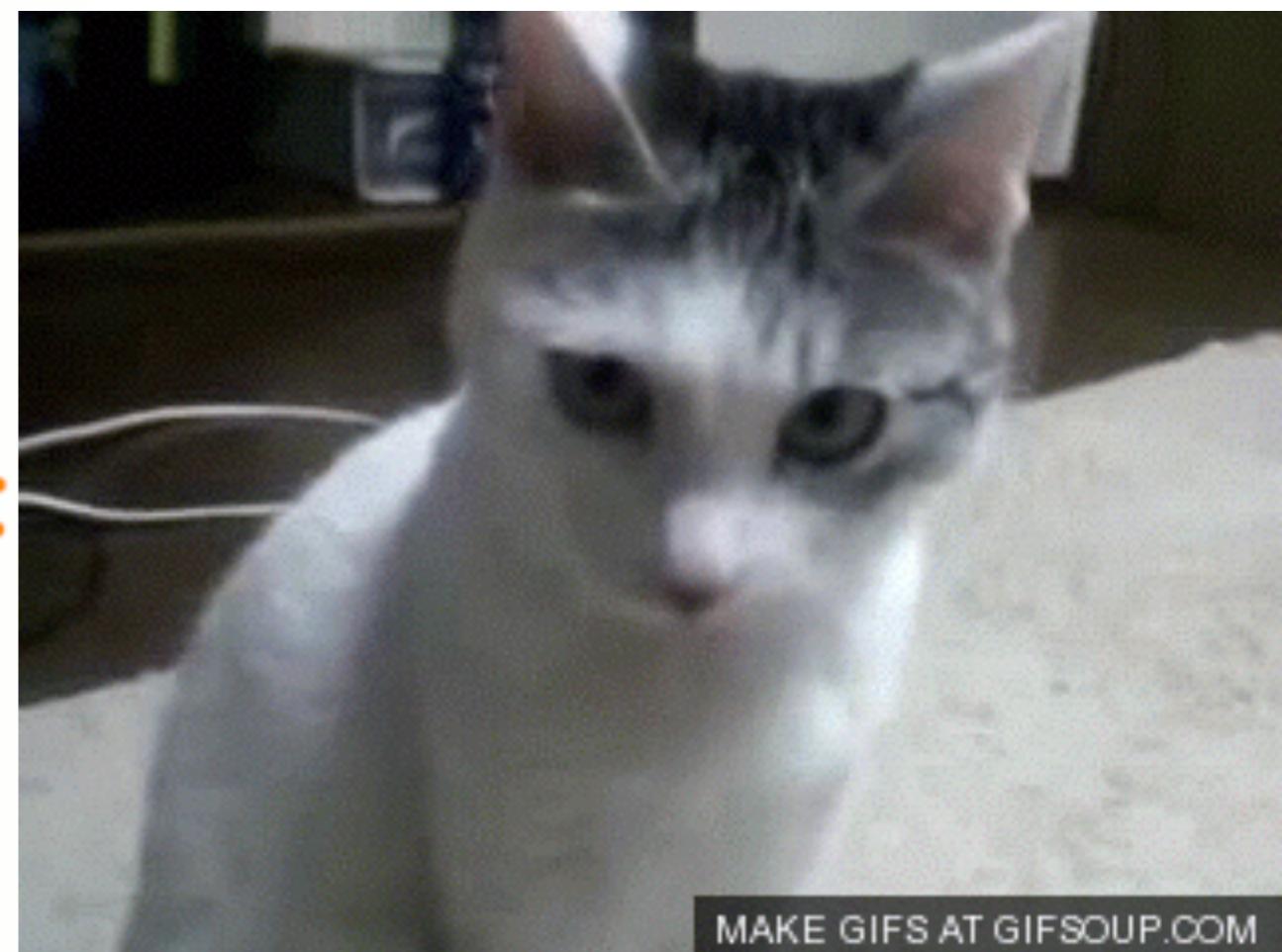
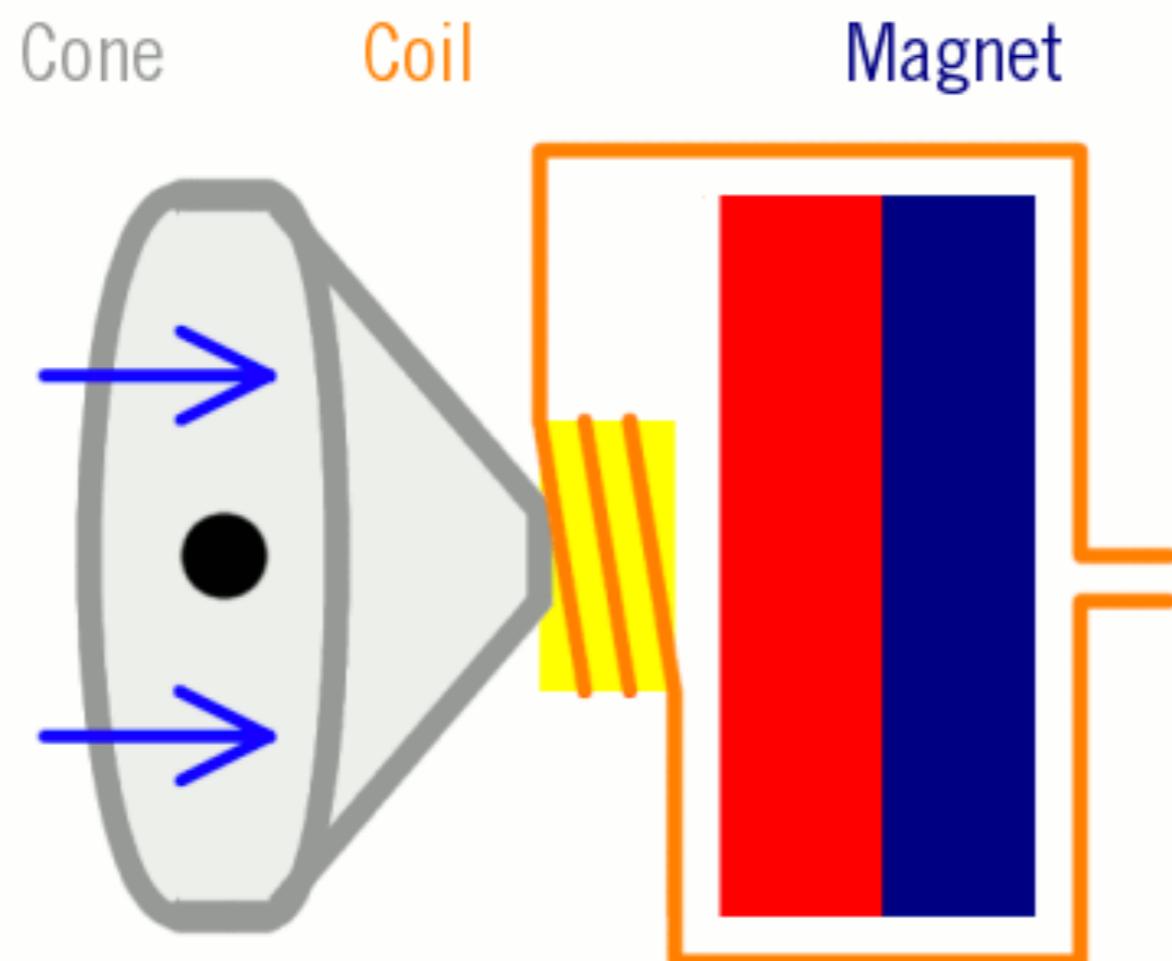
how does a speaker work?

If you separate a coil and a magnet, they'll pull together when you apply current and snap out when you stop the current. This will push the air outward with a velocity.

We can hear that - we call it sound.

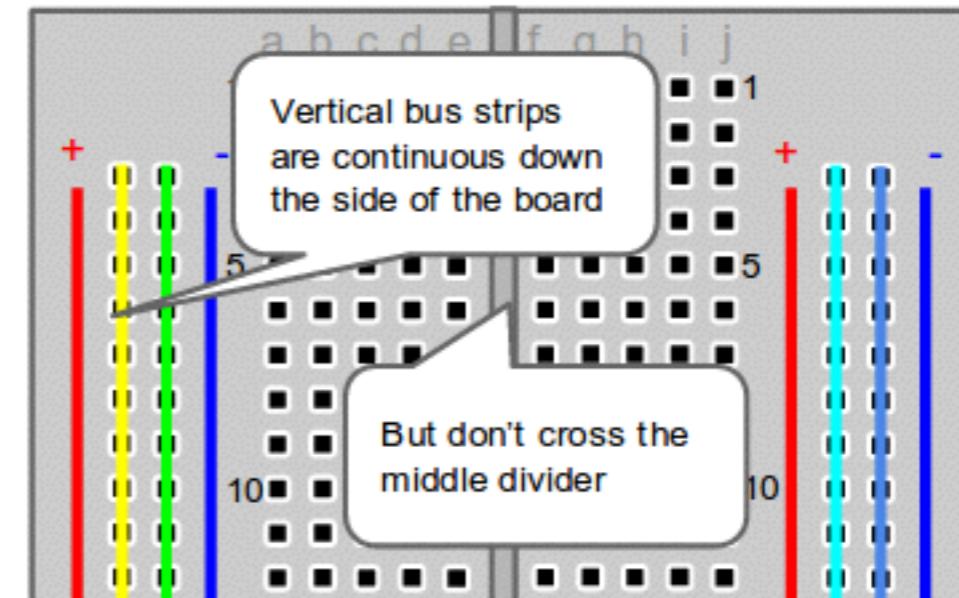
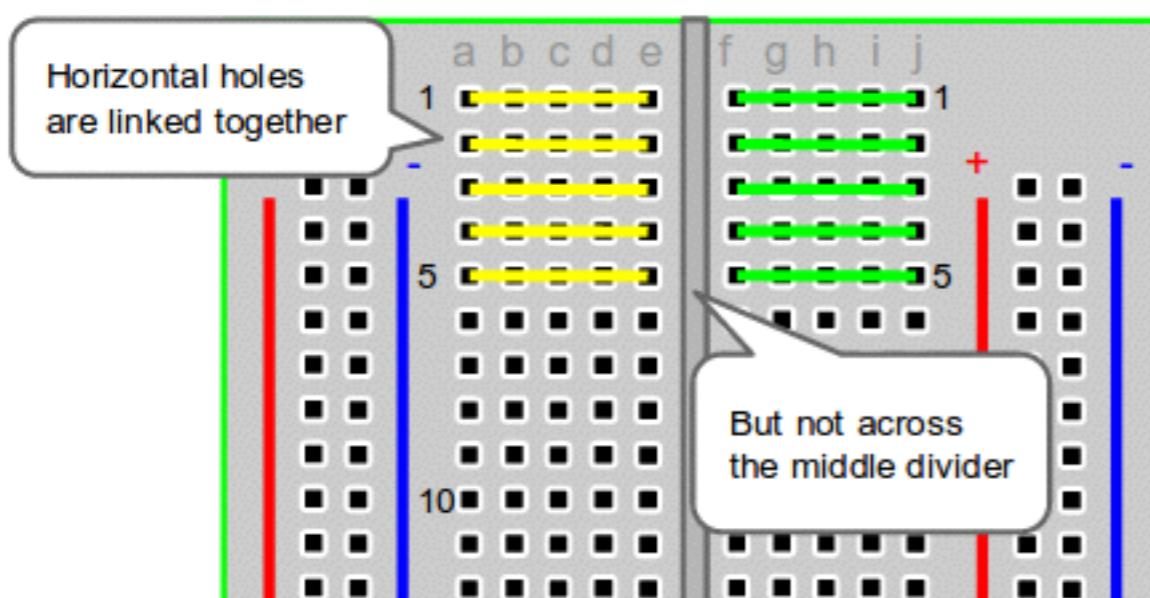


In this way we can control how fast the magnet contracts in and out using voltage. This lets us hear voltage as **sound**.



The Breadboard

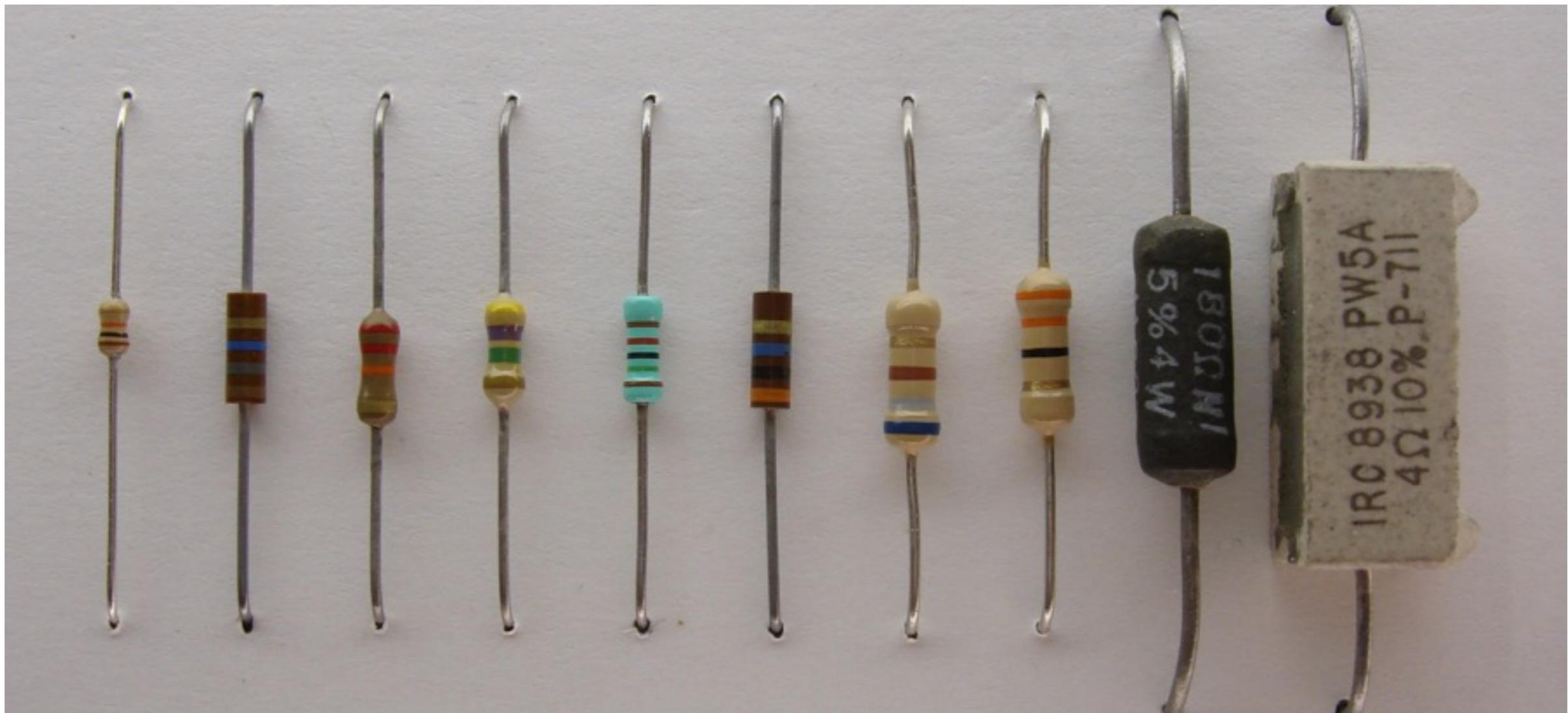
linked together conductive metal strips



linked together conductive
metal strips let the voltage flow

Resistors

dissipate voltage as heat to slow down your current and reduce your voltage.



it is measured in **ohms.**

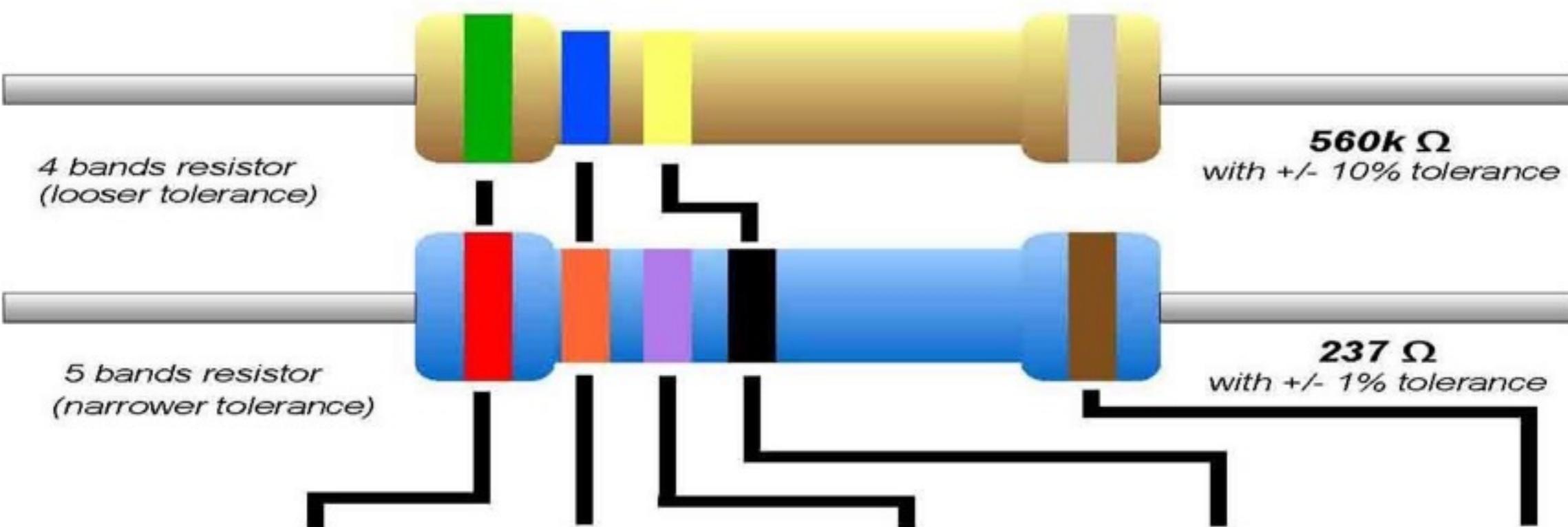
Ω

Ohms

Ohms usually get a prefix

PREFIX	NAME	MEANING
T	tera	multiply by 1 000 000 000 000 (i.e. $\times 10^{12}$)
G	giga	multiply by 1 000 000 000 (i.e. $\times 10^9$)
M	mega	multiply by 1000 000 (i.e. $\times 10^6$)
k	kilo	multiply by 1 000 (i.e. $\times 10^3$)
m	milli	divide by 1000 (i.e. $\times 10^{-3}$)
SI (μ)	micro	divide by 1 000 000 (i.e. $\times 10^{-6}$)
n	nano	divide by 1 000 000 000 (i.e. $\times 10^{-9}$)
p	pico	divide by 1 000 000 000 000 (i.e. $\times 10^{-12}$)

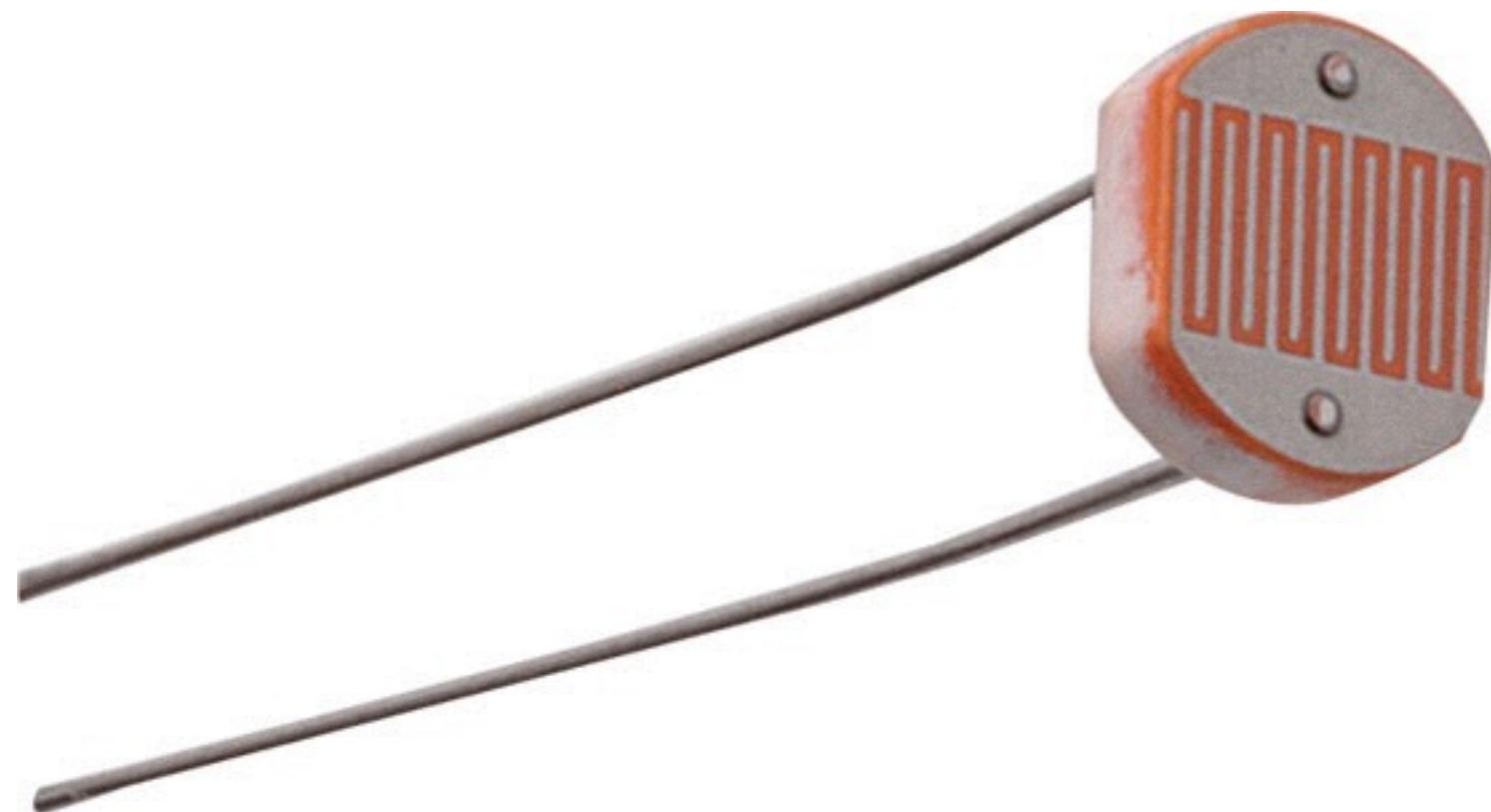
Resistor Color Code



Color	1 st Band	2 nd Band	3 rd Band	Multiplier	Tolerance
Black	0	0	0	x 1 Ω	
Brown	1	1	1	x 10 Ω	+/- 1%
Red	2	2	2	x 100 Ω	+/- 2%
Orange	3	3	3	x 1K Ω	
Yellow	4	4	4	x 10K Ω	
Green	5	5	5	x 100K Ω	+/- .5%
Blue	6	6	6	x 1M Ω	+/- .25%
Violet	7	7	7	x 10M Ω	+/- .1%
Grey	8	8	8		+/- .05%
White	9	9	9		
Gold				x .1 Ω	+/- 5%
Silver				x .01 Ω	+/- 10%

LDR (Light Dependant Resistors)

Light makes it more or less resistant, so resistance varies with light.

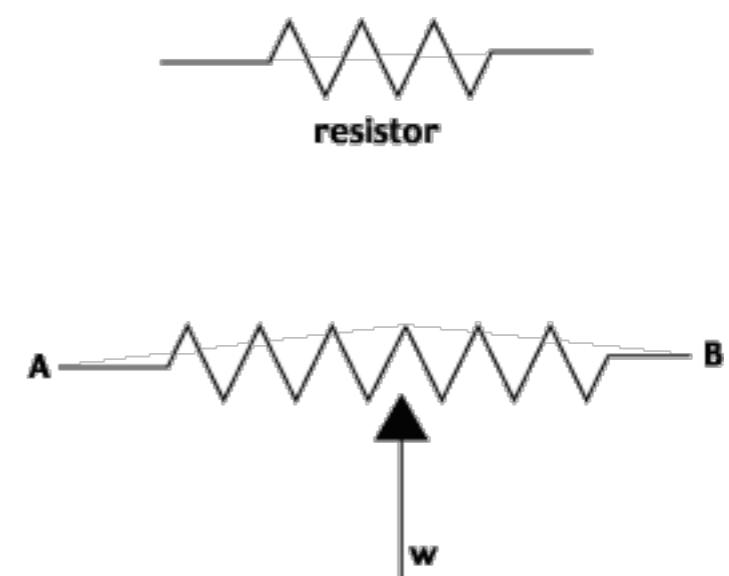
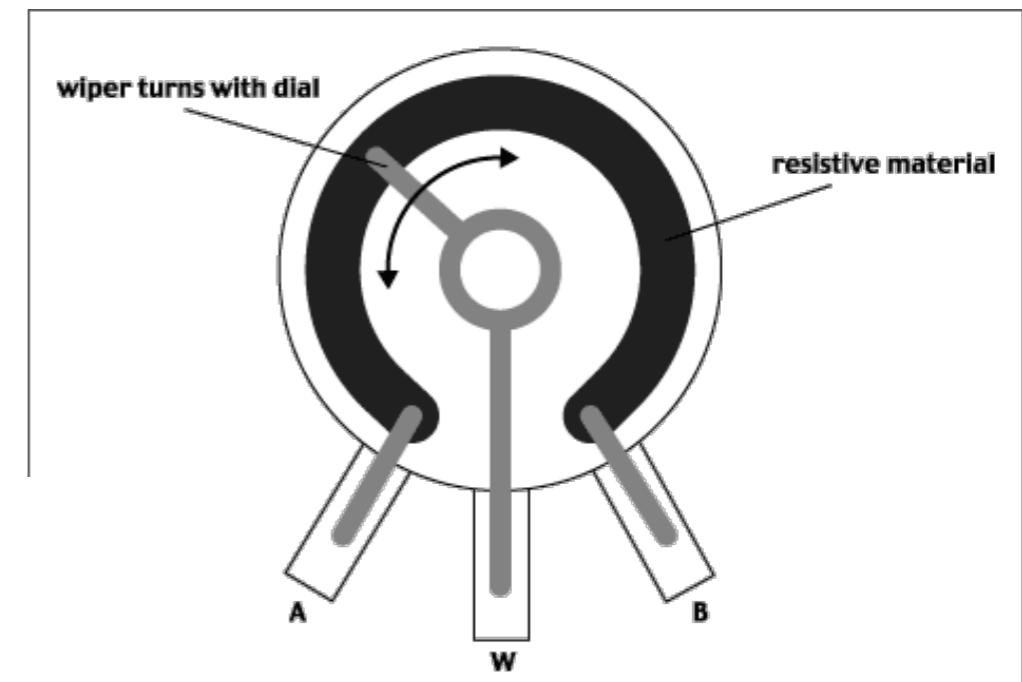
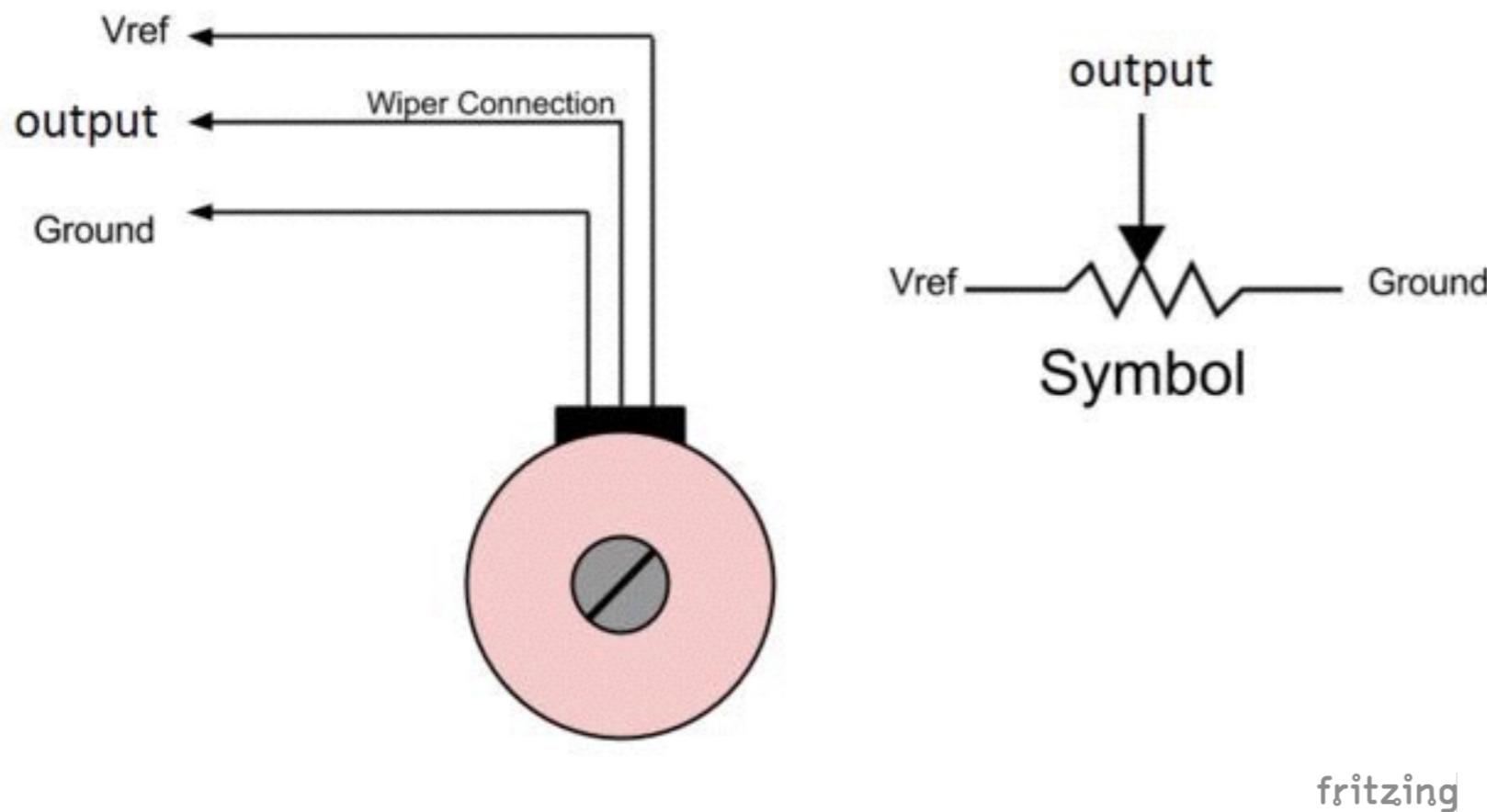




THE POTENTIOMETER

A variable resistor

Variable resistor / potentiometer Connection



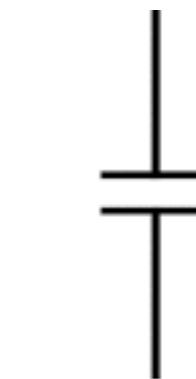
fritzing

potentiometer

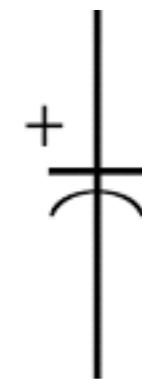
Capacitor

stores electronic current for use later.

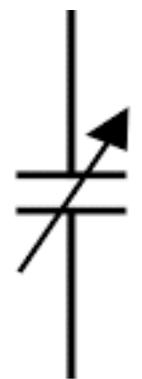
Often used to smooth power spikes in a circuit. If it wasn't for capacitors, in your car when your speakers boomed, the car lights would dim. In our circuit, they'll smooth out the on / off square waves our oscillator makes.



Fixed Capacitor



Polarized Capacitor



Variable Capacitor

Capacitors measure charge they store in farads

Pico Farads (pF)	Nano Farads (nF)	Micro Farads (μ F)
1	0.001	0.000001
10	0.01	0.00001
100	0.1	0.0001
1000	1	0.001
10000	10	0.01
100000	100	0.1
1000000	1000	1
10000000	10000	10
100000000	100000	100

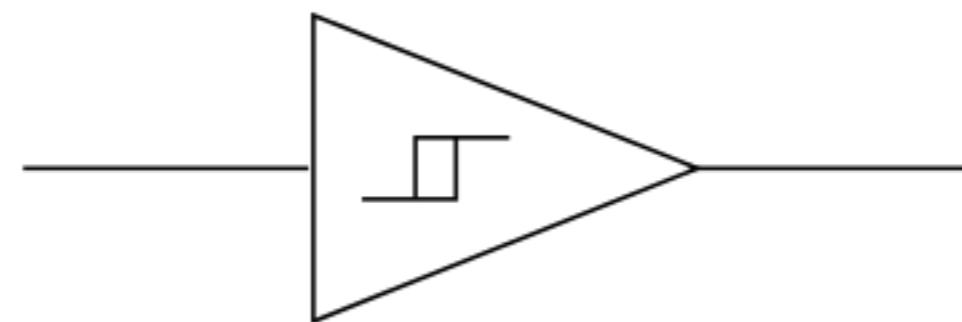
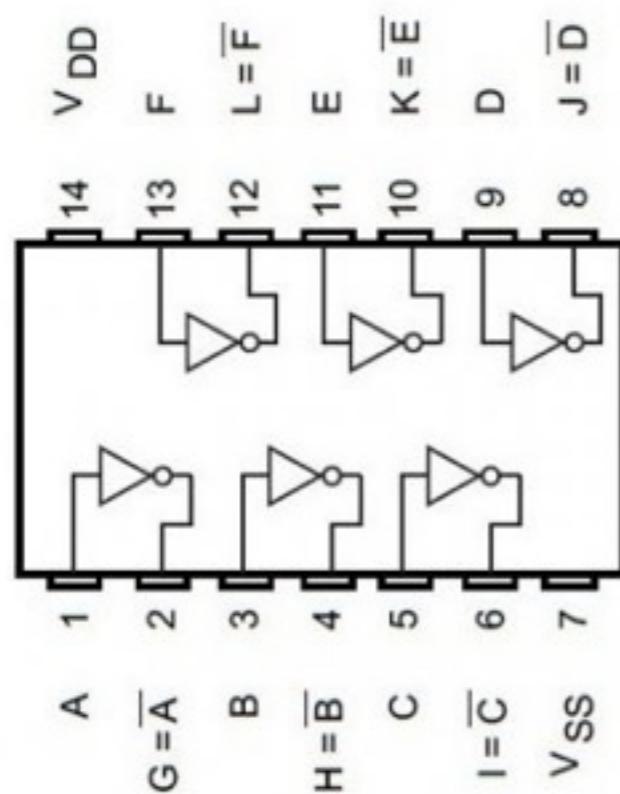
<http://mechatrotutor.blogspot.com/>

easy converter chart

<http://www.convertunits.com/from/microfarad/to/picofarad>

An Oscillator (Schmitt Trigger CD40106)

Basically when you apply voltage above a certain threshold, it flips state from off to on.



TRUTH TABLE

INPUTS	OUTPUTS
A, B, C, D, E, F	G, H, I, J, K, L
L	H
H	L

How does this make sound?

The frequency of the oscillator is controlled by the capacitor and resistor.

The **capacitor** sets the **pitch range**

The **resistor** changes the **frequency** within that range

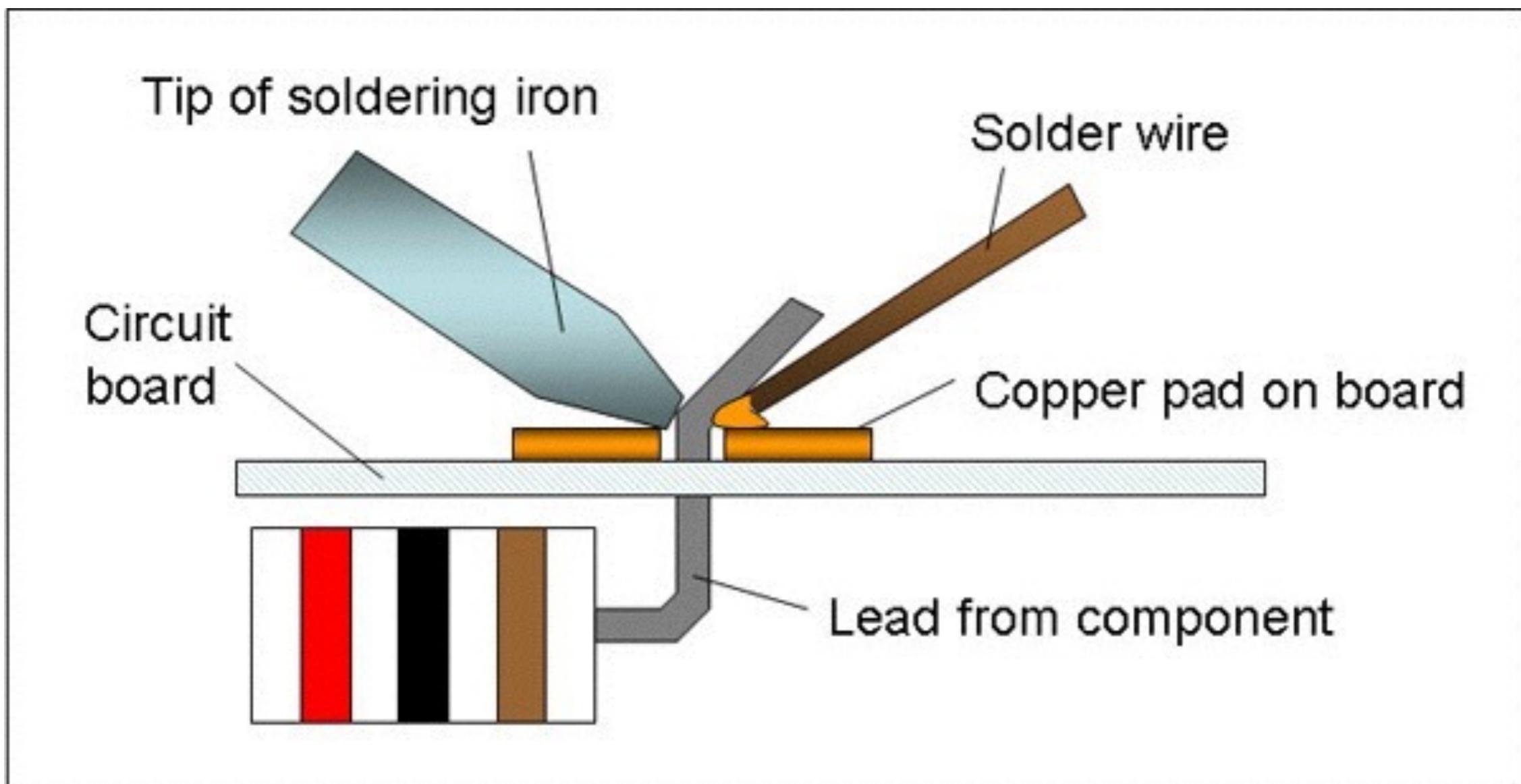
Ranges

.1uf = high frequency

1uf = mid frequency

10uf = low frequency

How to solder



NOW SOUND!



MUSIC

"Nicolas Collins wants to tear apart your CD player."

—WIRED magazine

"Nic Collins' book passes the torch of home-brew electronics to the next generation of musical experimentalists. Providing practical and fun recipes for sonic adventures, it simultaneously introduces the reader to the past and present field of electronic sound art."

—CHRIS BROWN, Mills College Center for Contemporary Music

"This is a terrific, unique, and much needed book; I wish I had it fifteen years ago."

—DAN TRUEMAN, Princeton Laptop Orchestra, Princeton University

"The most radical music book I've read so far this year. This jargon-free text offers a fresh alternative to the usual instruments prized by the music business."

—CHRISTOPHER DELAURENTI, *The Stranger*, Seattle

Handmade Electronic Music: The Art of Hardware Hacking provides a long-needed, practical, and engaging introduction to the craft of making—as well as creatively cannibalizing—electronic circuits for artistic purposes. With a sense of adventure and no prior knowledge, the reader can subvert the intentions designed into devices such as radios and toys to discover a new sonic world. At a time when computers dominate music production, this book offers a rare glimpse into the core technology of early live electronic music, as well as more recent developments at the hands of emerging artists. In addition to advice on hacking found electronics, the reader learns how to make contact microphones, pickups for electromagnetic fields, oscillators, distortion boxes, and unusual signal processors cheaply and quickly.

This revised and expanded second edition is extensively illustrated and includes a DVD featuring 87 video clips and 20 audio tracks by over 100 hackers, benders, musicians, artists, and inventors from around the world, as well as 13 video tutorials demonstrating projects in the book. Further enhancements include additional projects, photographs, diagrams, and illustrations.

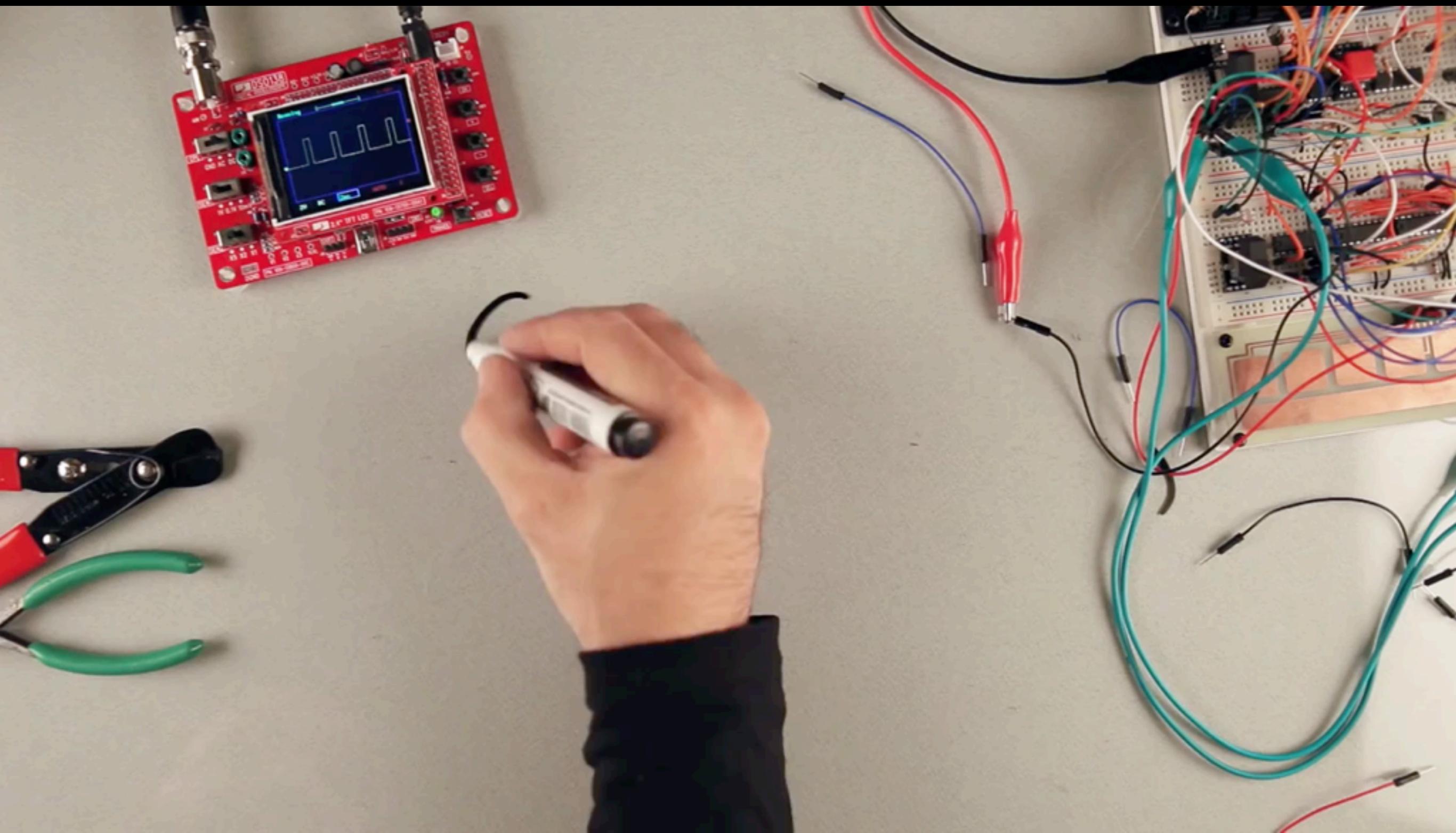
Nicolas Collins, an active composer and performer of electronic music, and has worked with John Cage, Alvin Lucier, David Tudor, and many other masters of modern music. Dr. Collins is Professor of Sound at The School of the Art Institute of Chicago, and has led hacking workshops around the world. He has been Visiting Artistic Director of STEIM (Amsterdam) and a DAAD composer-in-residence in Berlin. Since 1997 he has been editor-in-chief of Leonardo Music Journal.

COLLINS HANDMADE ELECTRONIC MUSIC
SECOND EDITION



DVD Included





<https://www.youtube.com/watch?v=FaoJaLmZaL4>

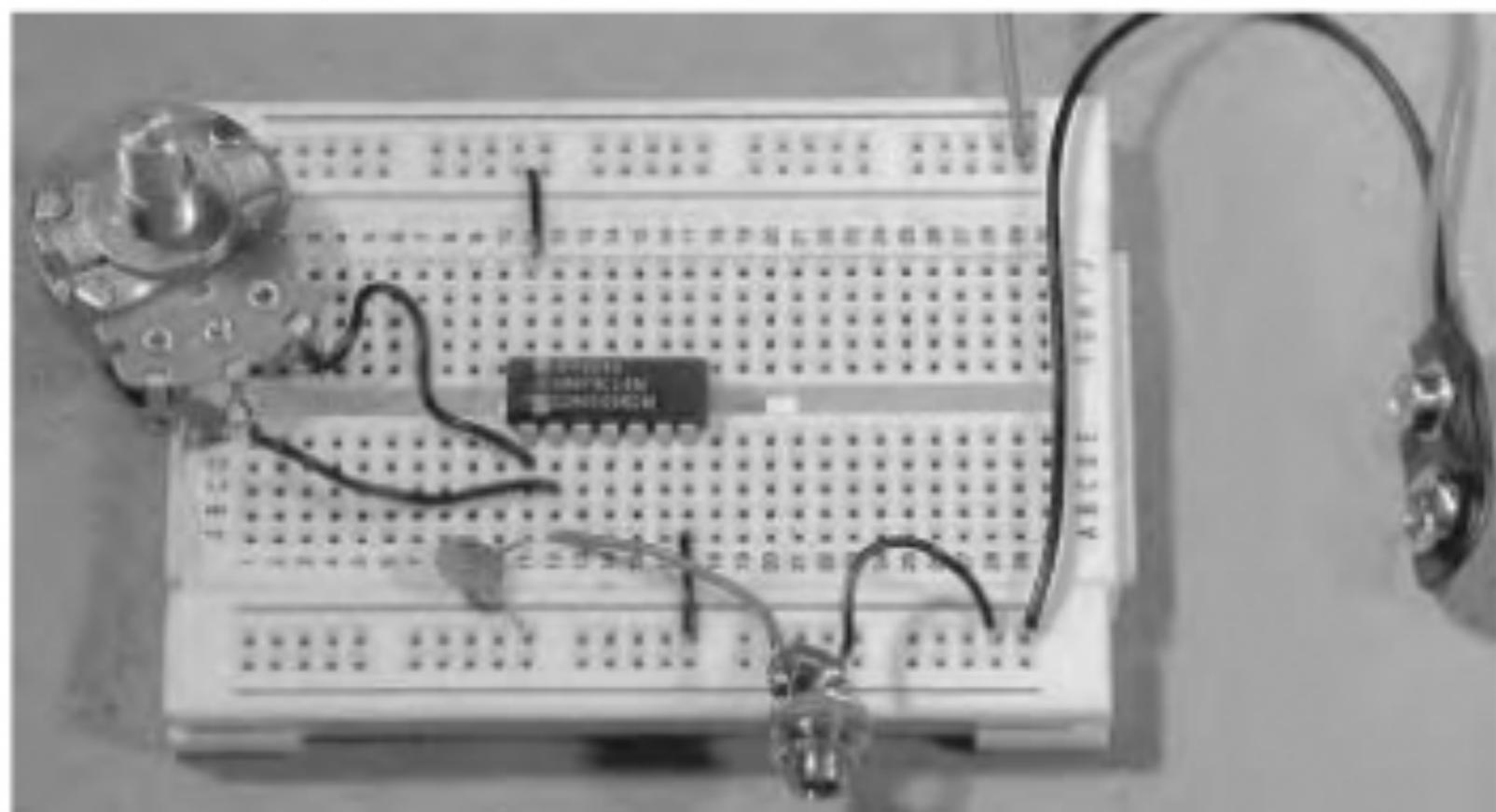
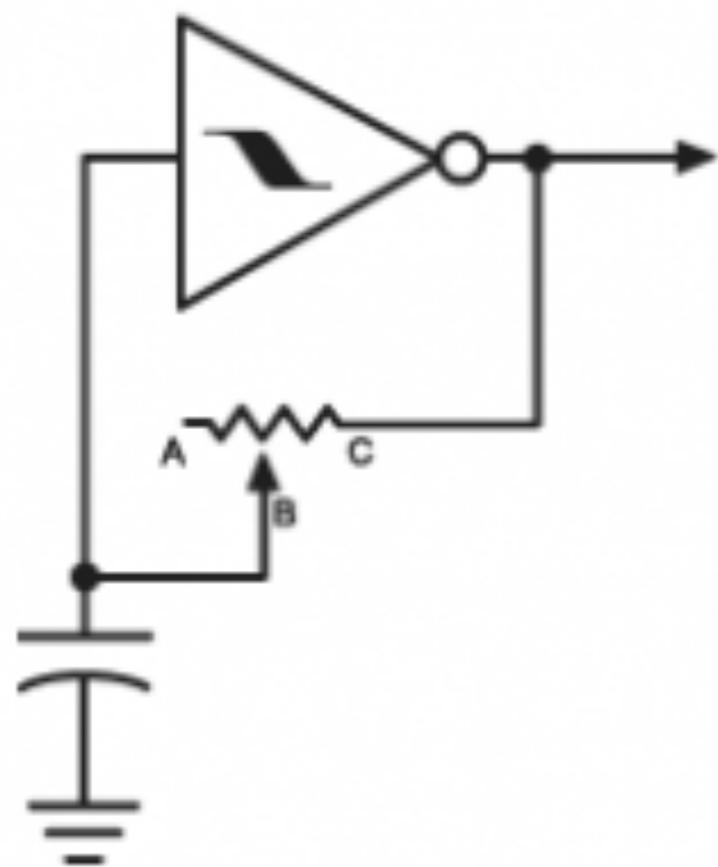
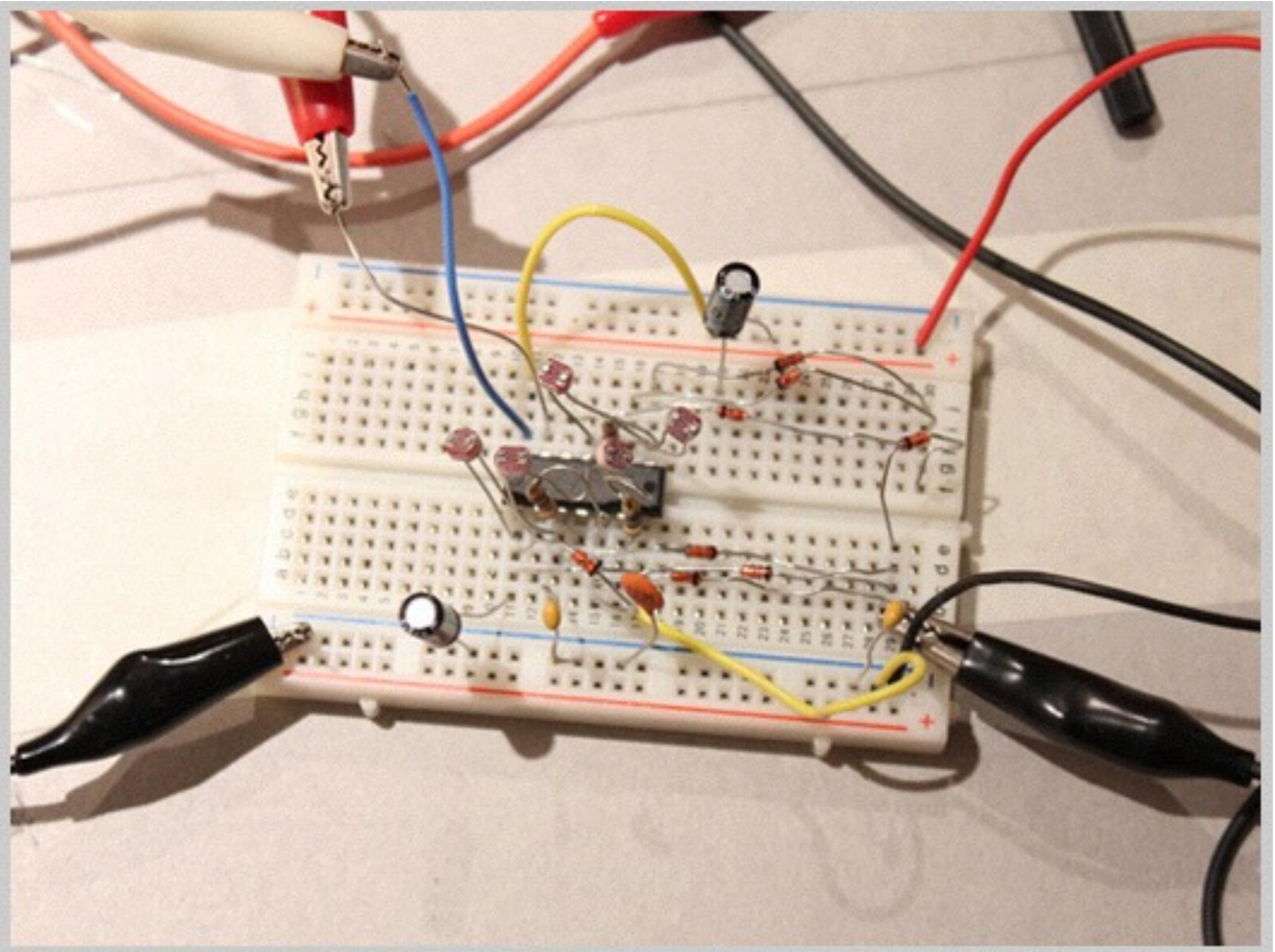
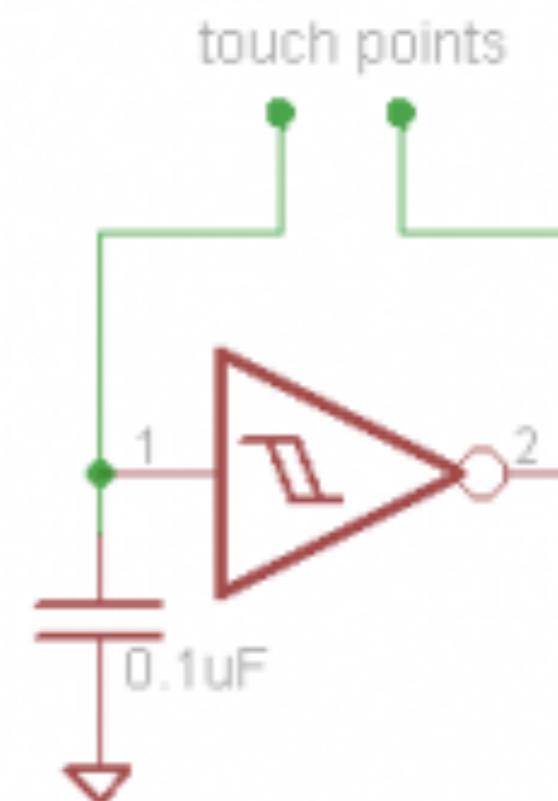
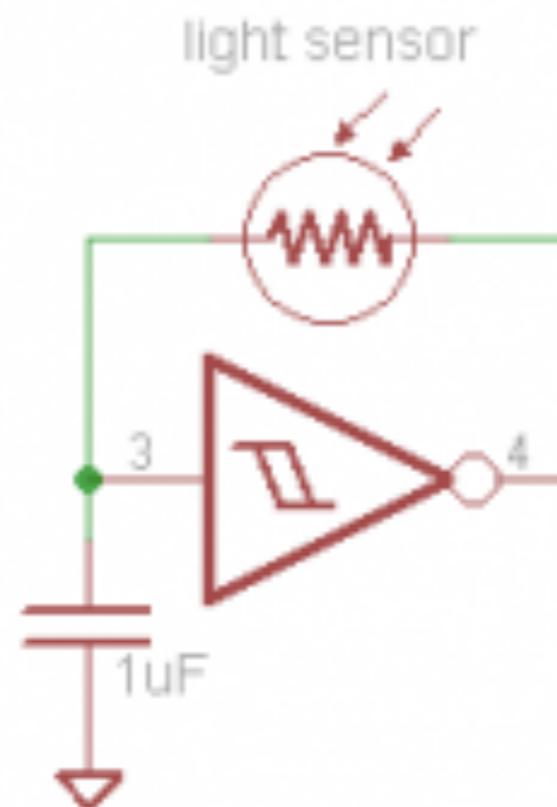
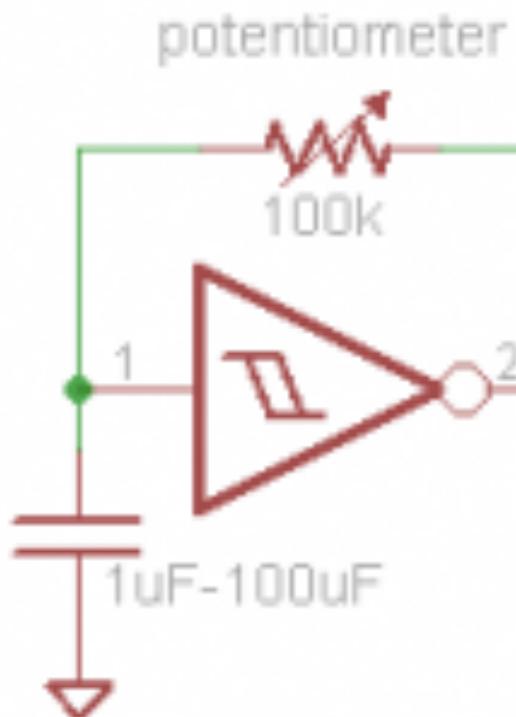


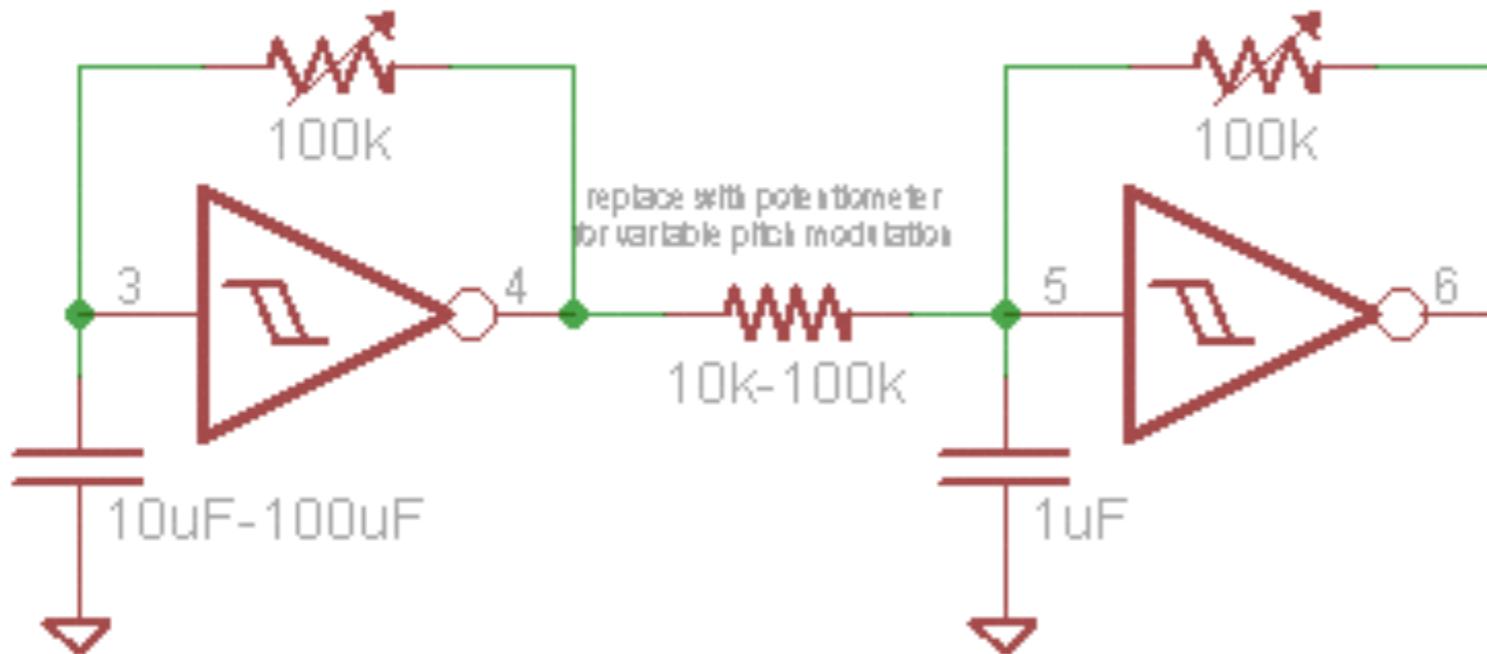
Figure 18.9 Potentiometer-controlled oscillator: schematic and photo.



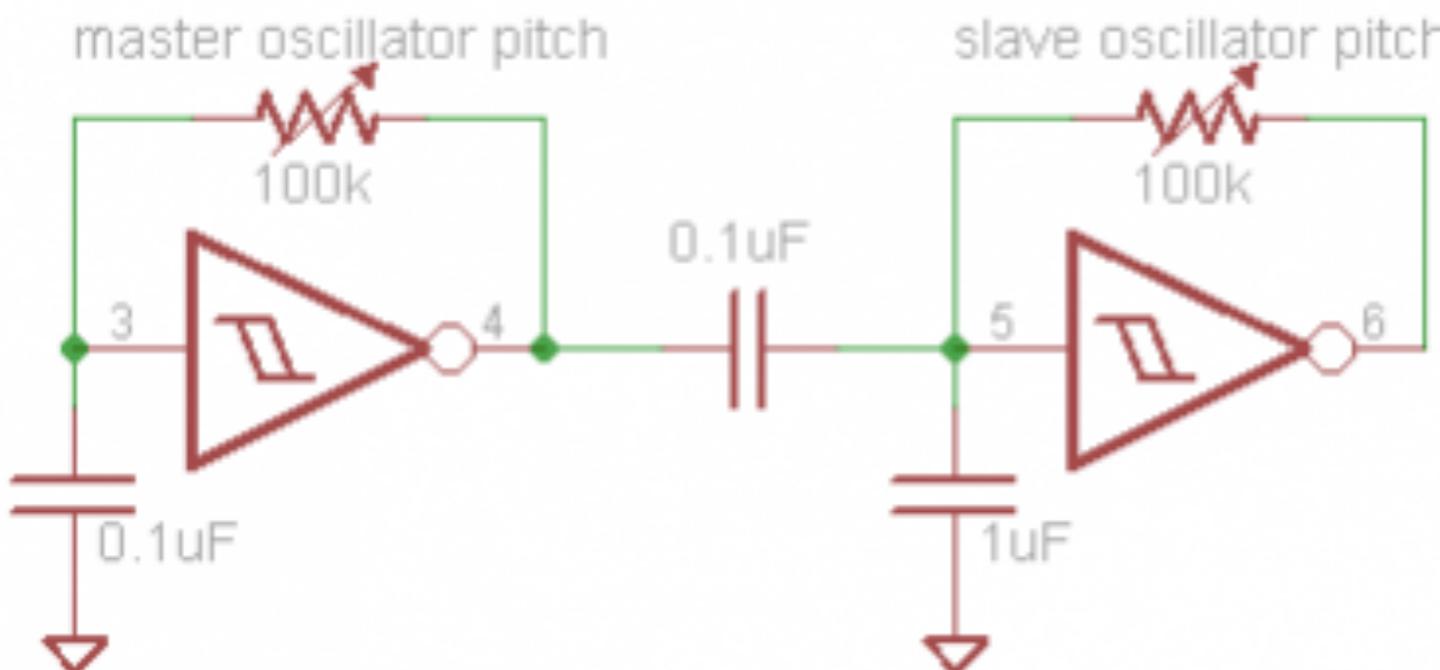
3 possible circuits



SIMPLE PITCH MODULATION



SYNCING OSCILLATORS



next steps

[http://casperelectronics.com/finished-pieces/omsynth-minilab/
omsynth-video-tutorials/video-1-oscillators/](http://casperelectronics.com/finished-pieces/omsynth-minilab/omsynth-video-tutorials/video-1-oscillators/)