

Physical Computing

Designing Physical Interactions for a Digital World

DESN 265

Spring 2012

Thursday 2PM – 5:30PM

Online and QC Makerspace

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Week 1-9

Week 1: What is Physical Computing?

Week 2: Introduction to Electronics

Week 3: Arduino, Hello World

Week 4: Analog Output

Week 5: Digital and Analog Review

Week 6: Enclosures

Week 7: Serial Communication, Processing and p5.js

Week 8: Soldering Workshop

Week 9: Midterm Presentation

Electricity

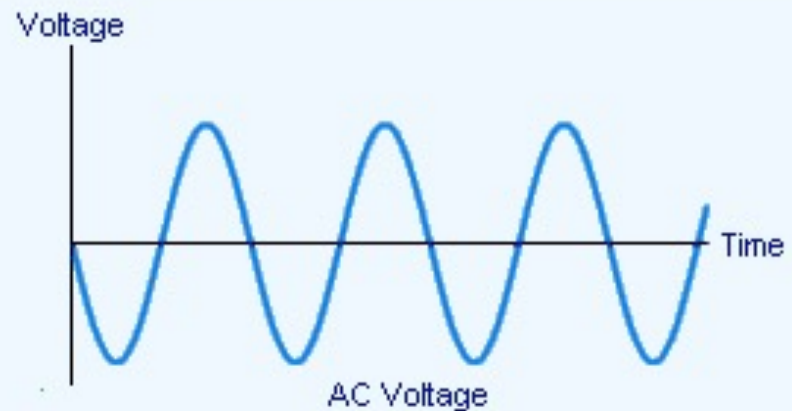
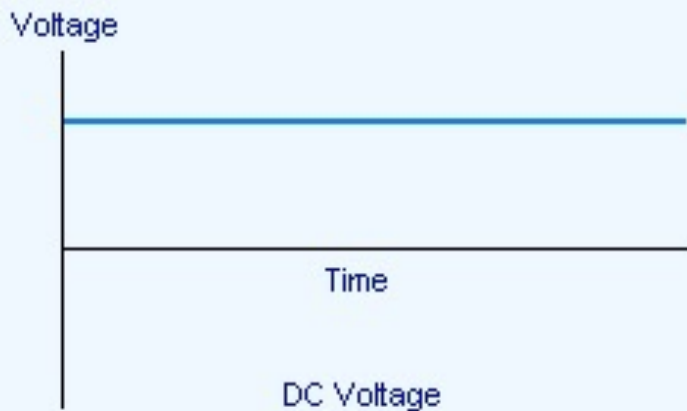
The background of the slide is a photograph of a power line tower and several high-voltage power lines stretching across the sky. The sky is a mix of blue and orange, suggesting a sunset or sunrise. The power lines are silhouetted against the bright sky, and the tower is a large, lattice-structured metal structure.

Flow of electrical energy through conductive materials (i.e. copper or aluminum).

AC/DC

DC (Direct Current): Flows in one direction.

AC (Alternating Current): Direction of current flow is reversed in a regular repeating cycle

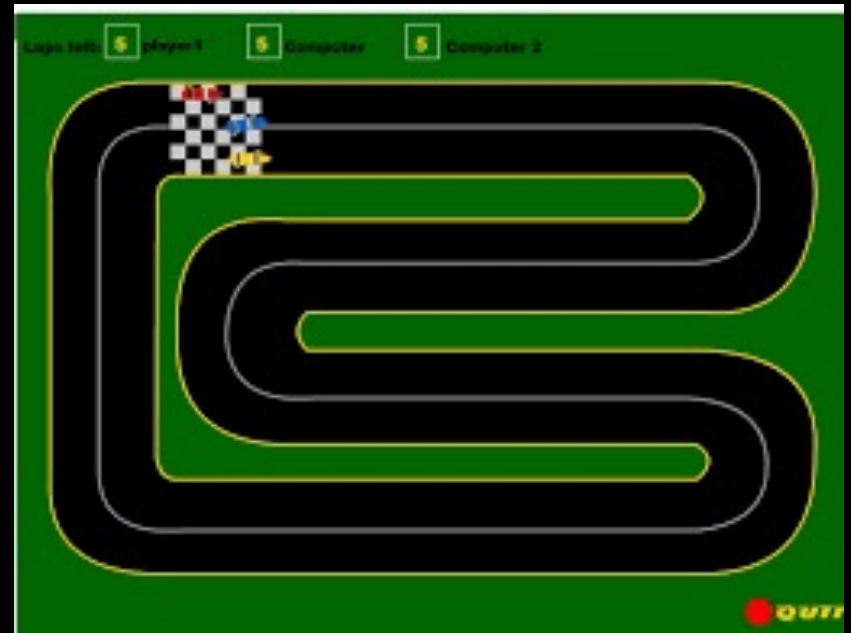
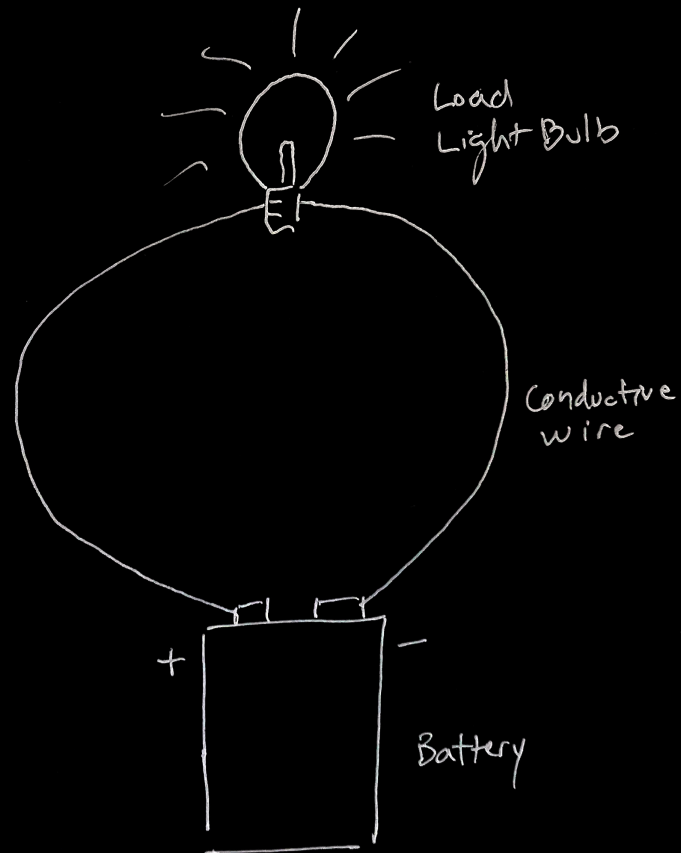


Representation of Visual Difference between DC and AC voltages

Electrical Circuit

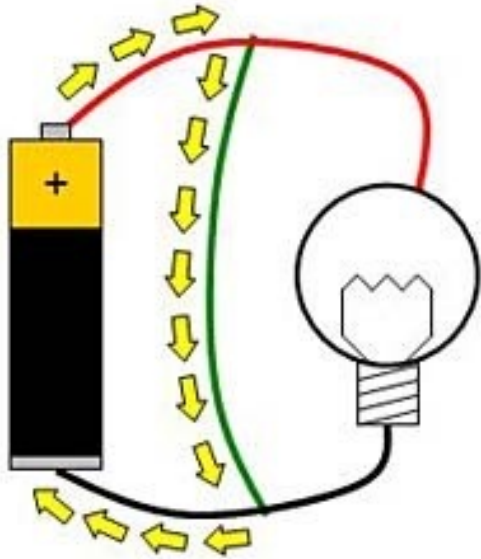
Made up by at least two elements: a power source (i.e. battery or outlet) and components that convert the electrical energy to other forms of energy (i.e. light, heat or kinetic) connected a highly conductive material.

Electrical Circuit



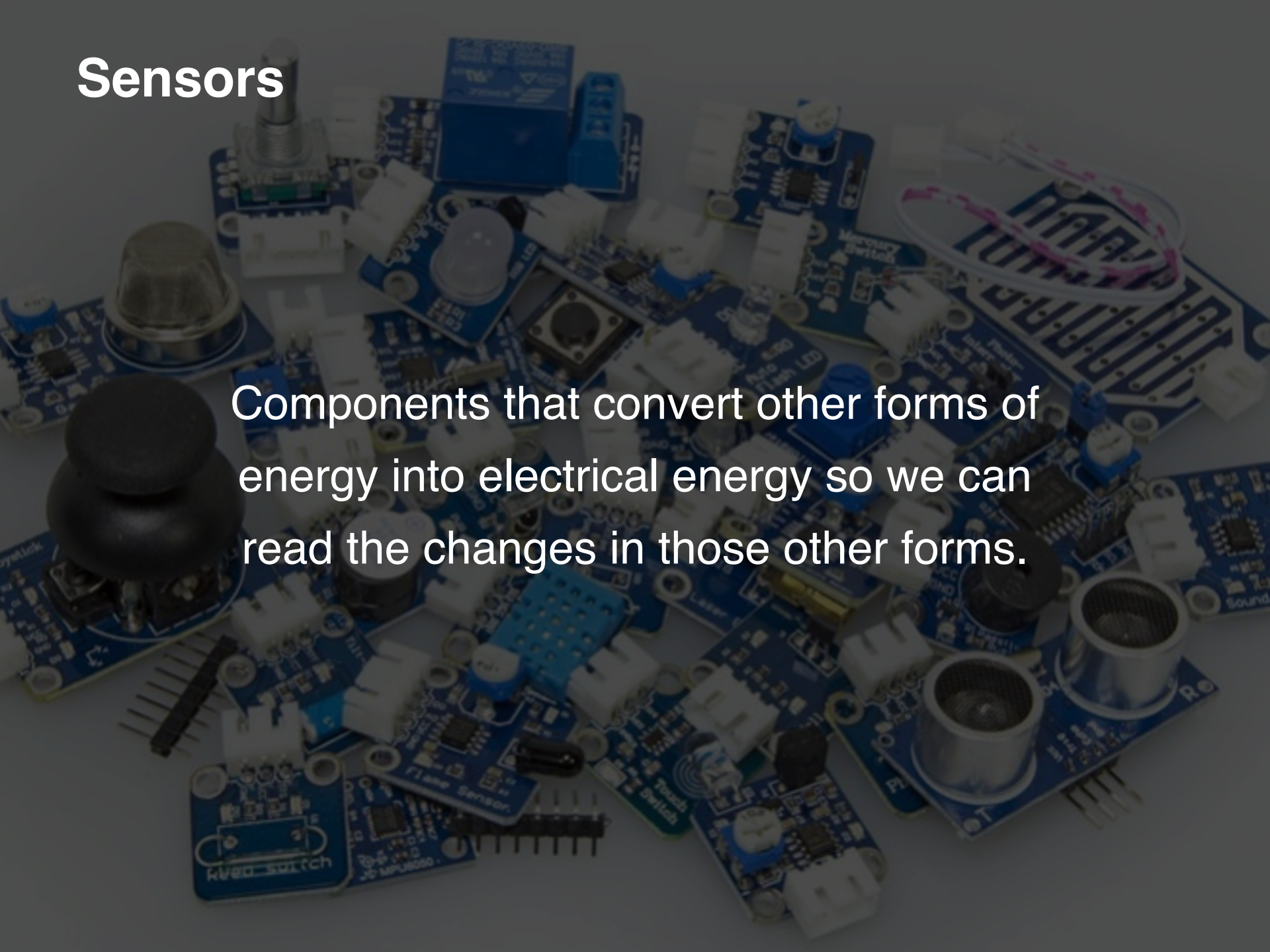
Short Circuit

Short circuit



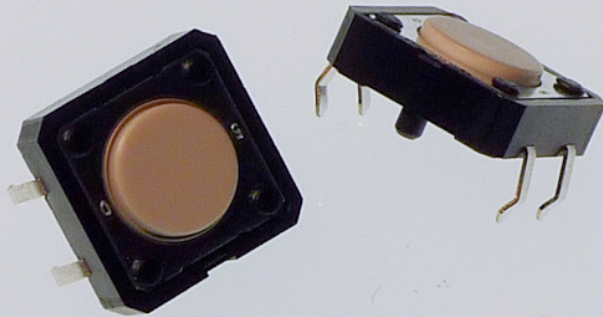
Sensors

Components that convert other forms of energy into electrical energy so we can read the changes in those other forms.

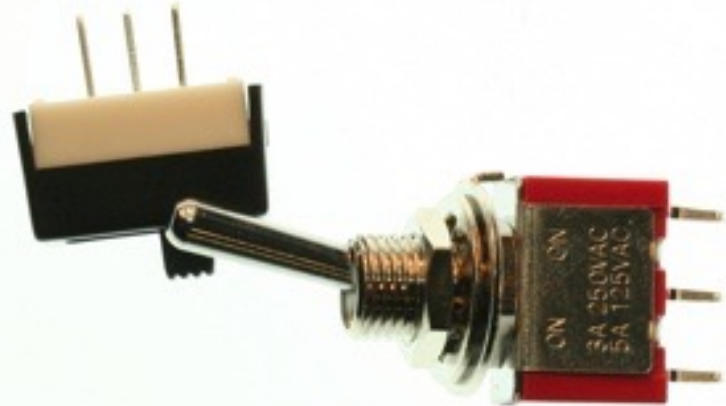


Sensors

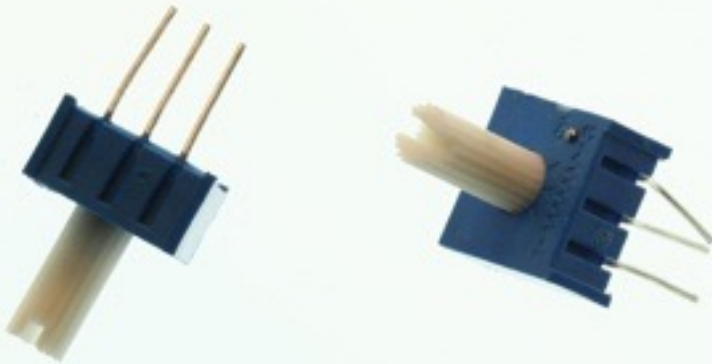
Momentary Switches (Buttons)



Toggle Switches



Potentiometers (Knobs)

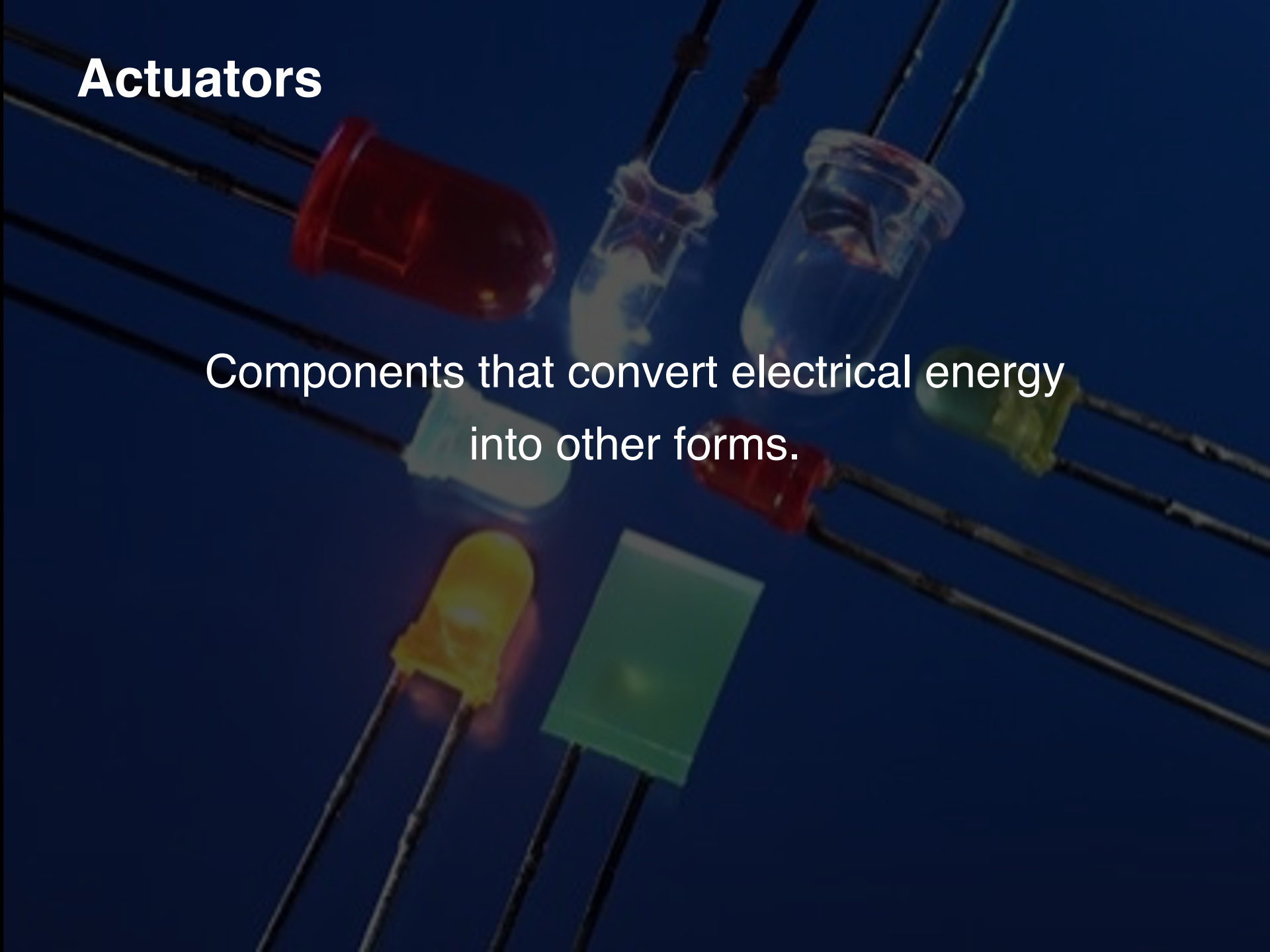


Light Sensor



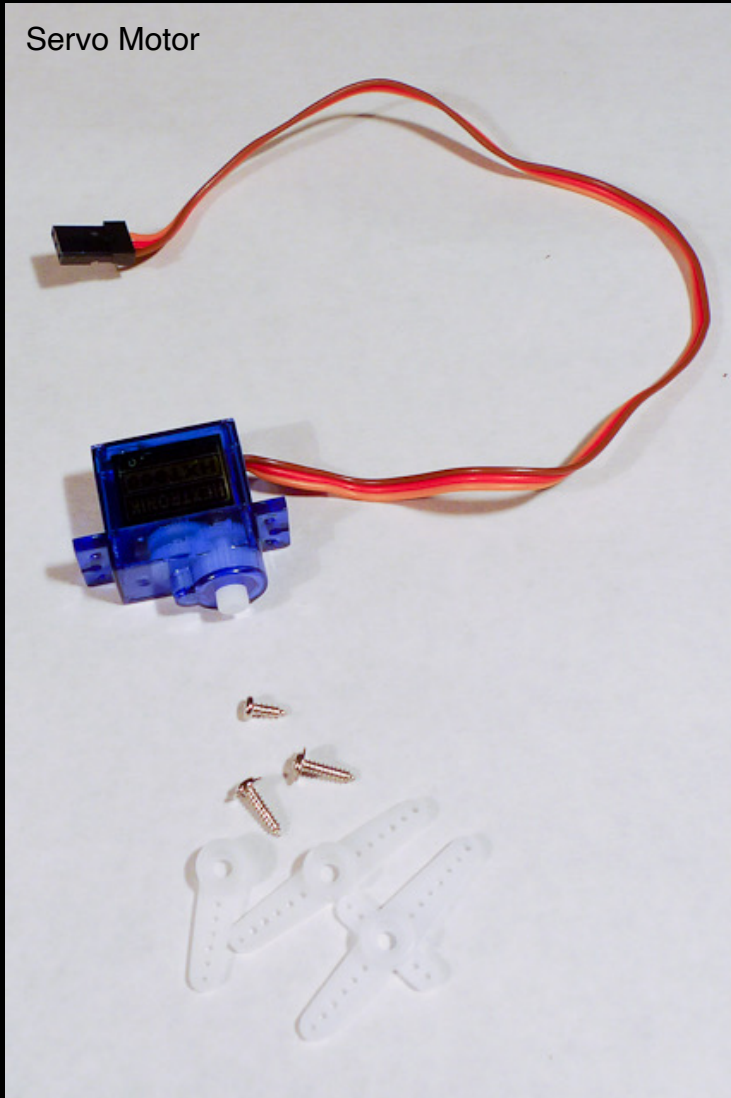
Actuators

Components that convert electrical energy into other forms.

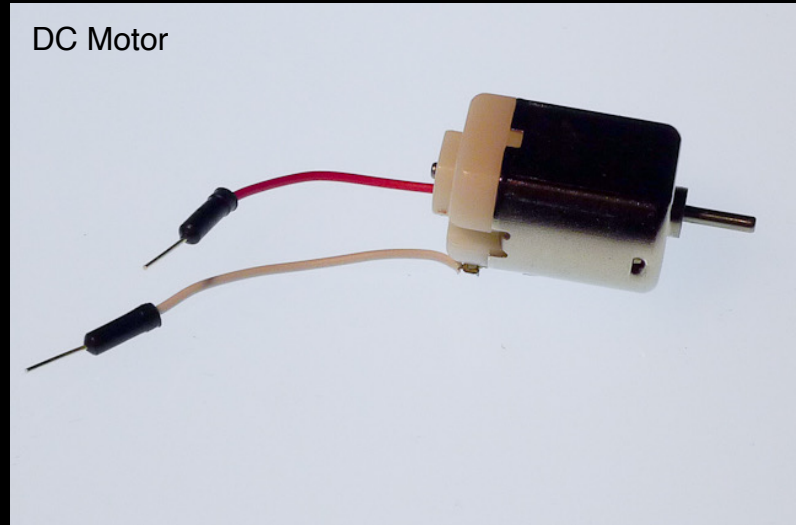


Actuators

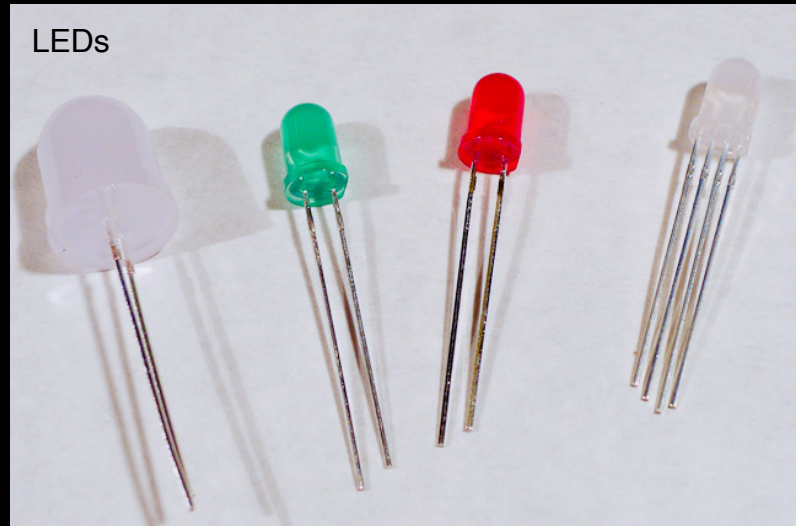
Servo Motor



DC Motor



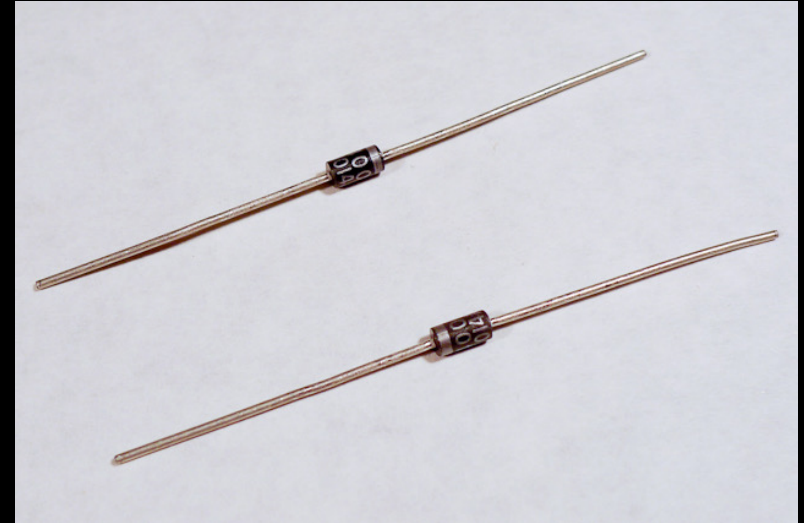
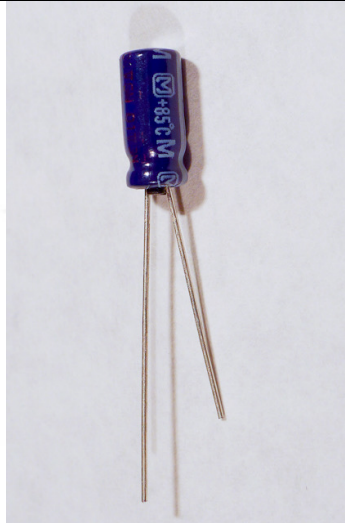
LEDs



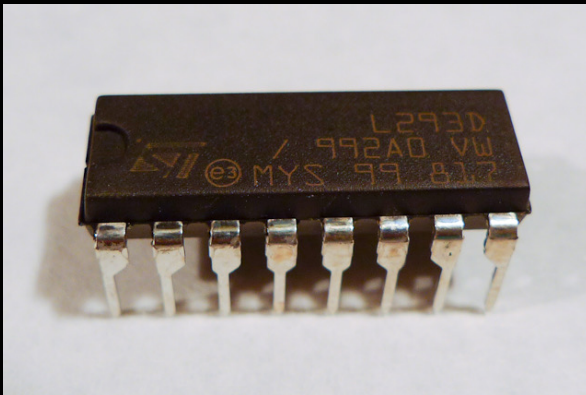
Other Components



Capacitors



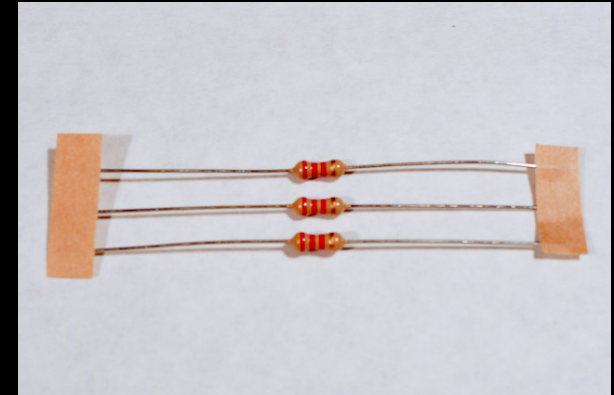
Diodes



H-Bridge

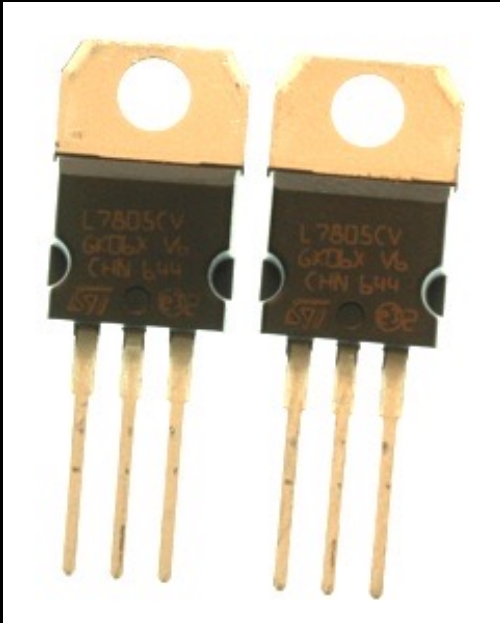


Relay

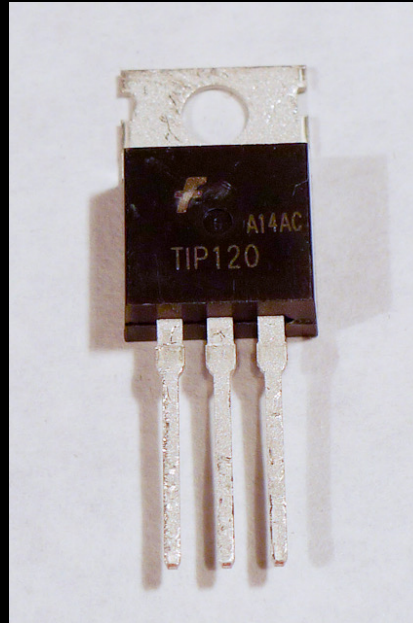


Resistor

Other Components



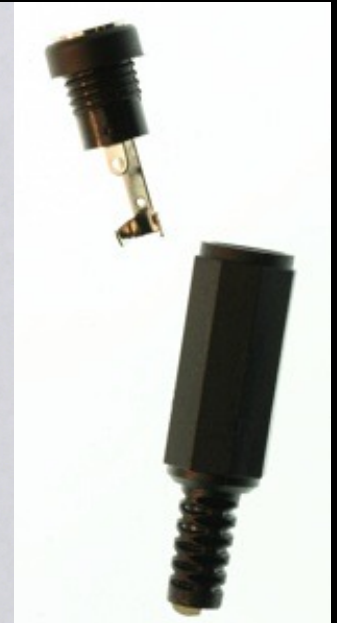
5V Voltage Regulator



Transistor



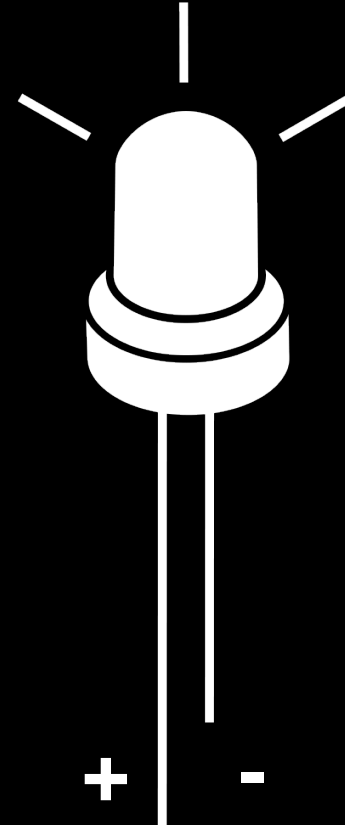
Power Connectors



Polarity

Electric current can only run in one direction through the component.

- LEDs
- Diodes
- Some capacitors



Datasheet

- Max and min current/voltage
- Input and output connections
- Polarity
- Dimensions

Kingbright®

T- 1 3/4 (5mm) SUPER BRIGHT LED LAMPS

L-53SG SUPER BRIGHT GREEN

L-53SR SUPER BRIGHT RED

Features

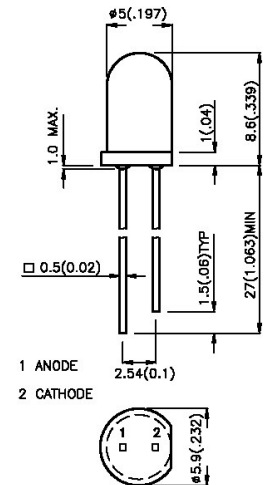
- ULTRA BRIGHTNESS.
- BOTH DIFFUSED AND WATER CLEAR LENS ARE AVAILABLE.
- OUTSTANDING MATERIAL EFFICIENCY.
- RELIABLE AND RUGGED.
- IC COMPATIBLE/LOW CURRENT CAPABILITY.

Description

The Super Bright Green source color devices are made with Gallium Phosphide Green Light Emitting Diode.

The Super Bright Red source color devices are made with Gallium Aluminum Arsenide Red Light Emitting Diode.

Package Dimensions



Notes:

1. All dimensions are in millimeters (inches).
2. Tolerance is $\pm 0.25 (0.01")$ unless otherwise noted.
3. Lead spacing is measured where the lead emerge package.
4. Specifications are subjected to change without notice.

Selection Guide

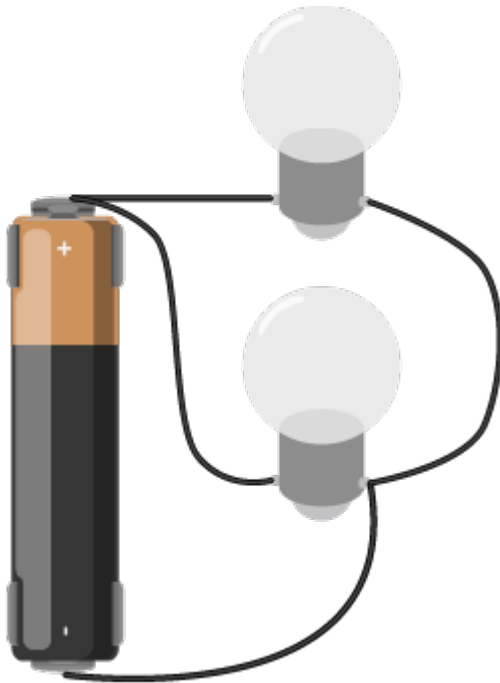
Part No.	Dice	Lens Type	Iv (mcd) @ 20 mA		Viewing Angle
			Min.	Max.	
L-53SGC	SUPER BRIGHT GREEN (GaP)	WATER CLEAR	100	300	30°
L-53SRC-A	SUPER BRIGHT RED (GaAlAs)	WATER CLEAR	300	400	
L-53SRC-B			400	500	
L-53SRC-C			500	1000	
L-53SRC-DU			1000	1300	
L-53SRC-DV			1300	1600	
L-53SRC-DW			1600	2000	
L-53SRC-E			2000	3500	
L-53SRC-F			3500	4500	
L-53SGD	SUPER BRIGHT GREEN (GaP)	GREEN DIFFUSED	20	60	60°
L-53SRD-B	SUPER BRIGHT RED (GaAlAs)	RED DIFFUSED	90	110	
L-53SRD-C			110	200	
L-53SRD-D			200	300	
L-53SRD-E			300	500	
L-53SRD-F			500	700	
L-53SRD-G			700	1000	
L-53SRD-H			1000	1600	

Note:

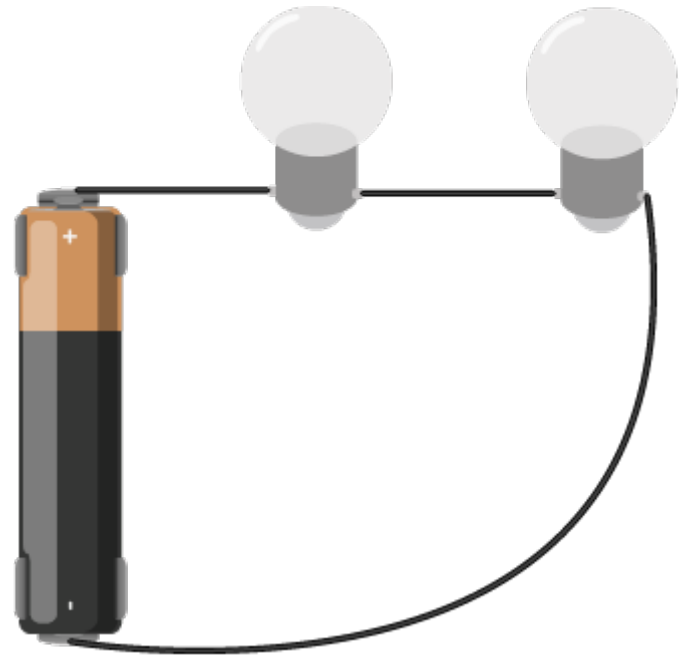
1. $\theta 1/2$ is the angle from optical centerline where the luminous intensity is 1/2 the optical centerline value.

Parallel vs Series

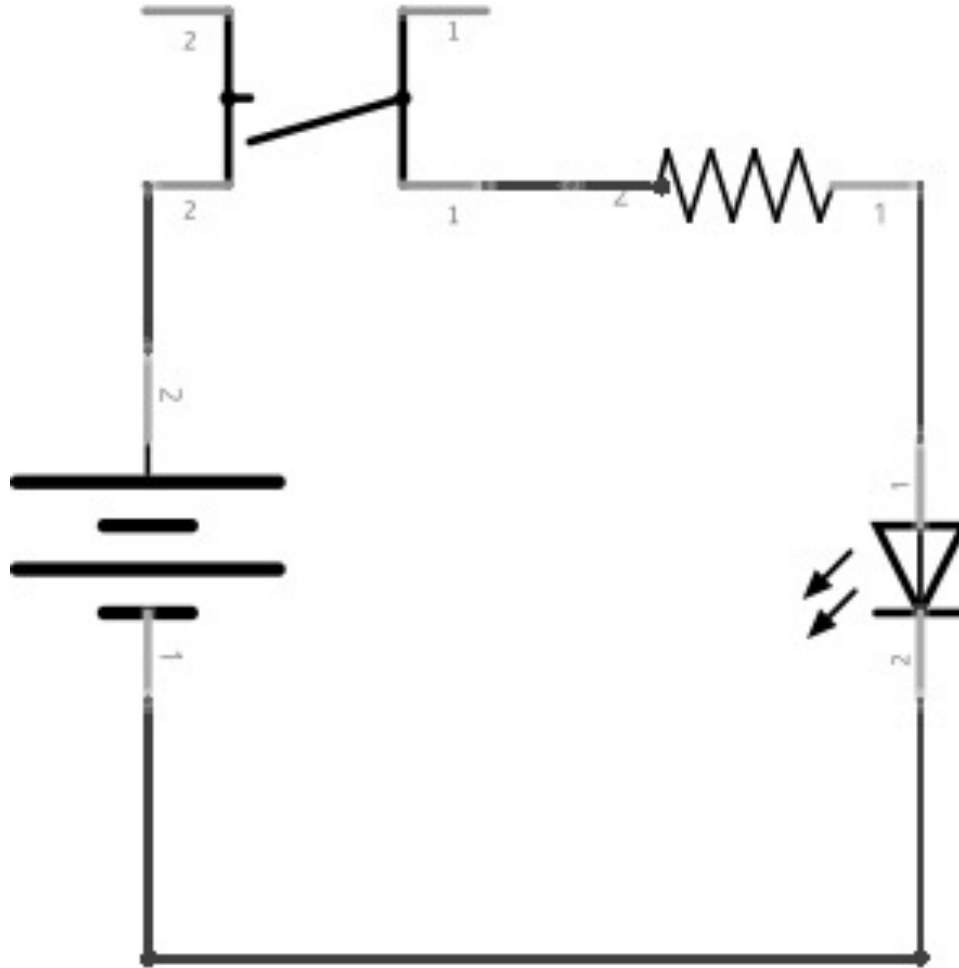
Circuit in Parallel



Circuit in Series



Schematics



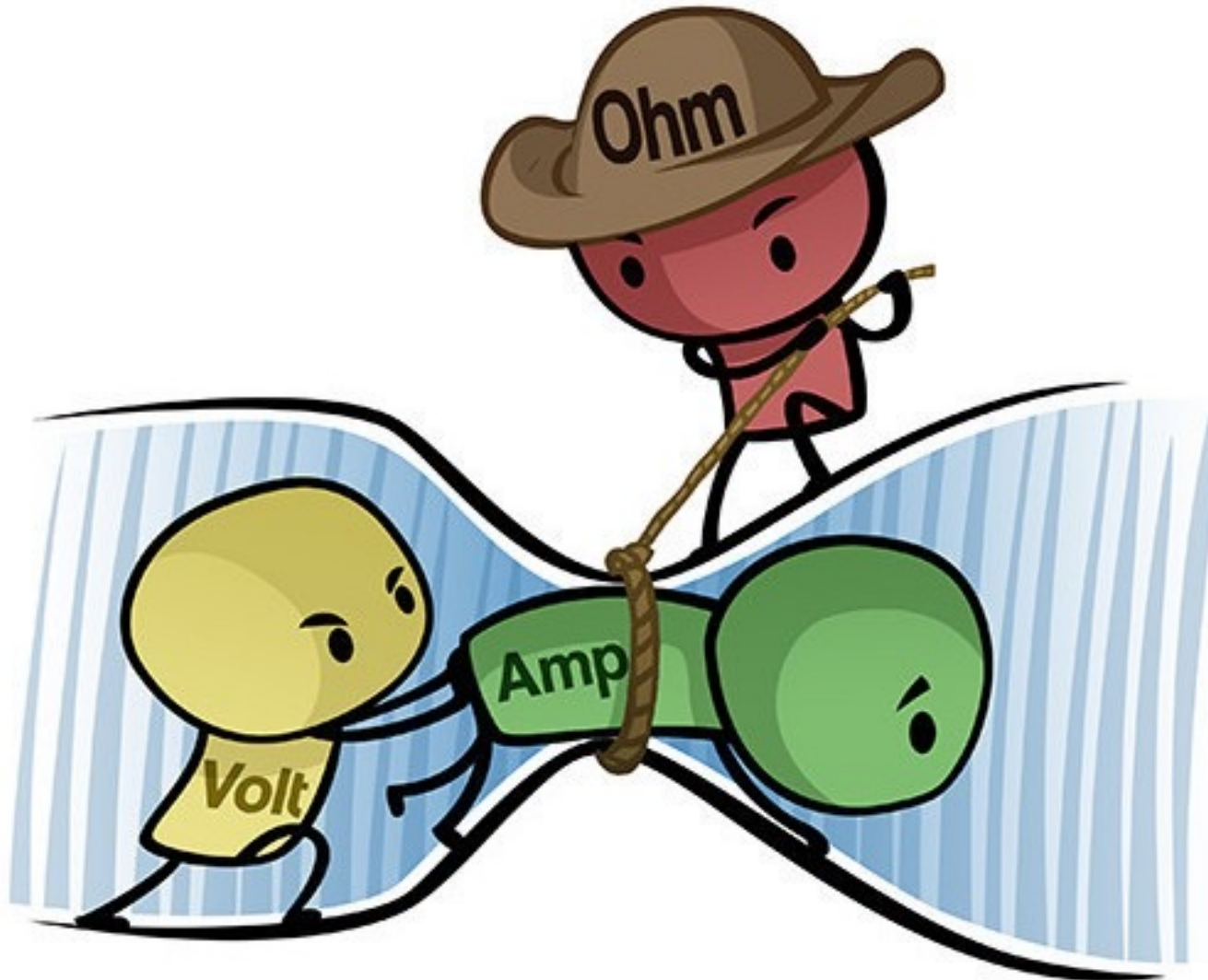
Electricity 101

Voltage: Measure of the difference in electric potential energy between two points in a circuit. (Volts)

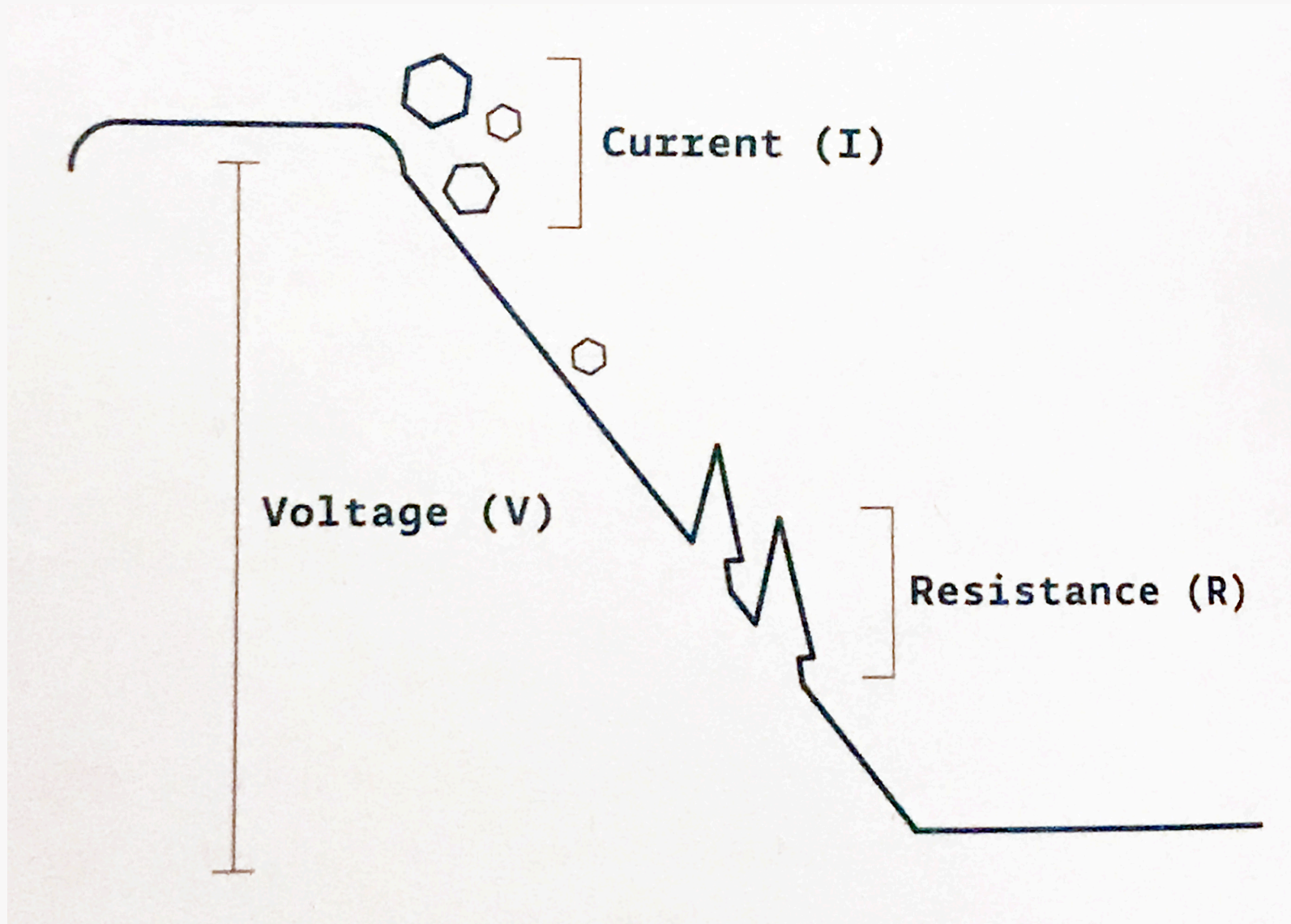
Current: Measure of the magnitude of the flow of electrons. (Amps)

Resistance: Measure of a materials ability to oppose the flow of electricity. (Ohms)

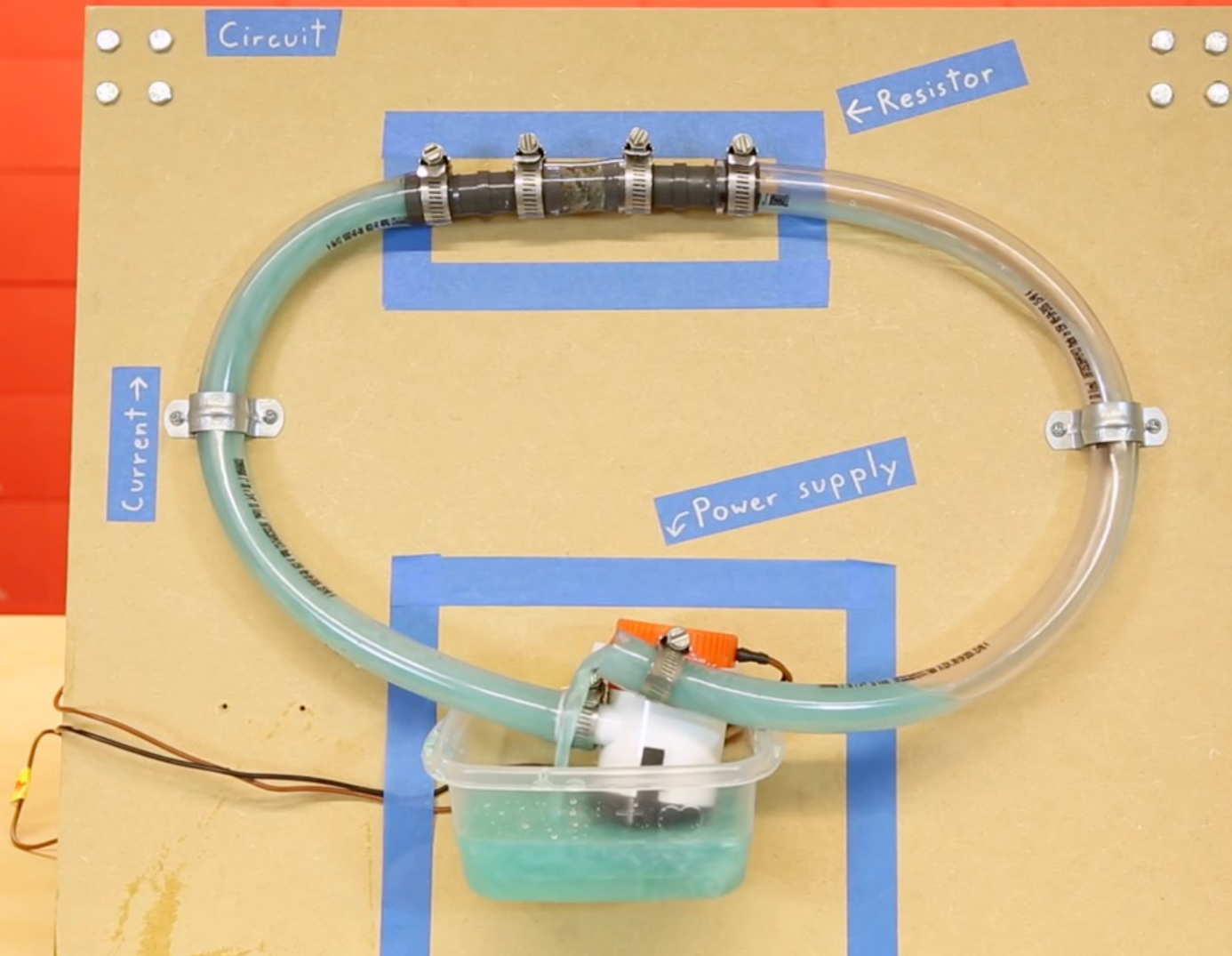
Electricity 101



Electricity 101



Electricity 101



Electricity 101

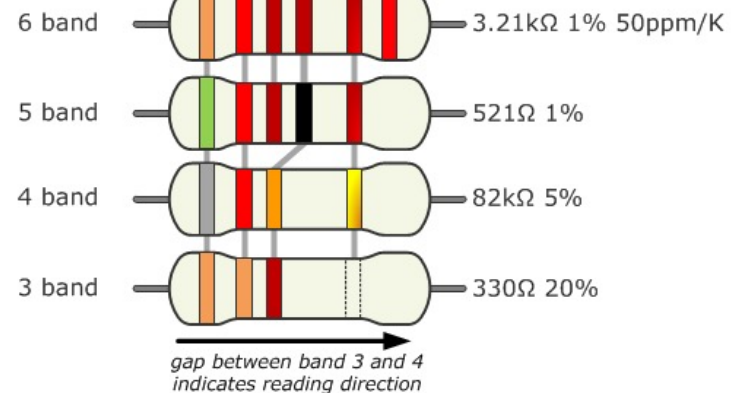


Resistors



www.resistorguide.com

	Color	Significant figures			Multiply	Tolerance (%)	Temp. Coeff. (ppm/K)	Fail Rate (%)
Bad	black	0	0	0	x 1		250 (U)	
Beer	brown	1	1	1	x 10	1 (F)	100 (S)	1
Rots	red	2	2	2	x 100	2 (G)	50 (R)	0.1
Our	orange	3	3	3	x 1K		15 (P)	0.01
Young	yellow	4	4	4	x 10K		25 (Q)	0.001
Guts	green	5	5	5	x 100K	0.5 (D)	20 (Z)	
But	blue	6	6	6	x 1M	0.25 (C)	10 (Z)	
Vodka	violet	7	7	7	x 10M	0.1 (B)	5 (M)	
Goes	grey	8	8	8	x 100M	0.05 (A)	1(K)	
Well	white	9	9	9	x 1G			
Get	gold			3th digit only for 5 and 6 bands	x 0.1	5 (J)		
Some	silver				x 0.01	10 (K)		
Now!	none					20 (M)		



Resistors

Resistor color code calculator

www.resistorguide.com/resistor-color-code-calculator/

part of a **standard E-series value**, this will be shown in brackets after the resistance value.

How to use the color code calculator

- Select the amount of bands of the resistor on the top-left
- Choose the colors of the bands by clicking on the corresponding box in the chart
- The corresponding ohmic value and tolerance of the resistor is shown


Bands:

3

4

5

6



220Ω ±5% [E24]

	1 st digit	2 nd digit	3 rd digit	multiply	tolerance	TCR (ppm/K)
Bad	Black	0	0	0	1% (F)	100
Beer	Brown	1	1	1	2% (G)	50
Rots	Red	2	2	2	100	15
Our	Orange	3	3	3	1K	25
Young	Yellow	4	4	4	10K	
Guts	Green	5	5	5	100K	0.5% (D)
But	Blue	6	6	6	1M	0.25% (C)
Vodka	Violet	7	7	7	10M	0.1% (B)
Goes	Gray	8	8	8	100M	0.05% (A)
Well	White	9	9	9	1G	
Get	Gold				0.1	5% (J)
Some	Silver				0.01	10% (K)
Now	None					20% (M)

Popular pages

- What is a resistor?
- Resistor color code
- Color code calculator
- Varistor
- NTC thermistor
- Potentiometer

SMD resistor calculator

If you are looking for an SMD resistor code calculator, please take a look at:

- Surface mount resistor codes

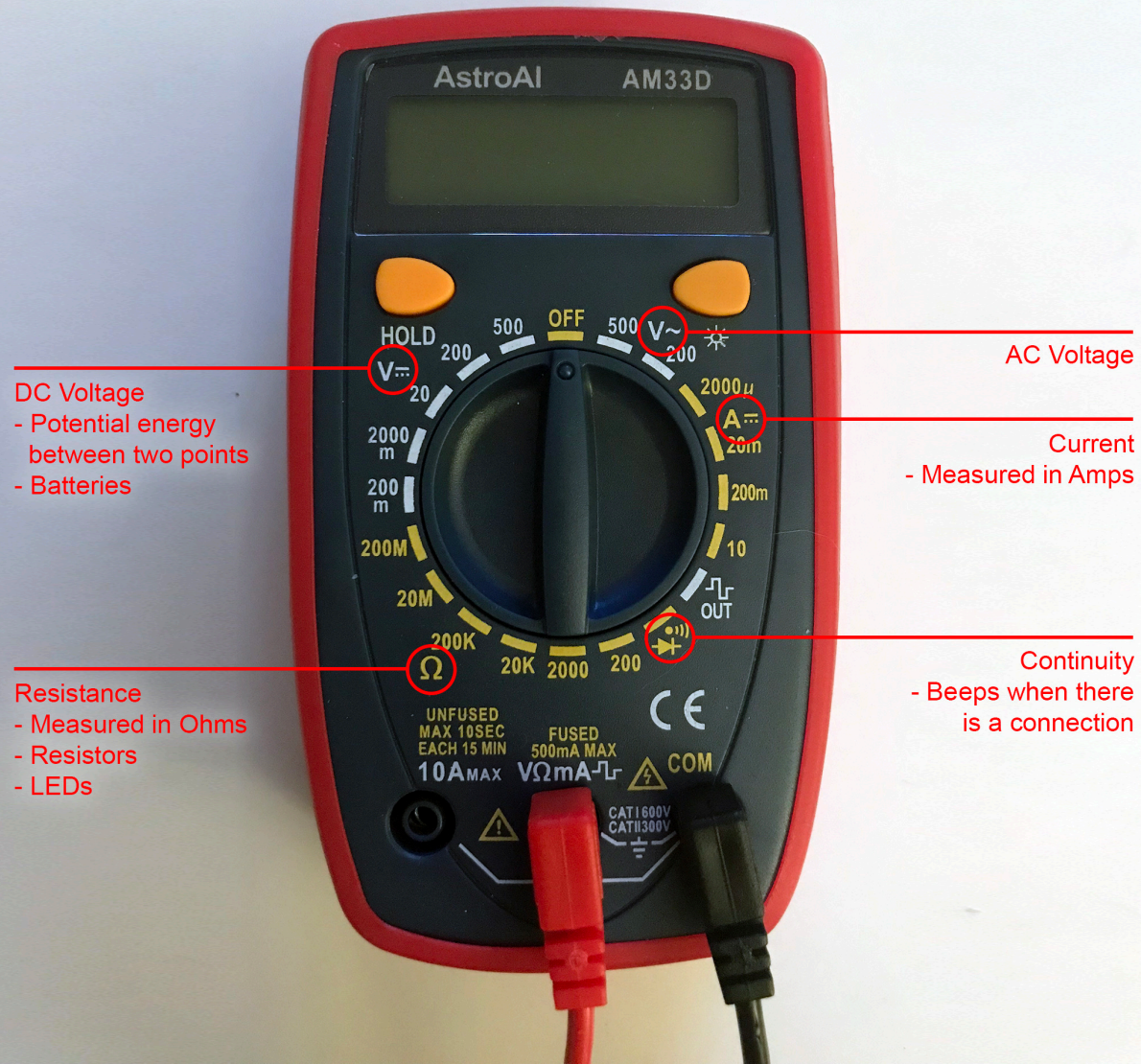
Tags

codes, color, color code calculator, five band resistor code, four band resistor code, ohm, resistance color code, resistor, resistor calculator, resistor code, resistor color, resistor color code, resistor color code calculator, resistor color coding, resistor colour code, six band resistor code, standards

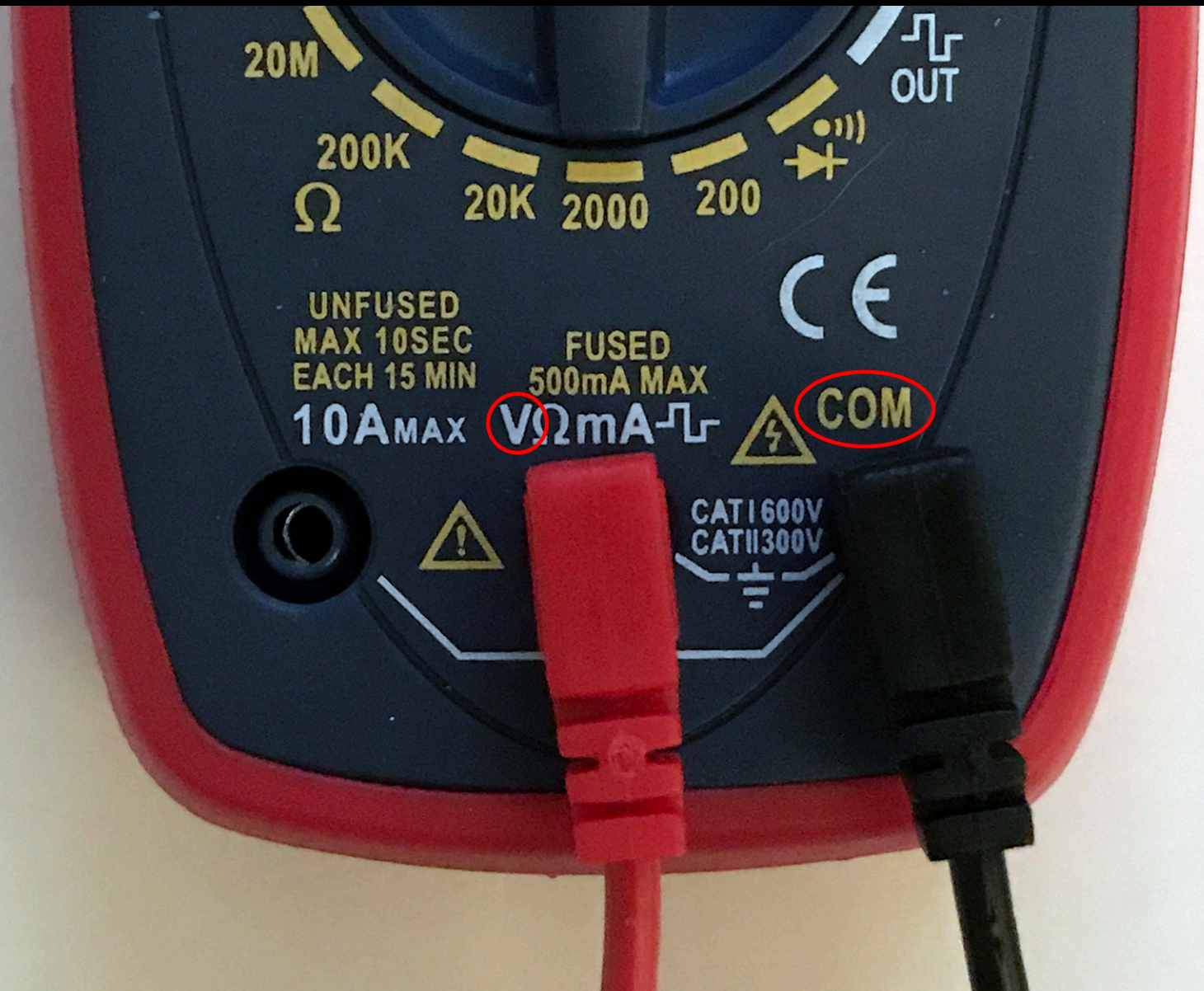
Special cases

<http://www.resistorguide.com/resistor-color-code-calculator/>

Digital Multimeter



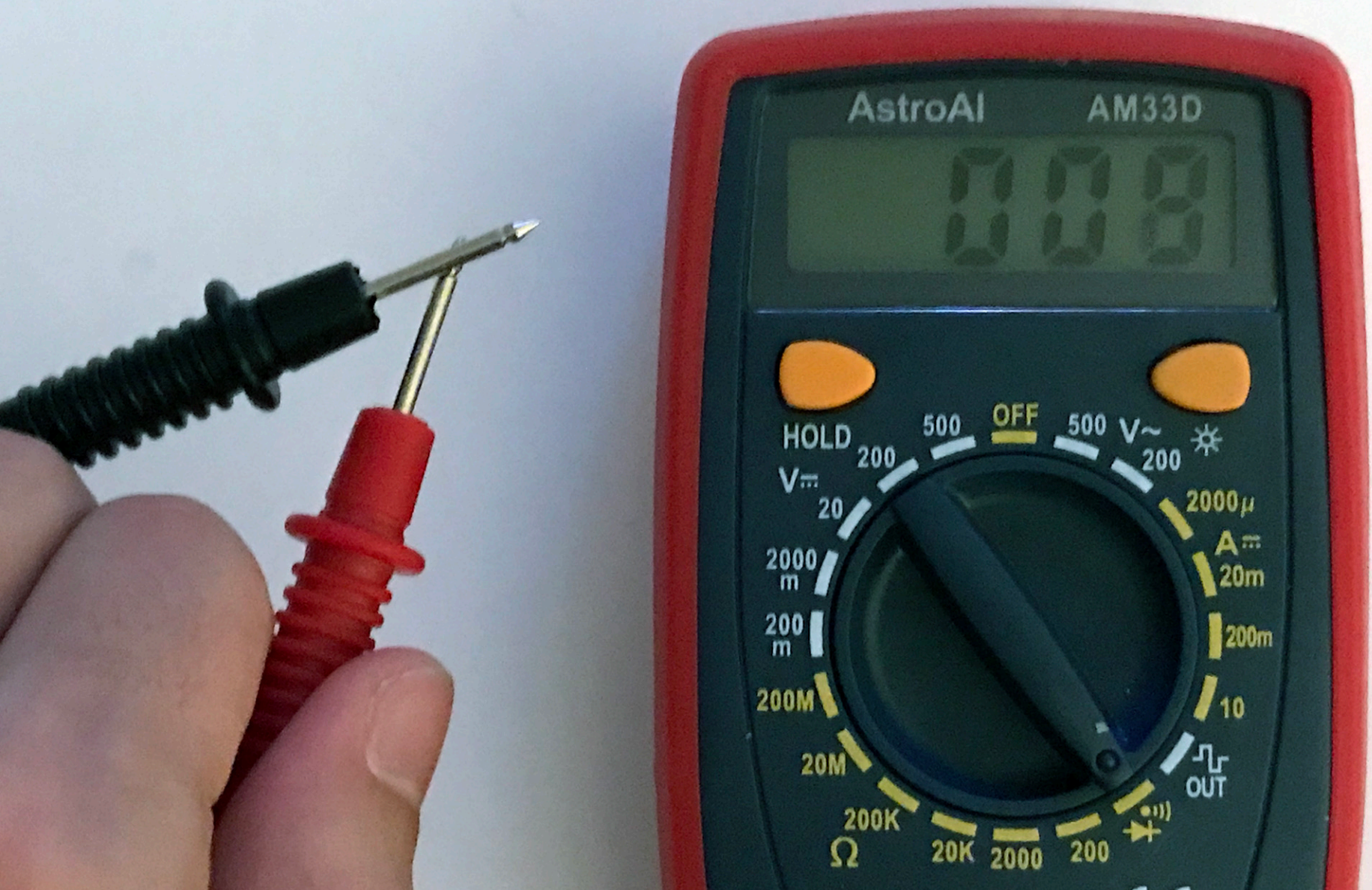
Digital Multimeter



Digital Multimeter – Continuity



Digital Multimeter – Continuity



Digital Multimeter – Voltage



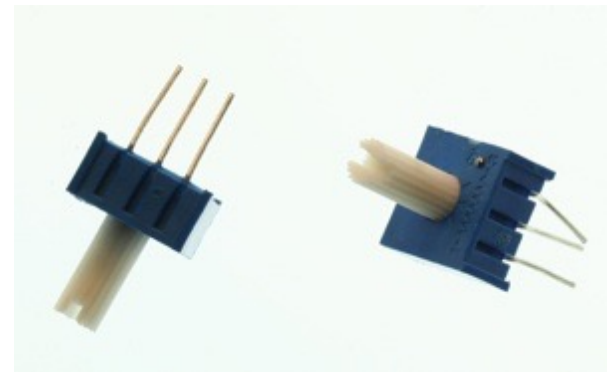
Digital Multimeter – Resistance



Resistors



Variable Resistors



Digital Multimeter – Current

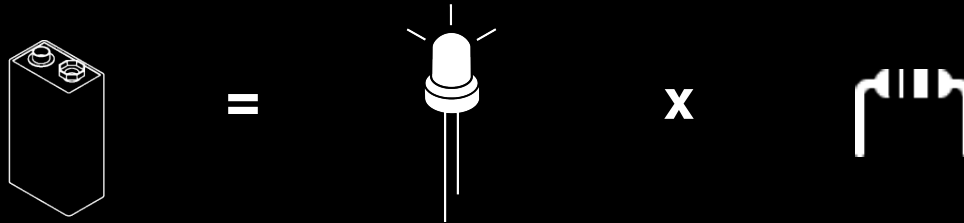


Ohms Law

$$\text{Voltage (V)} = \text{Current (I / Amps)} \times \text{Resistance (R / Ohms / } \Omega \text{)}$$

Ohms Law

$$\text{Voltage (V)} = \text{Current (I / Amps)} \times \text{Resistance (R / Ohms / } \Omega \text{)}$$

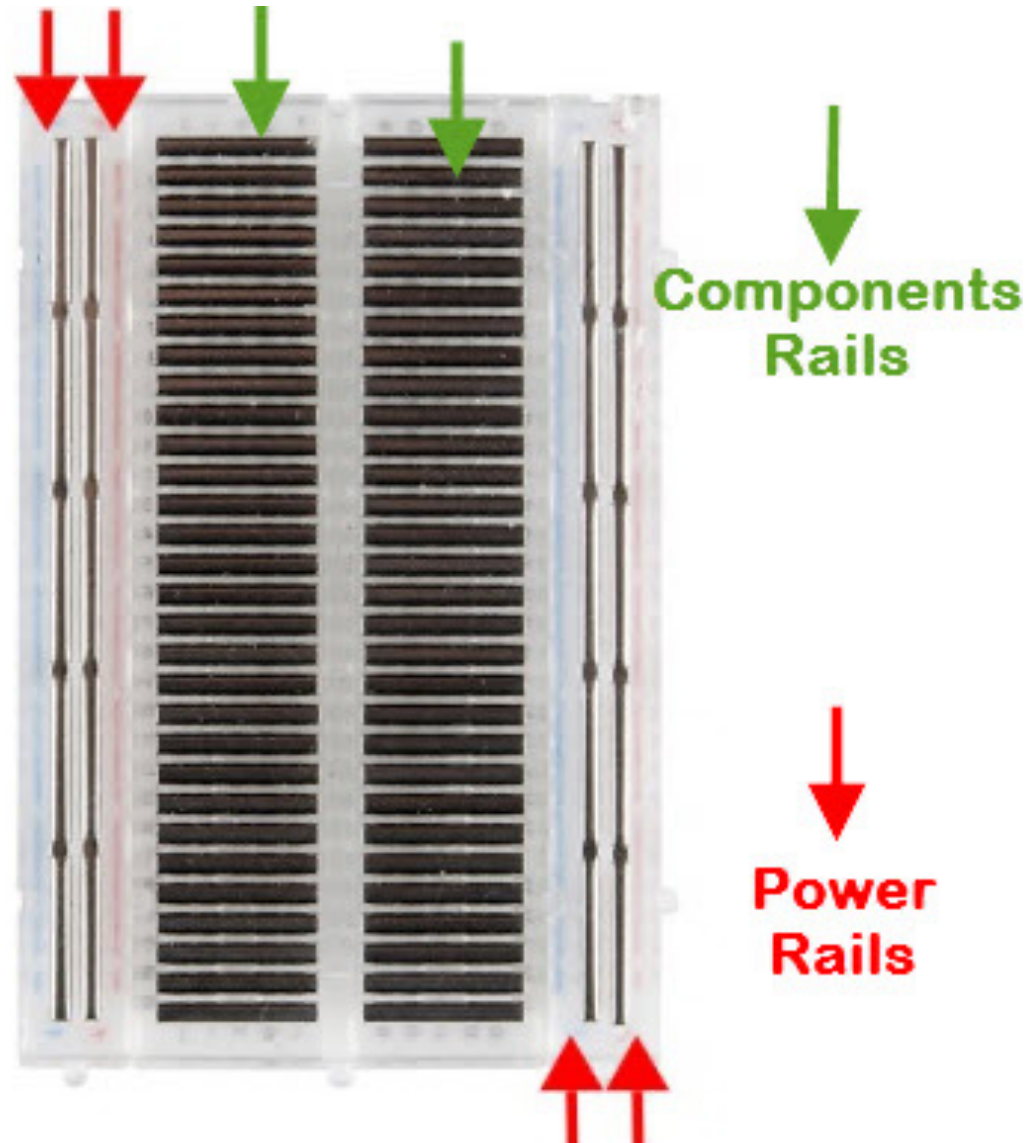
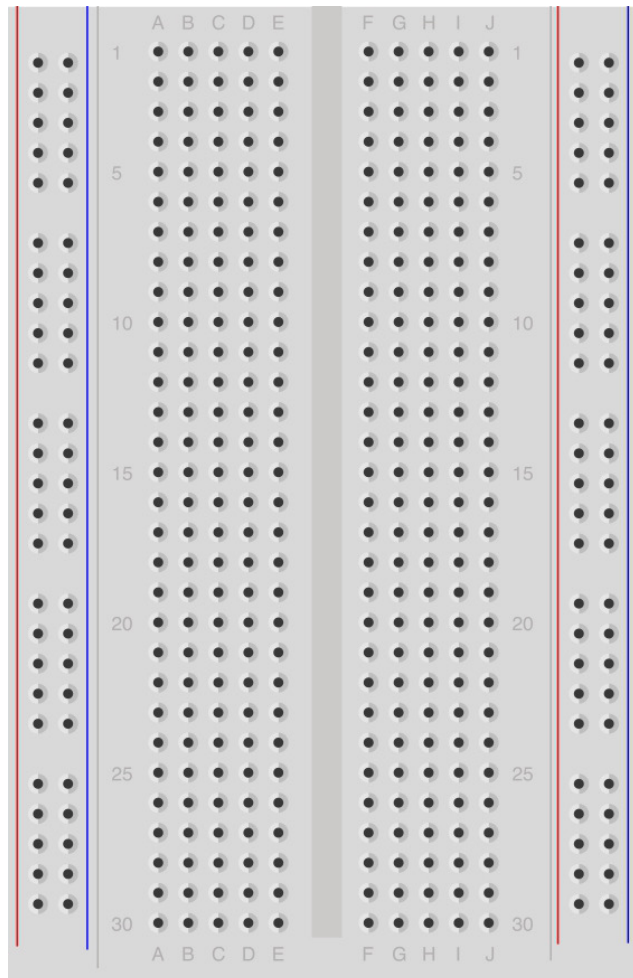


$$9\text{v} = 11.5\text{mA} \times ???$$

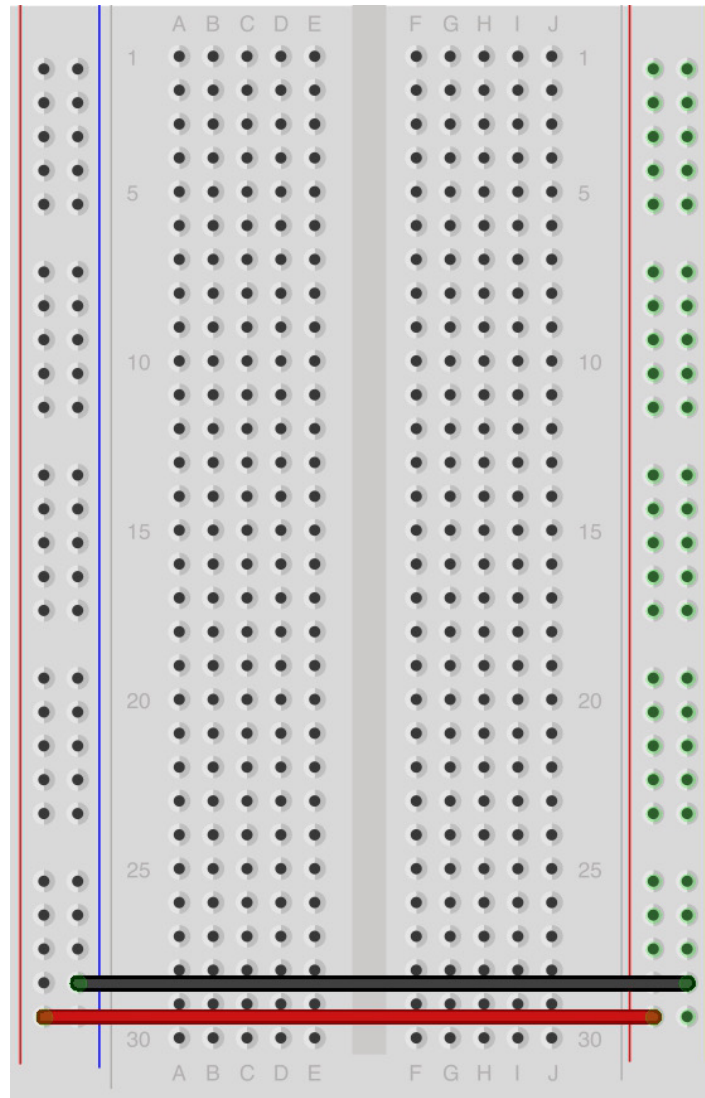
0.0115 amps

$$\frac{9}{0.0115} = 780 \text{ Ohms}$$

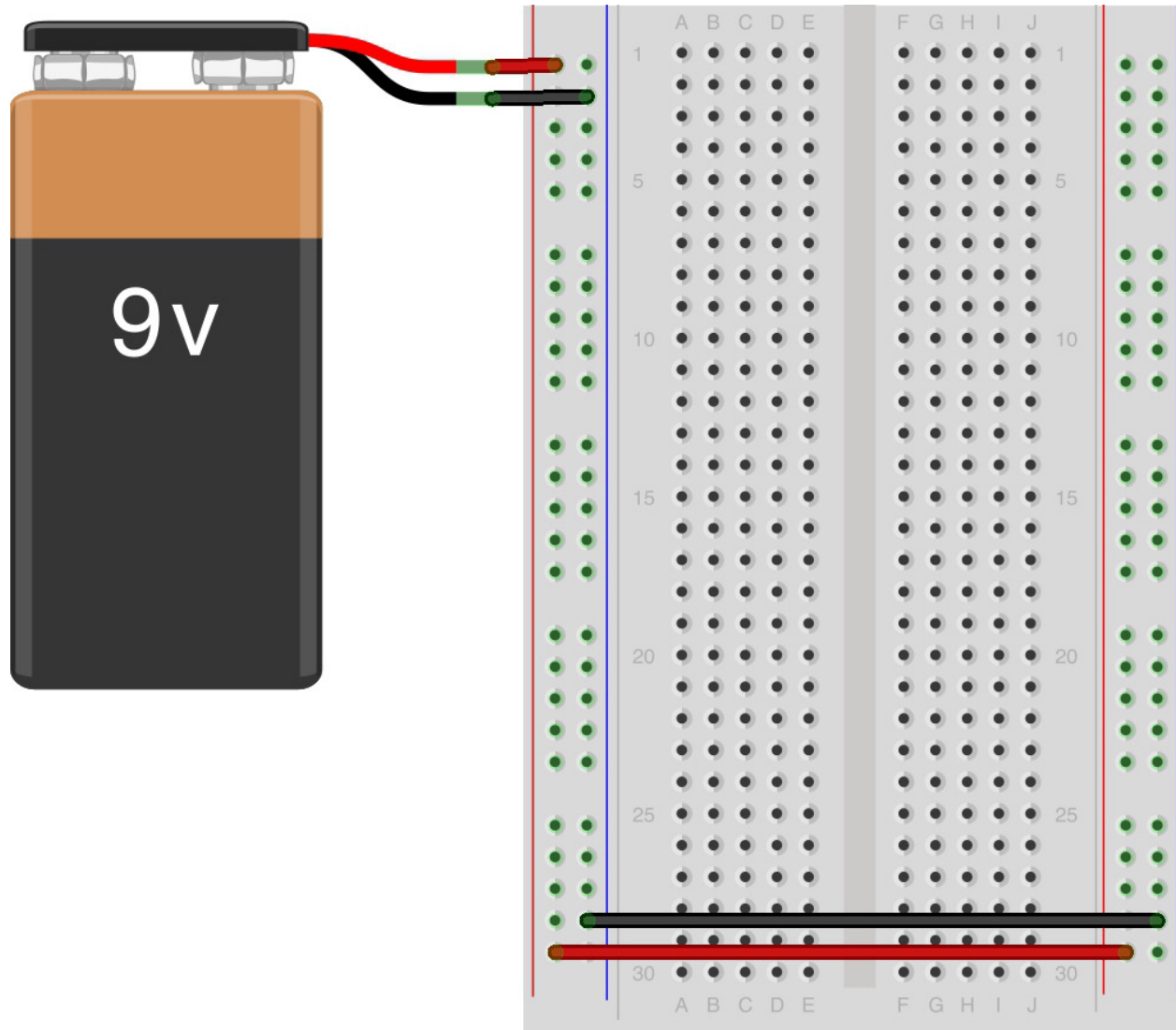
Breadboard



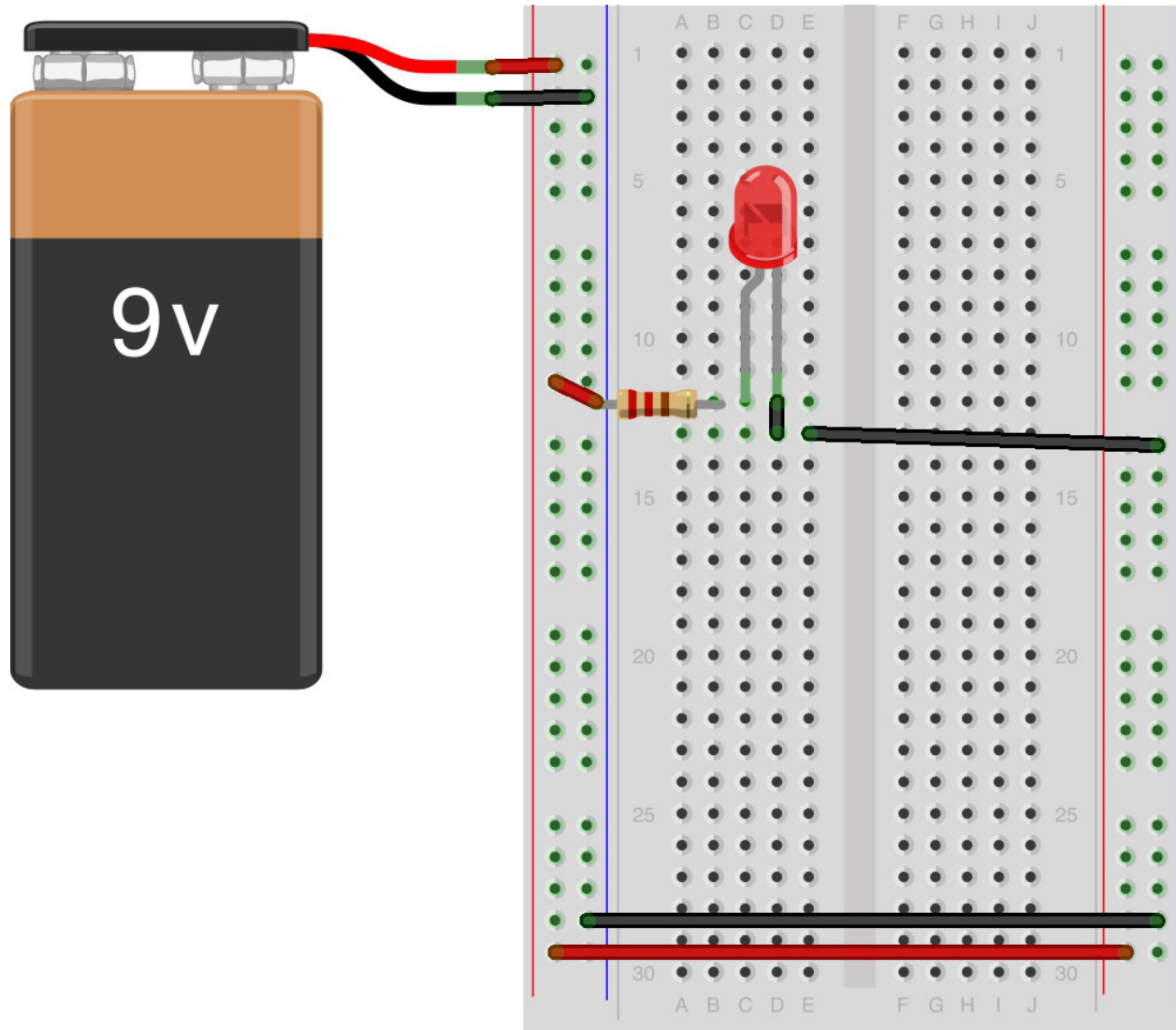
Basic Circuit and Breadboard



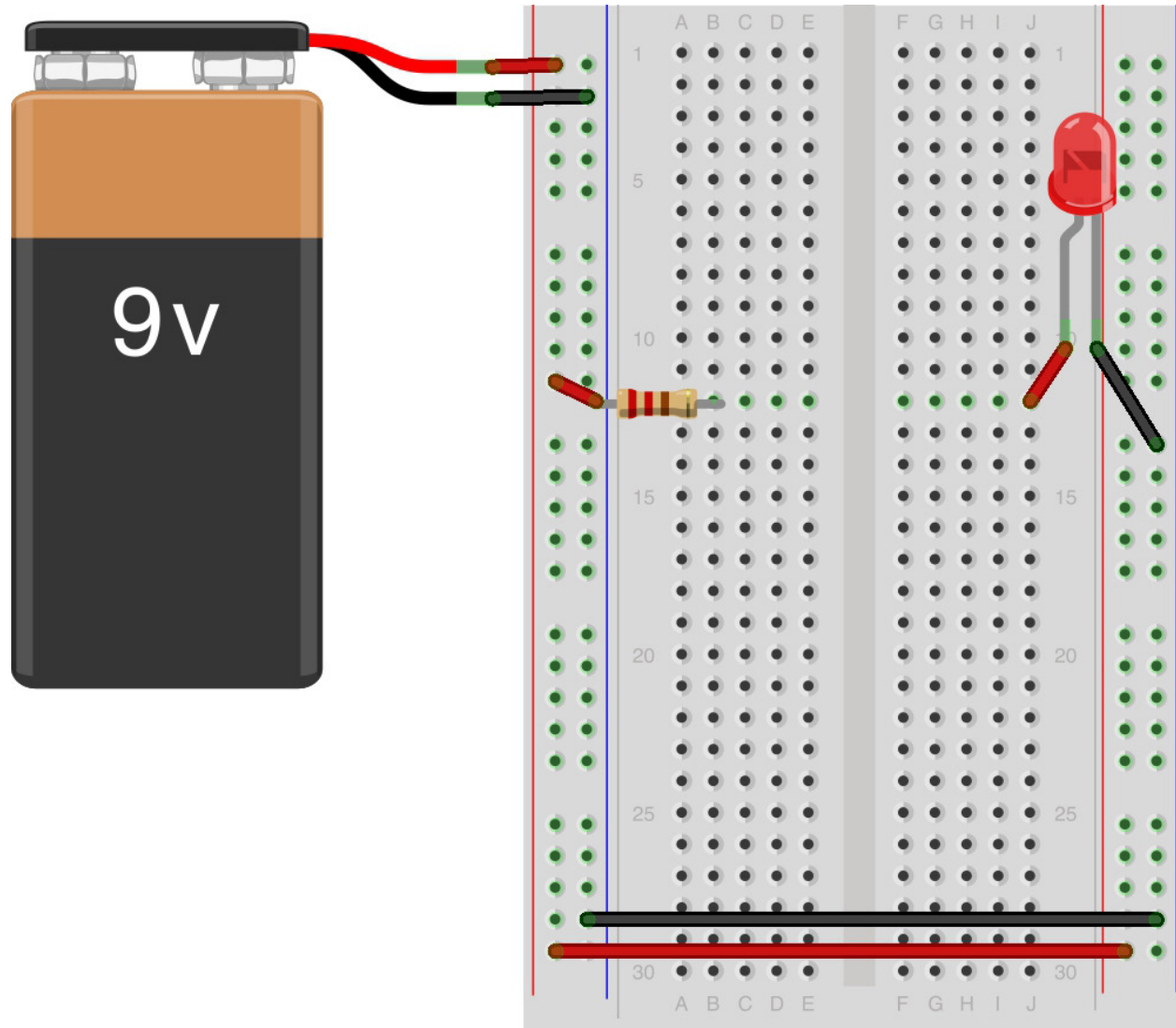
Basic Circuit and Breadboard



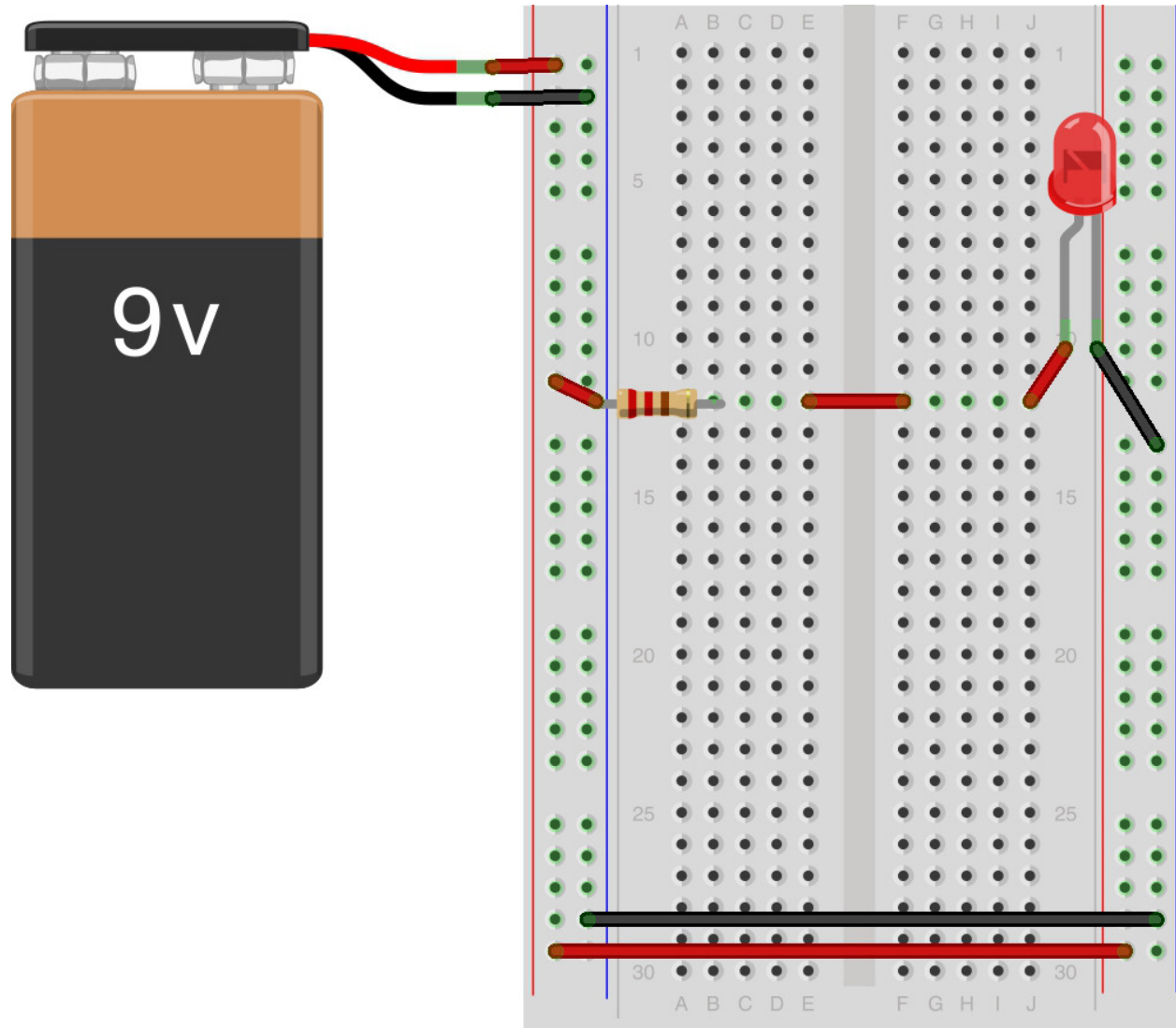
Basic Circuit and Breadboard



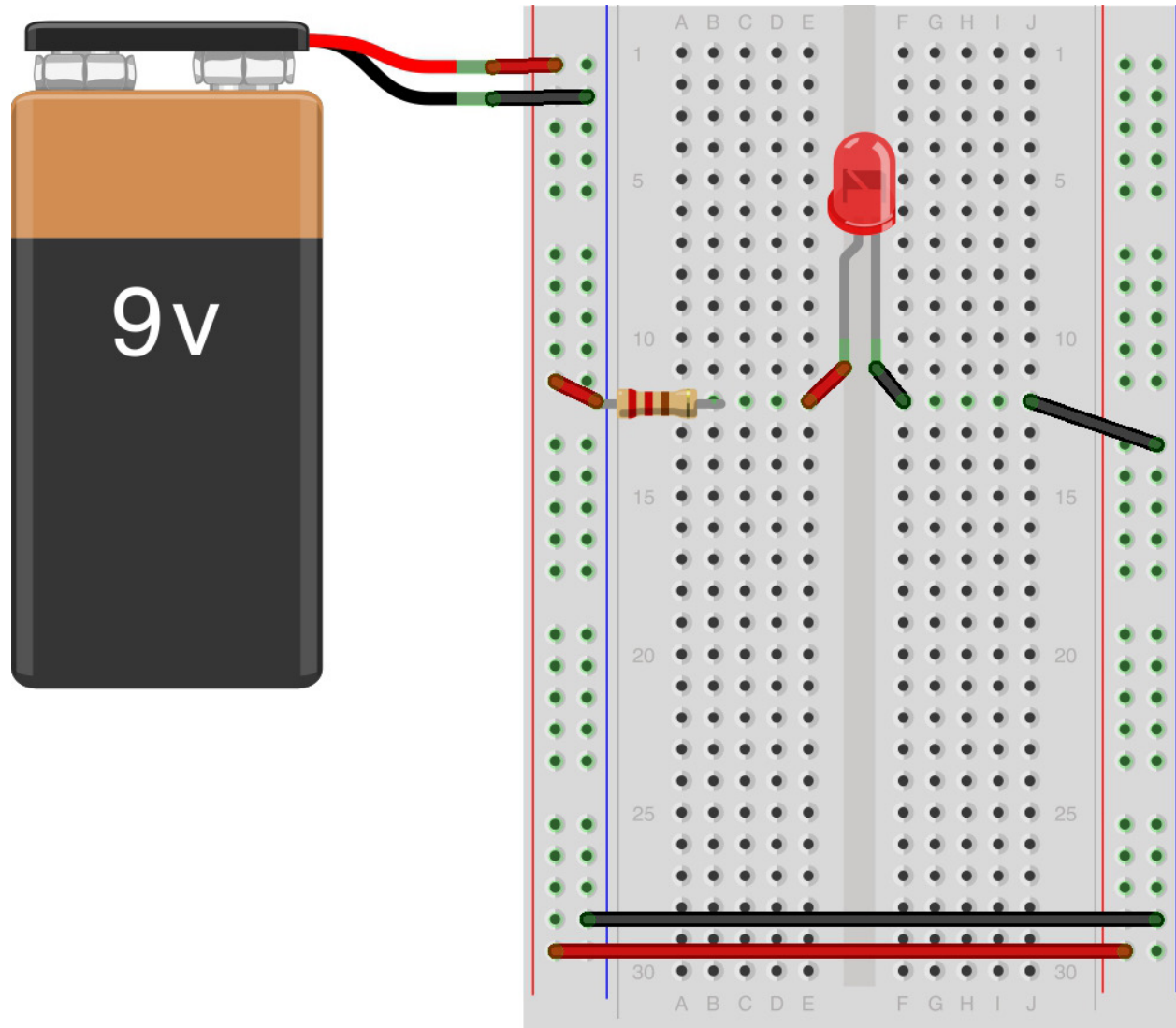
Basic Circuit and Breadboard



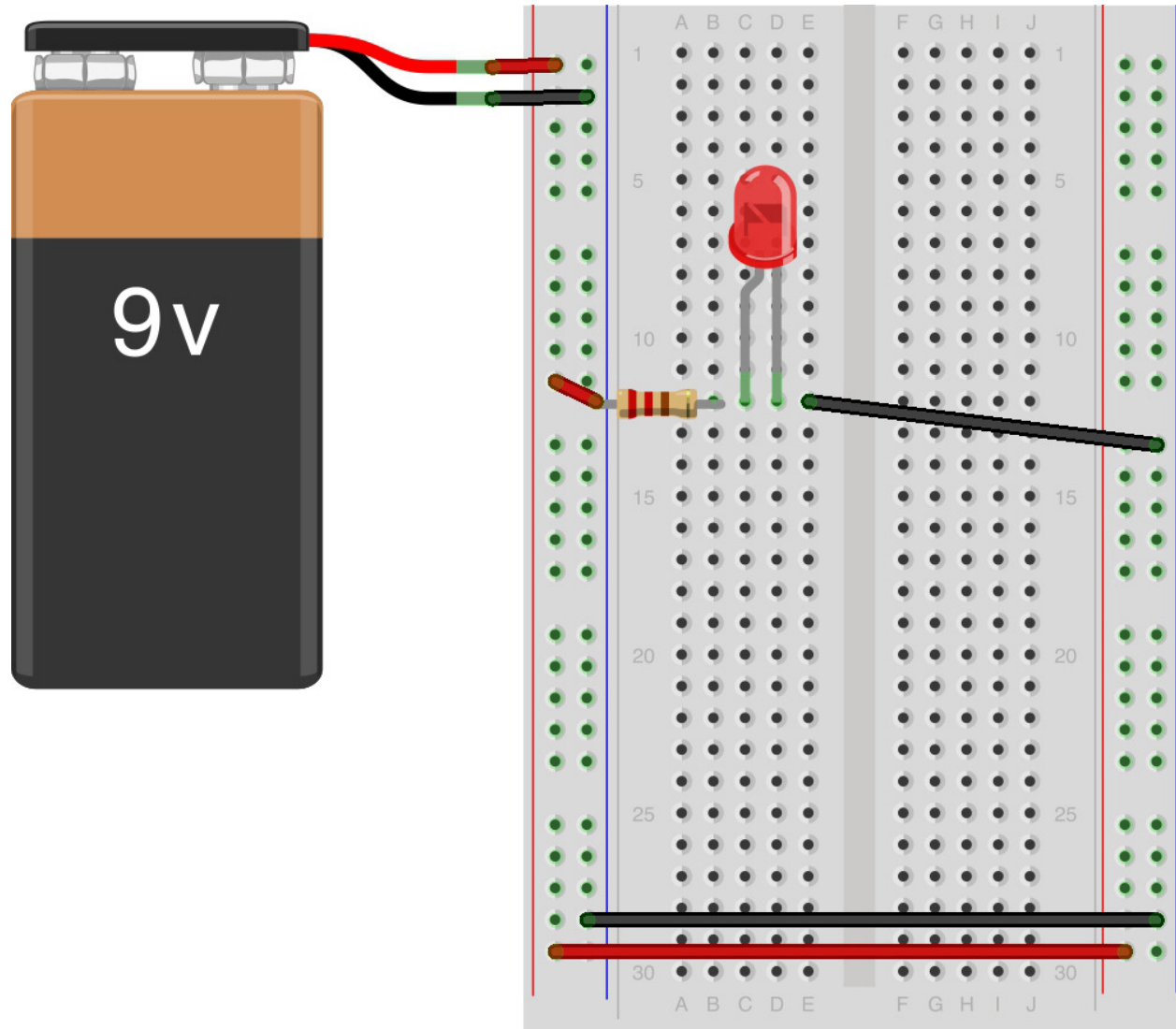
Basic Circuit and Breadboard



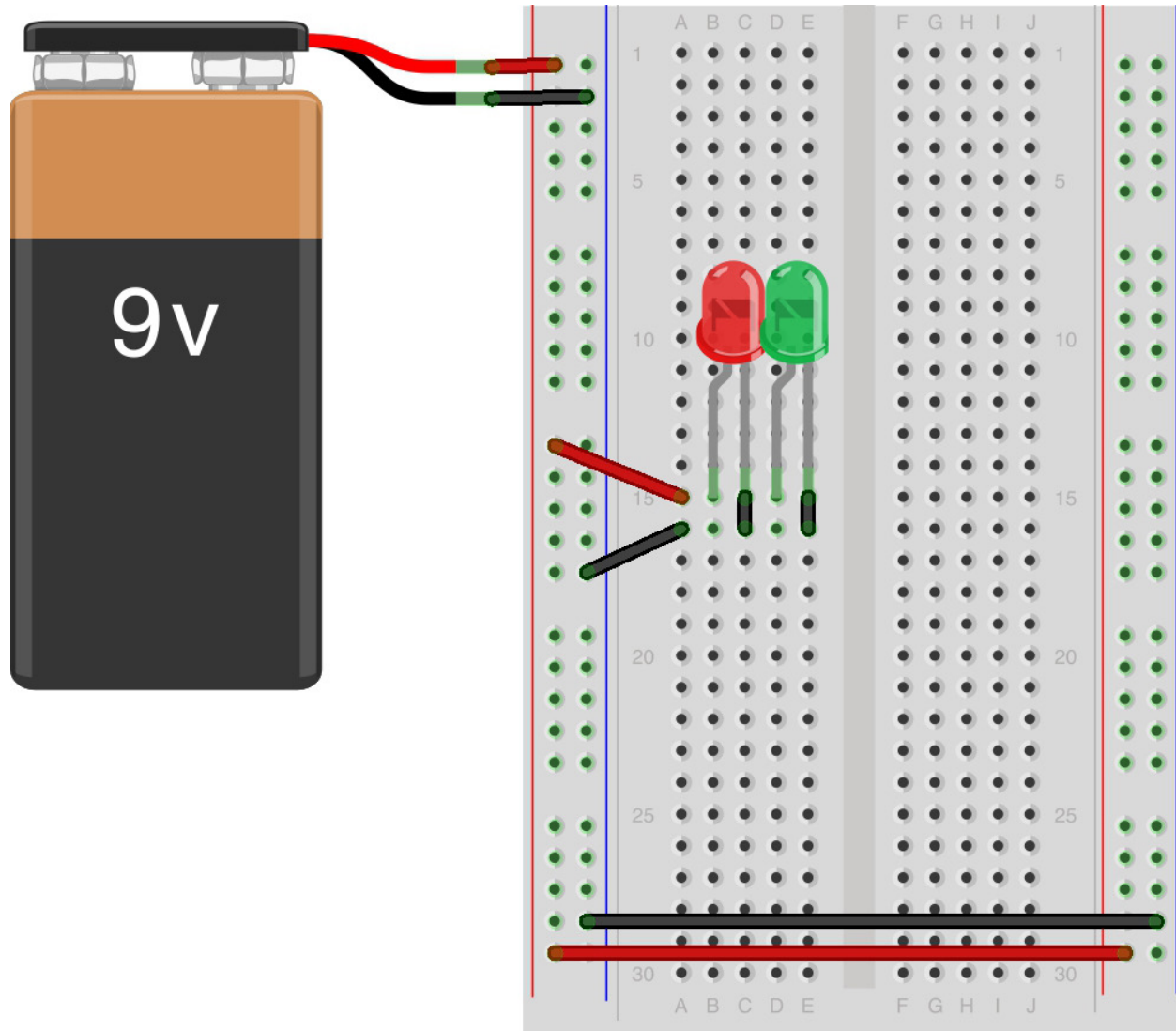
Basic Circuit and Breadboard



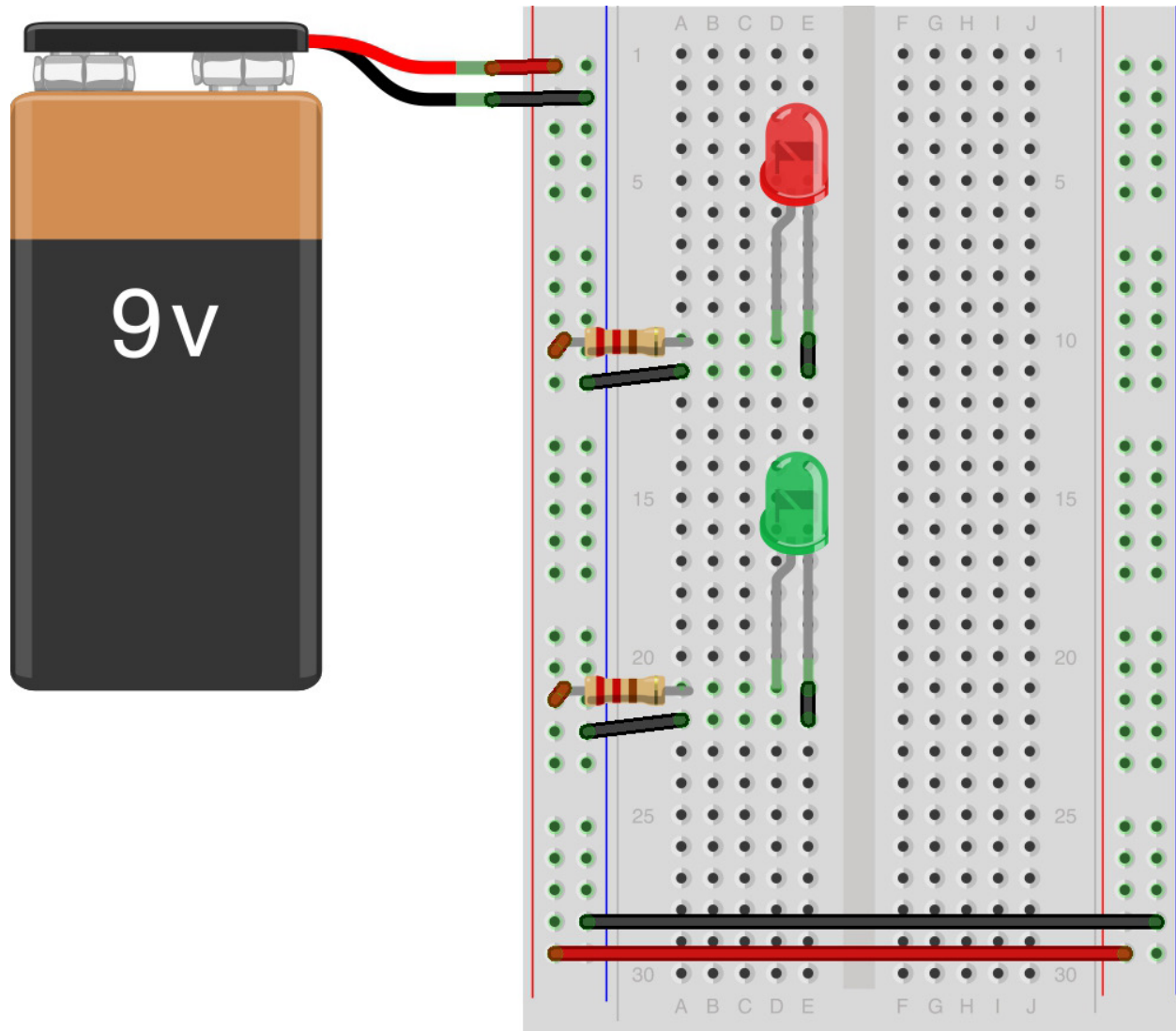
Basic Circuit and Breadboard



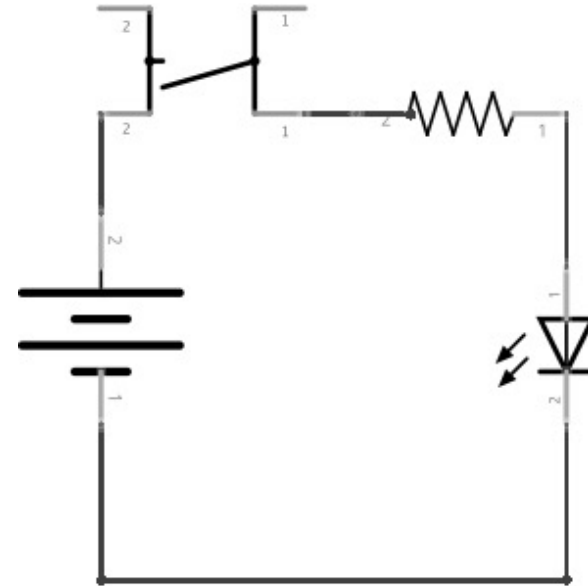
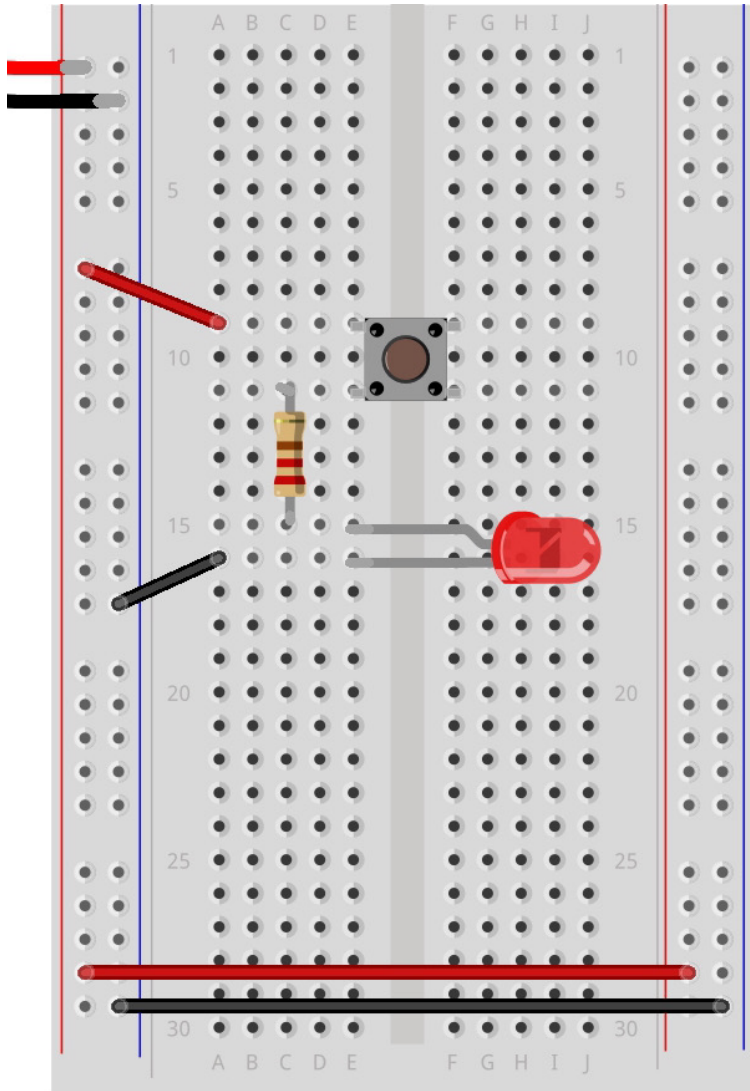
Basic Circuit Series



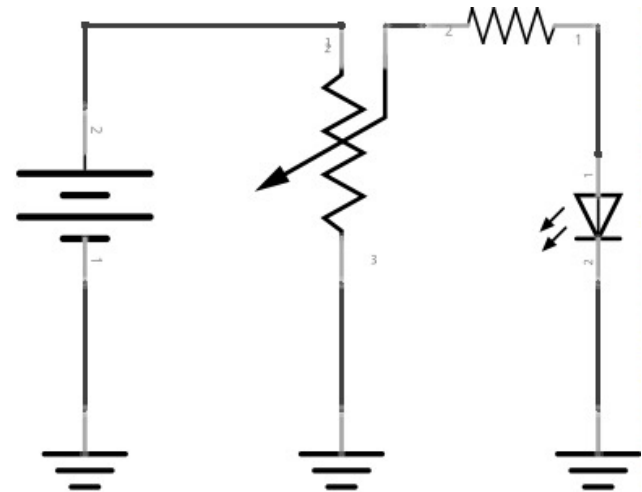
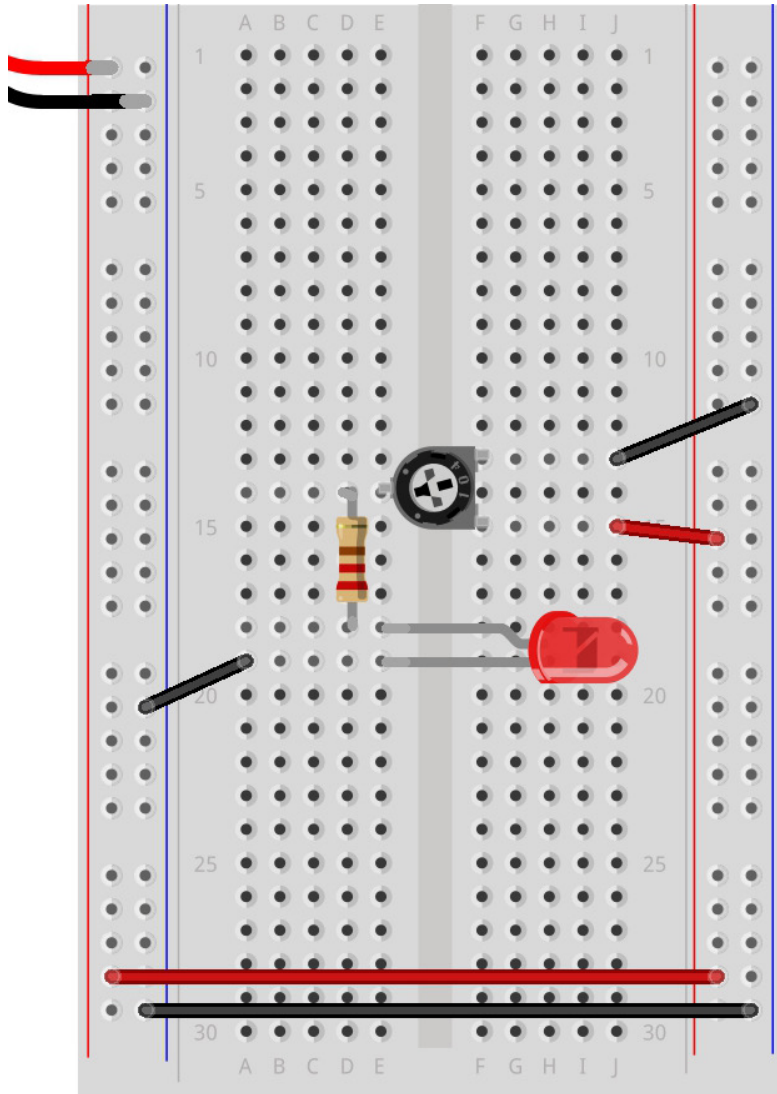
Basic Circuit Parallel



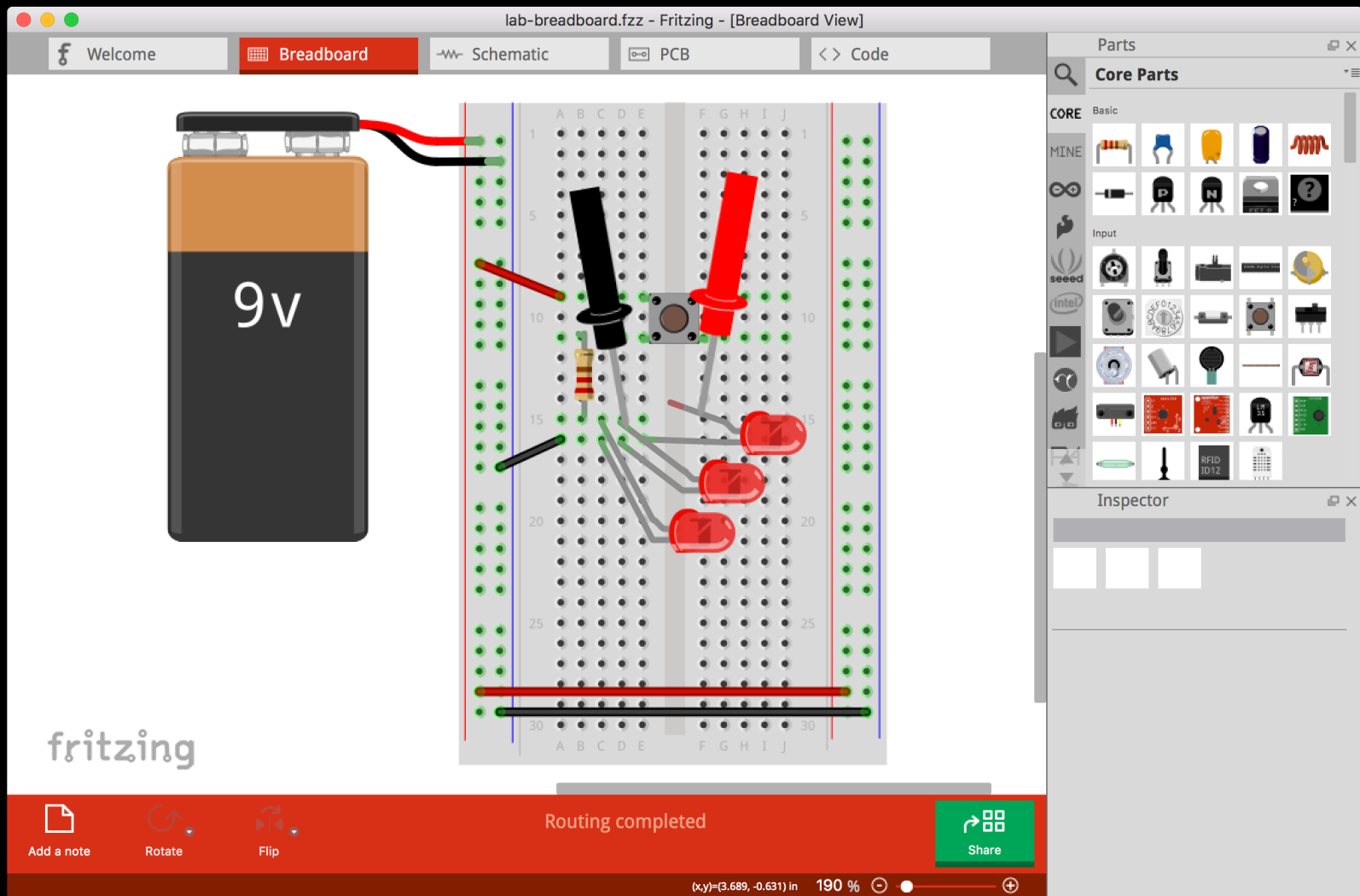
Basic Circuit Switch



Basic Circuit Potentiometer



Fritzing



Simple Switches

Review what we covered in class and come up with and build a simple yet creative concept that uses a switch and an LED. Write a blog post about this project.

Homework

1. Finish the in class assignment and post to blog.
2. Read Tom Igoe's, Physical Computing's Greatest Hits (and misses), link is on our website.
3. Look around at all the sensors you interact with on a regular basis, pick one and write a blog post on how you interact with it and how it effects your daily life.

Physical Computing

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