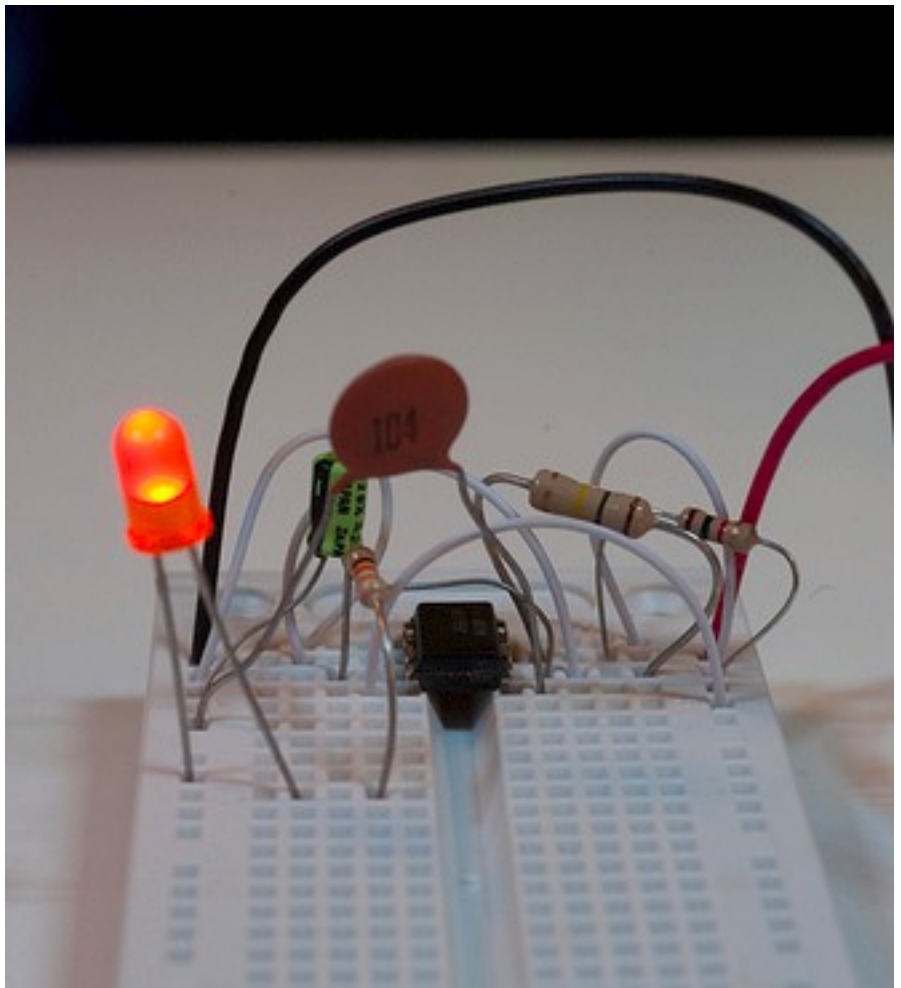
Introduction to Electronics

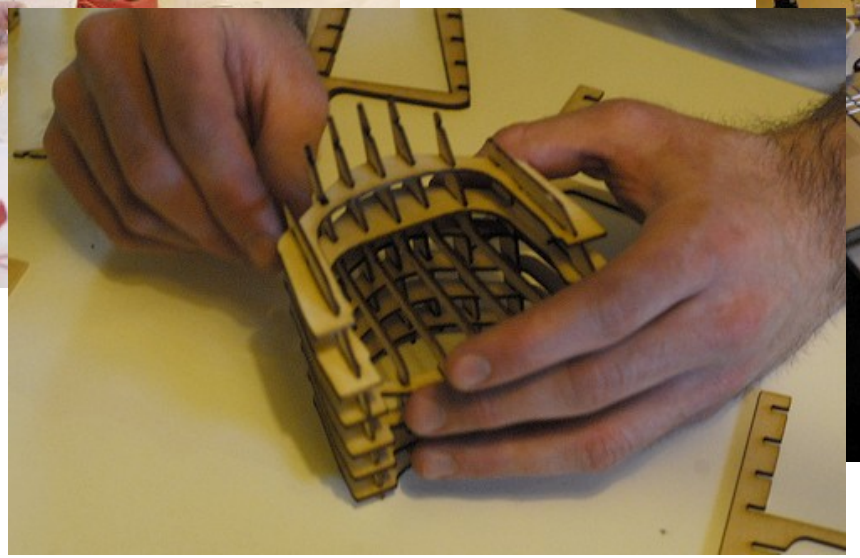


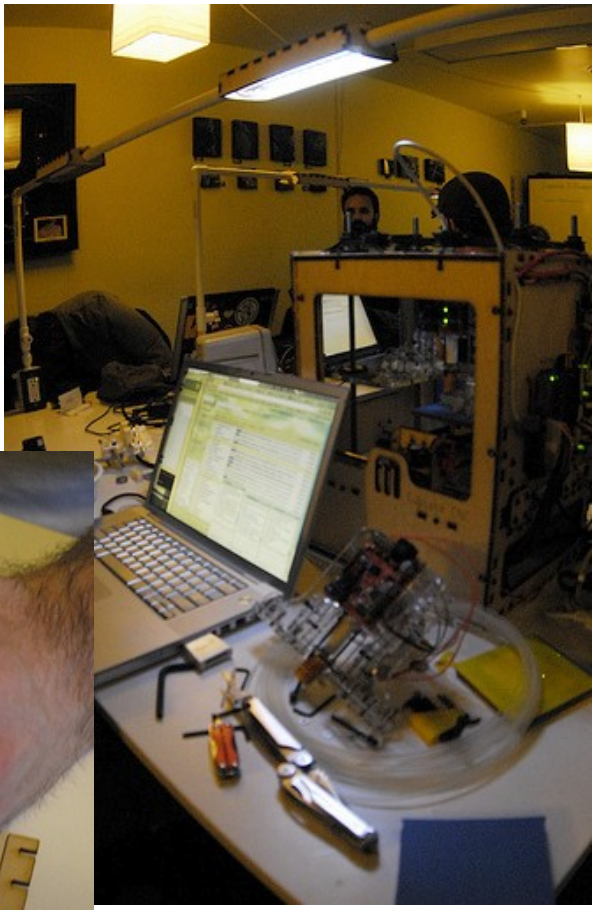
Instructor: Morgan Redfield
T.A.: Yuting Hsieh
2010 February 25
6-9 PM

Who are we?

Morgan Redfield and Yuting Hsieh

From Metrix Create:Space

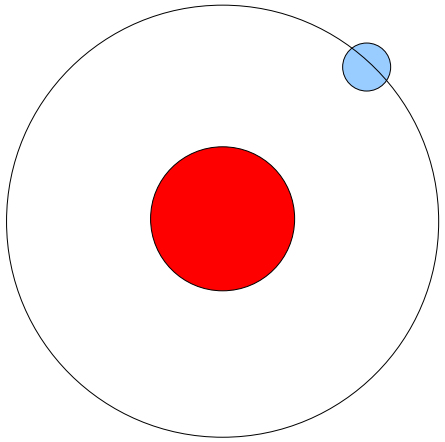


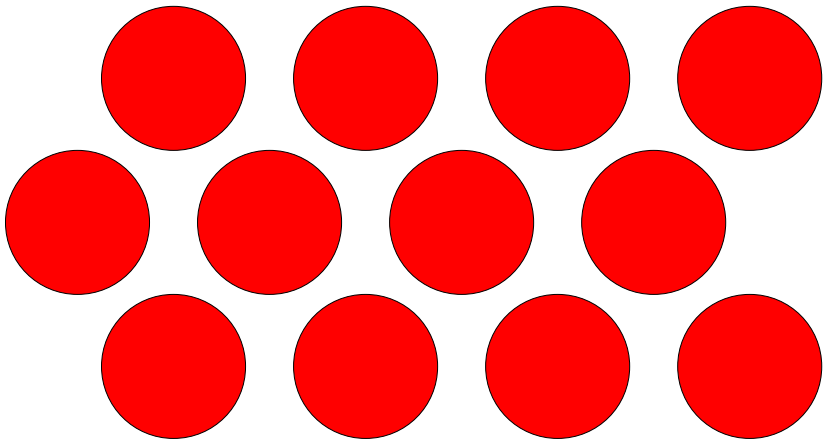


Today we'll be covering:

- Voltage
- Current
- Simple electrical components
- Circuit diagrams
- Simple circuits and designs
- Useful applications

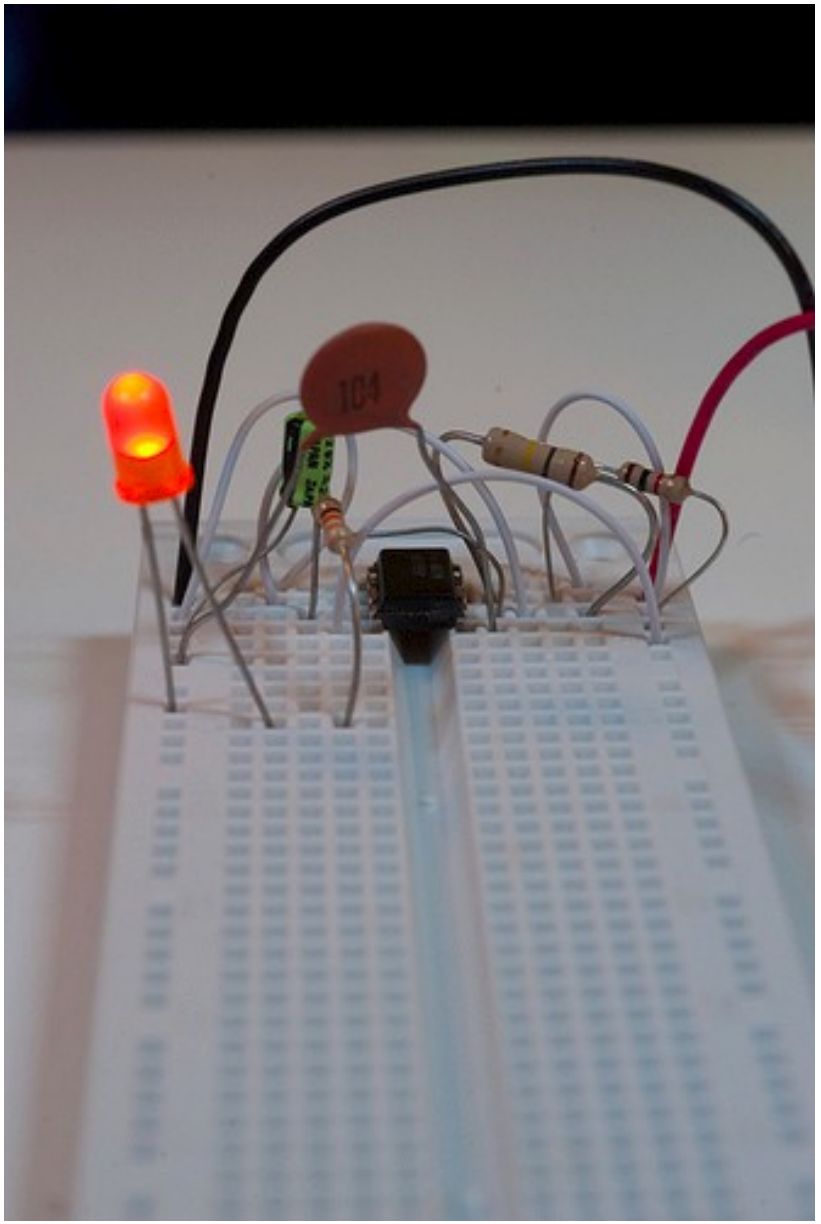
Atoms and Electrons





- All matter is made up of charged particles
- When these particles interact, crazy things happen
- Positive particles (protons) are stationary
- Negative particles (electrons) can sometimes move

Electricity: Voltage and Current



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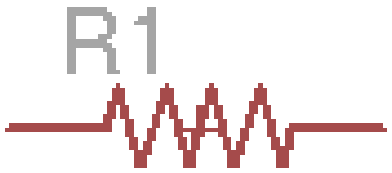
Voltage Sources

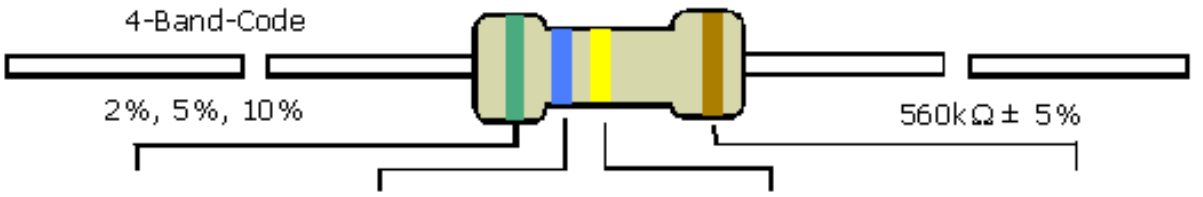
- Supply a constant voltage
- Current may vary
- Output has units of Volts

Resistors



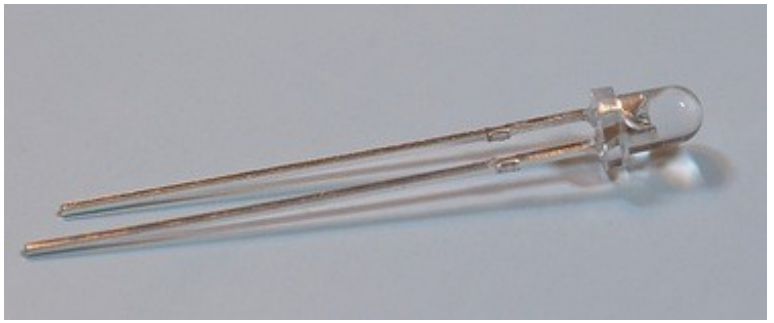
- Has a voltage drop proportional to the current across it
- Used to control current and voltage
- Has units of Ohms
- Ohm's law: $V = I \times R$

Resistor Values



COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE
Black	0	0	0	1Ω	
Brown	1	1	1	10Ω	± 1% (F)
Red	2	2	2	100Ω	± 2% (G)
Orange	3	3	3	1KΩ	
Yellow	4	4	4	10KΩ	
Green	5	5	5	100KΩ	±0.5% (D)
Blue	6	6	6	1MΩ	±0.25% (C)
Violet	7	7	7	10MΩ	±0.10% (B)
Grey	8	8	8		±0.05%
White	9	9	9		
Gold				0.1	± 5% (J)
Silver				0.01	± 10% (K)

LEDS

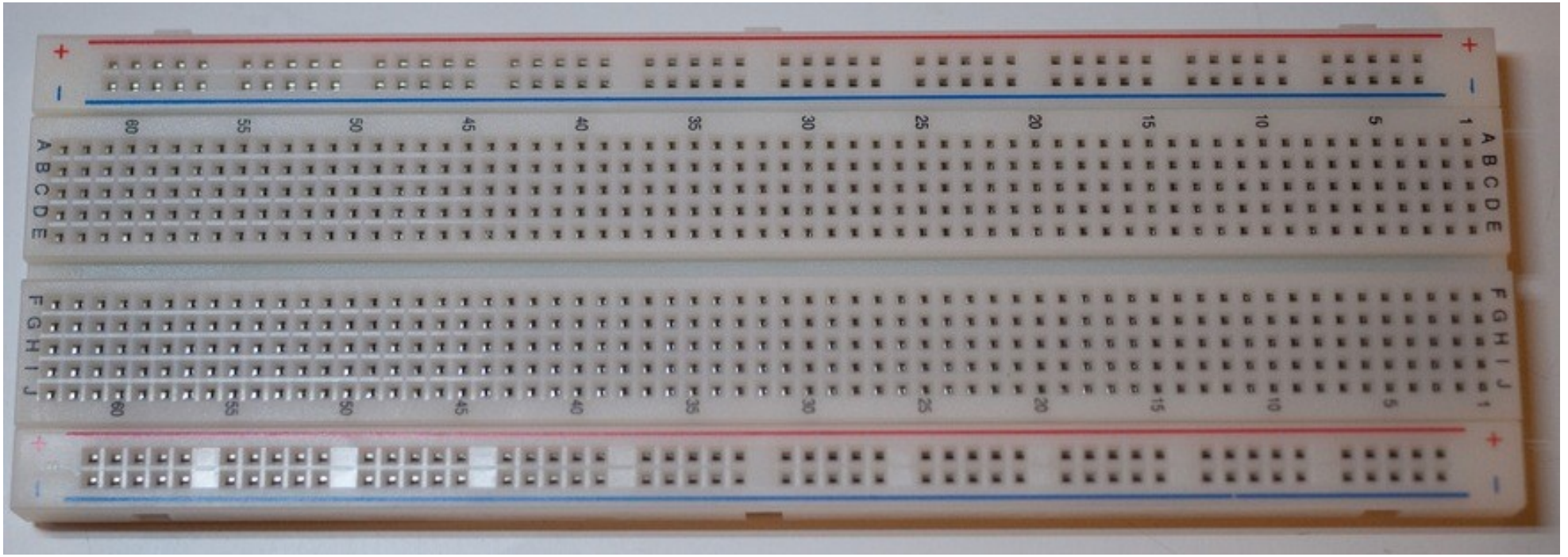


- Light Emitting Diodes
- Have a constant voltage drop
- Light is proportional to current
- Damaged by too much current

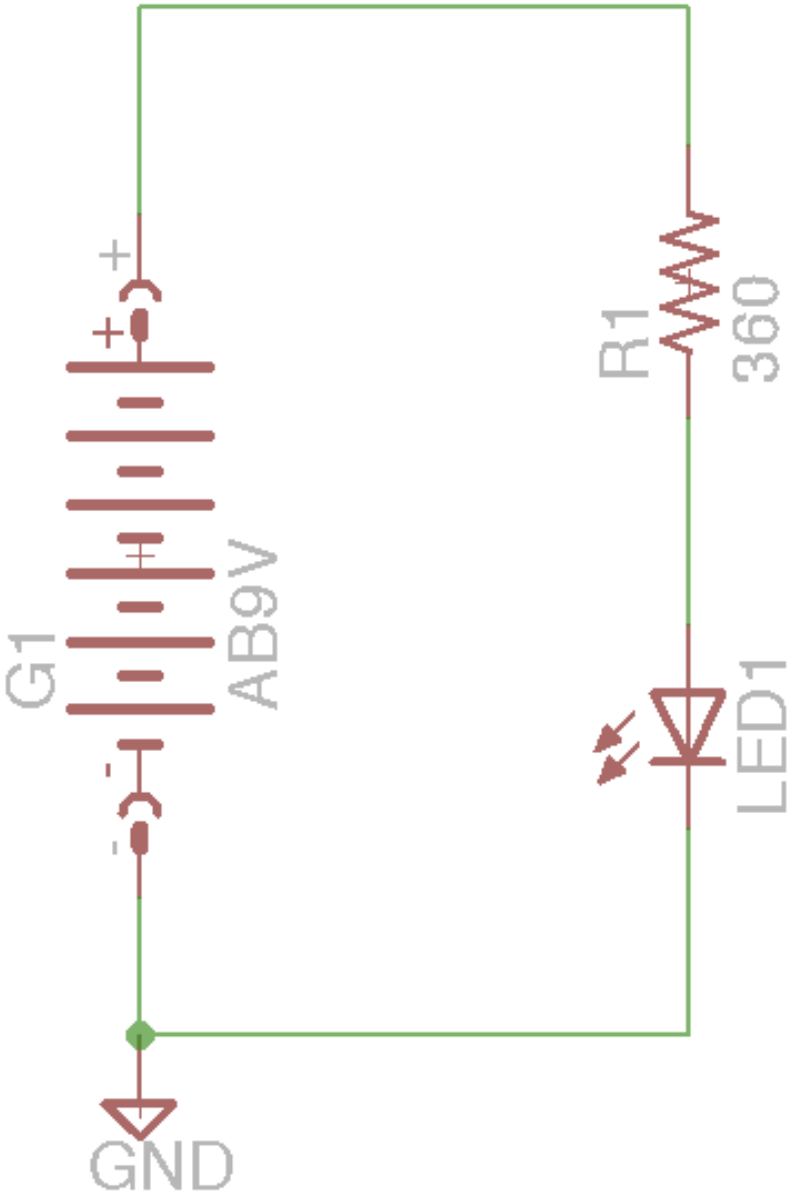
What is GND?

Voltage is always measured with respect to some zero. GND defines where zero is in the circuit.

Breadboards



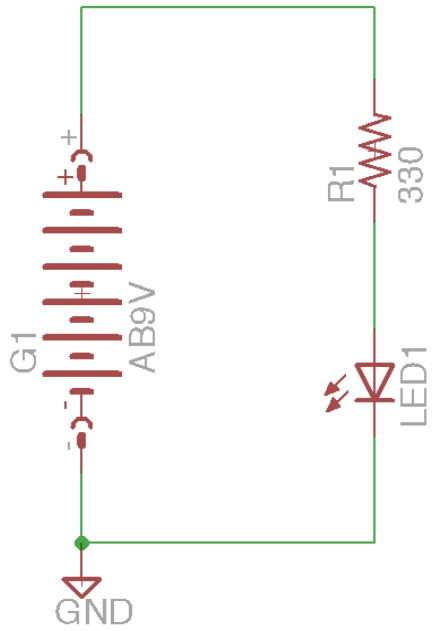
Our first circuit: light an LED



Kirchhoff and his laws

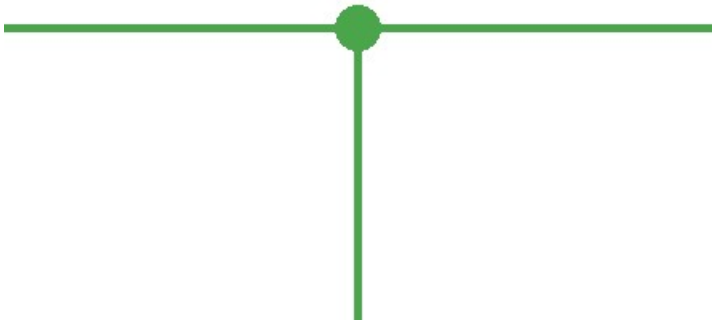
The Voltage Law:

- The sum of the voltage drops around a loop is always zero



The Current Law:

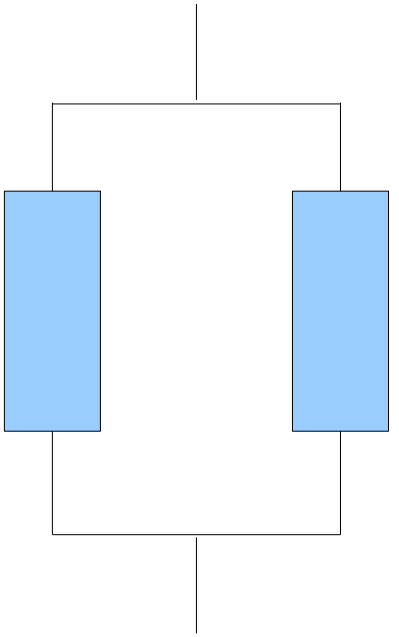
- Current into a wire node is equal to the current out of the node



Placing Components

Series

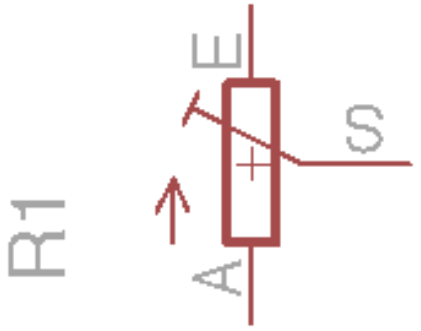
Parallel

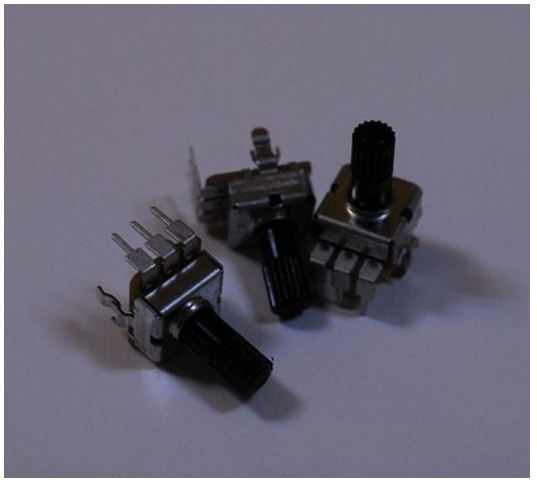


Your friend, the multimeter

- Voltage: place probes in parallel
- Current: place probes in series

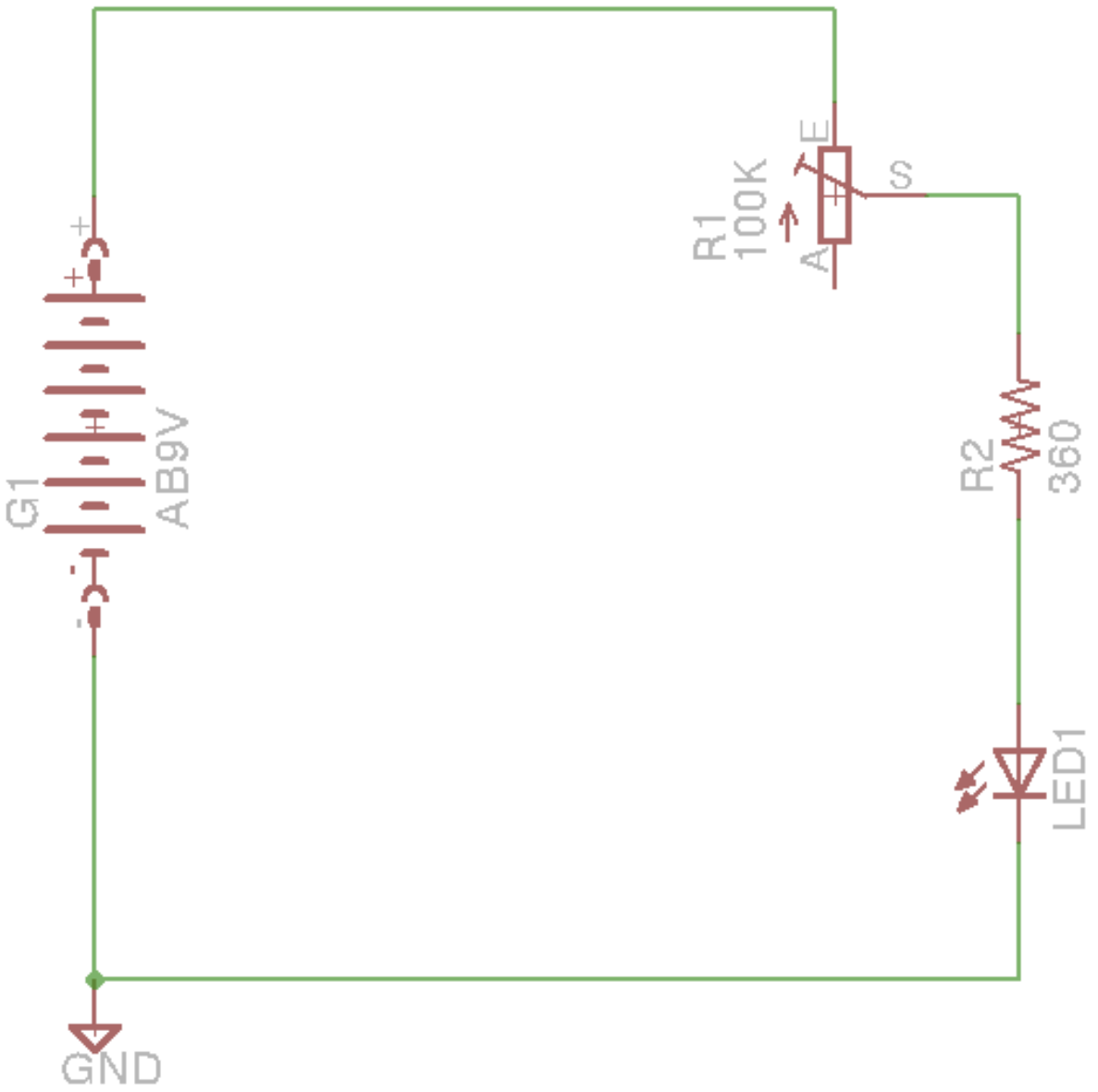
Potentiometers



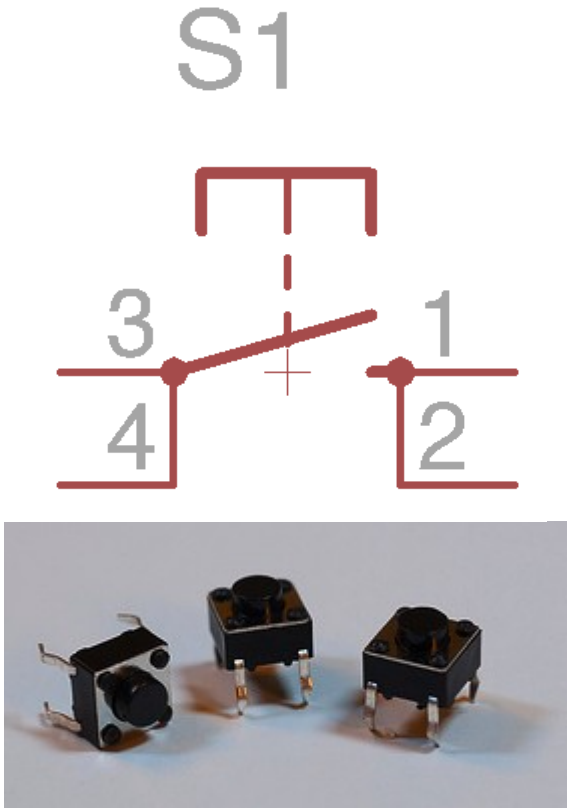


- Constant Resistance between outer leads
- Variable resistance between center lead and either outer lead.

Change the brightness

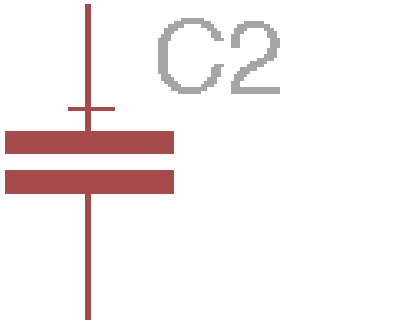


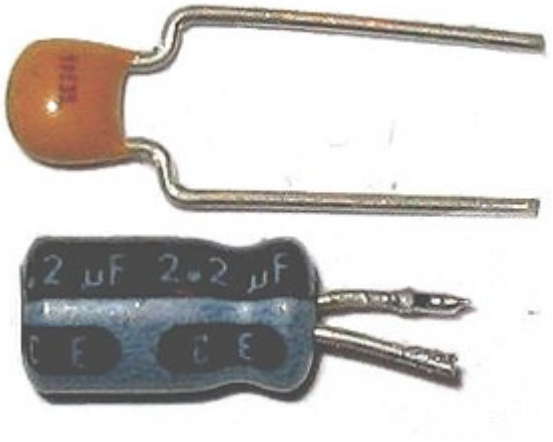
Buttons and Switches



- Single Pole/Double Throw
- These are exactly what you think they are

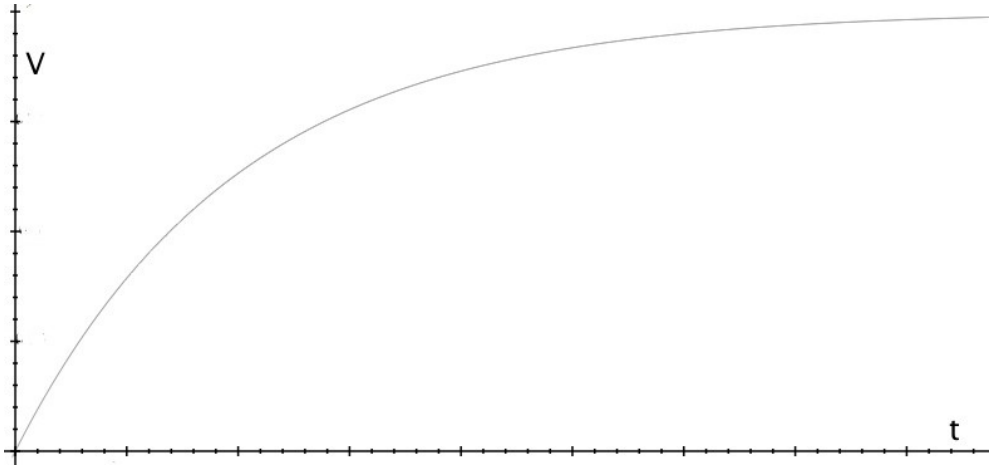
Capacitors



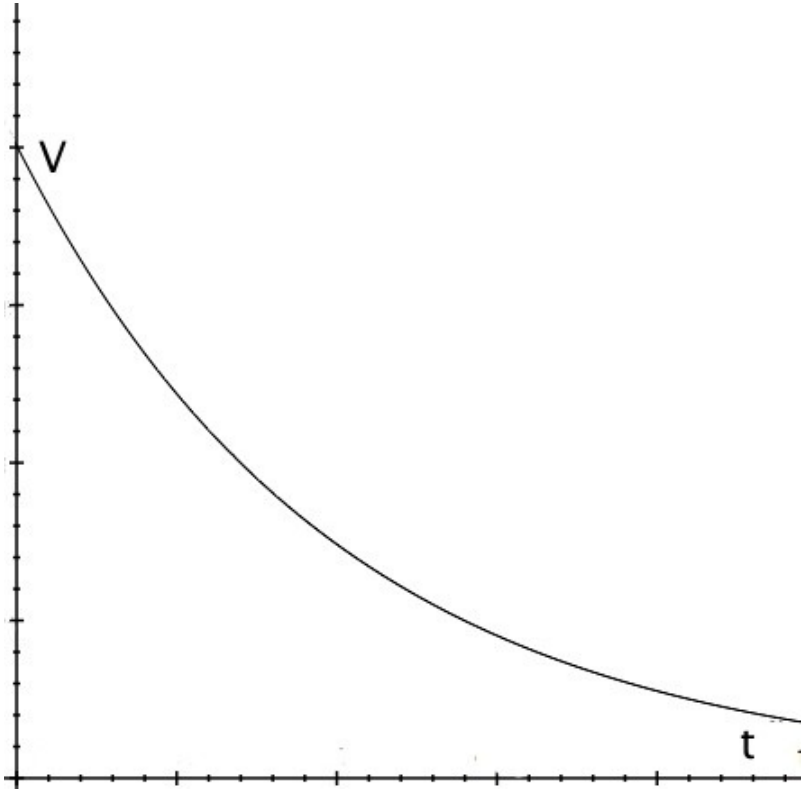


- Store voltage
- Has units of Farads
- Higher capacitance means more power can be stored
- 63% charge time is R×C

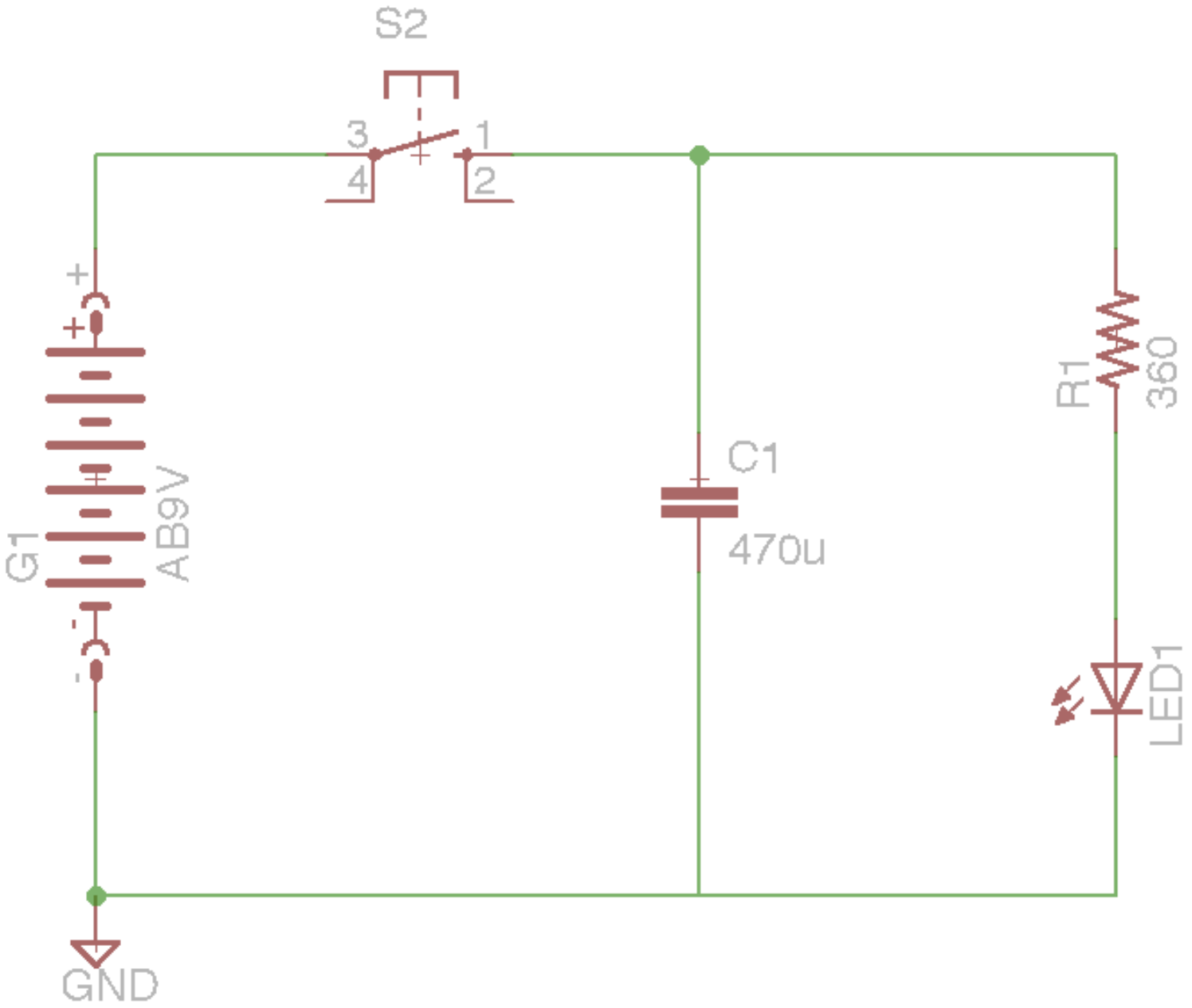
Charging and Discharging



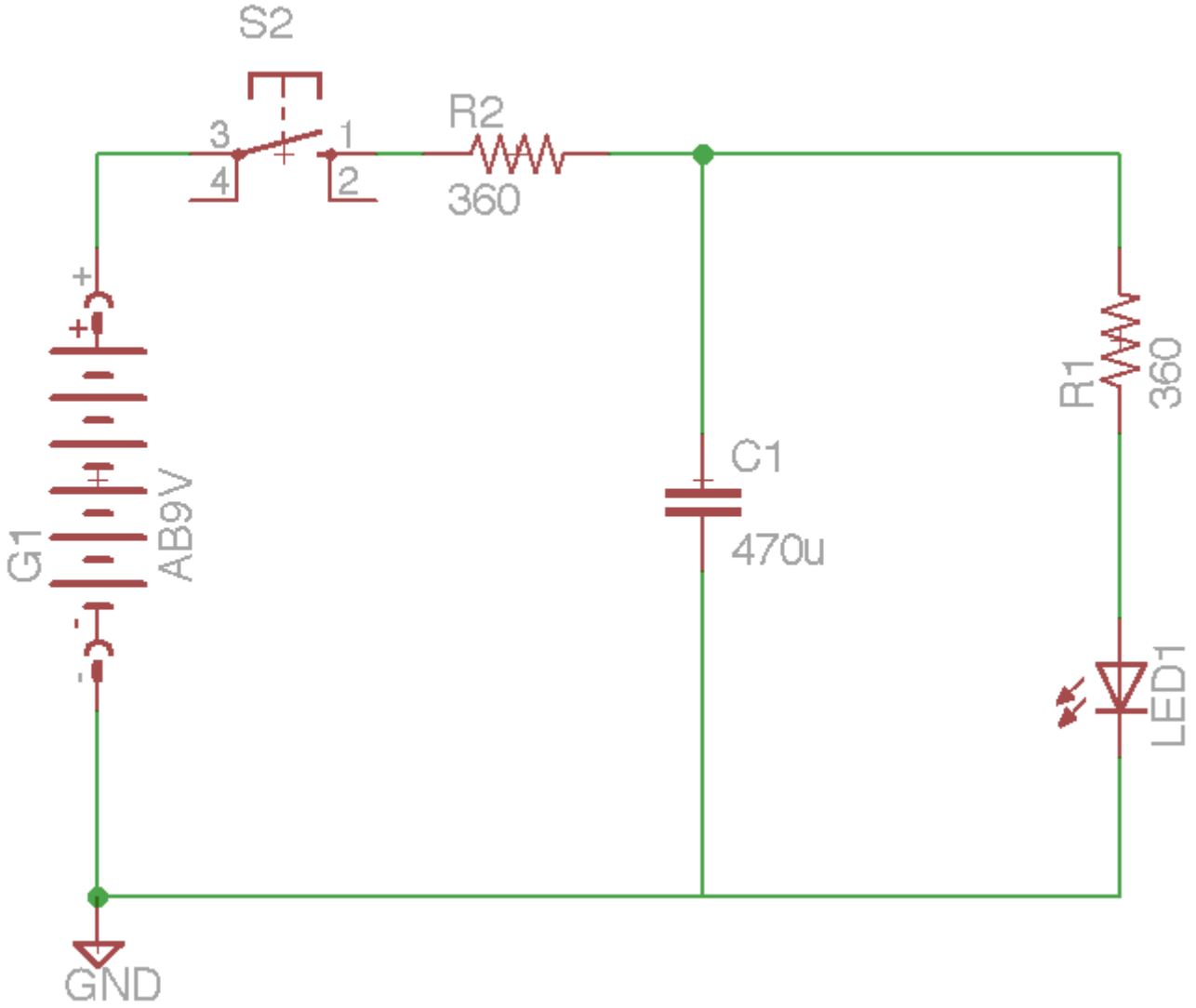
Capacitors charge and discharge asymptotically



Fading the brightness



Fade in and fade out

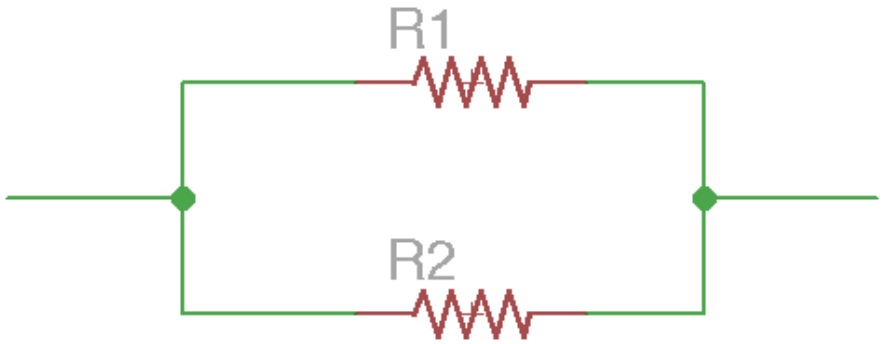


Series Components

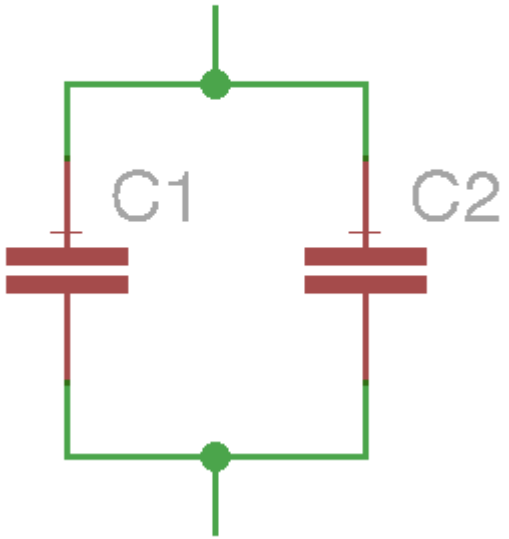
$$Rt = R1 + R2$$

$$Ct = \frac{1}{1/C1 + 1/C2}$$

Parallel Components

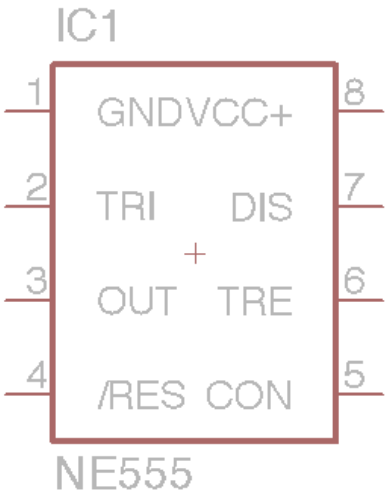


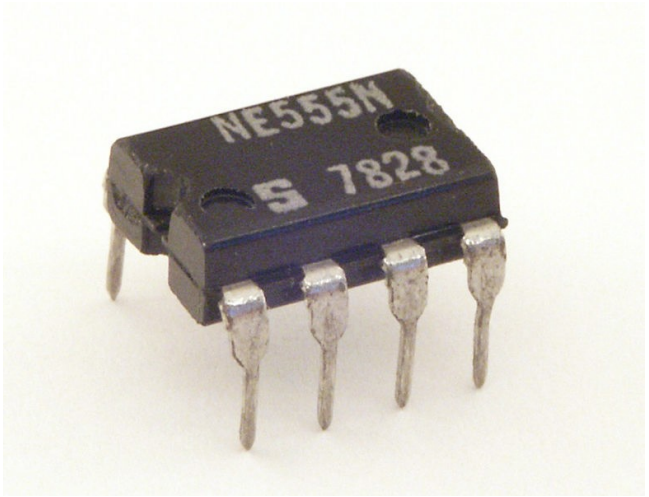
$$Rt = \frac{1}{1/R1 + 1/R2}$$



$$Ct = C1 + C2$$

Integrated Circuits (the 555 timer)



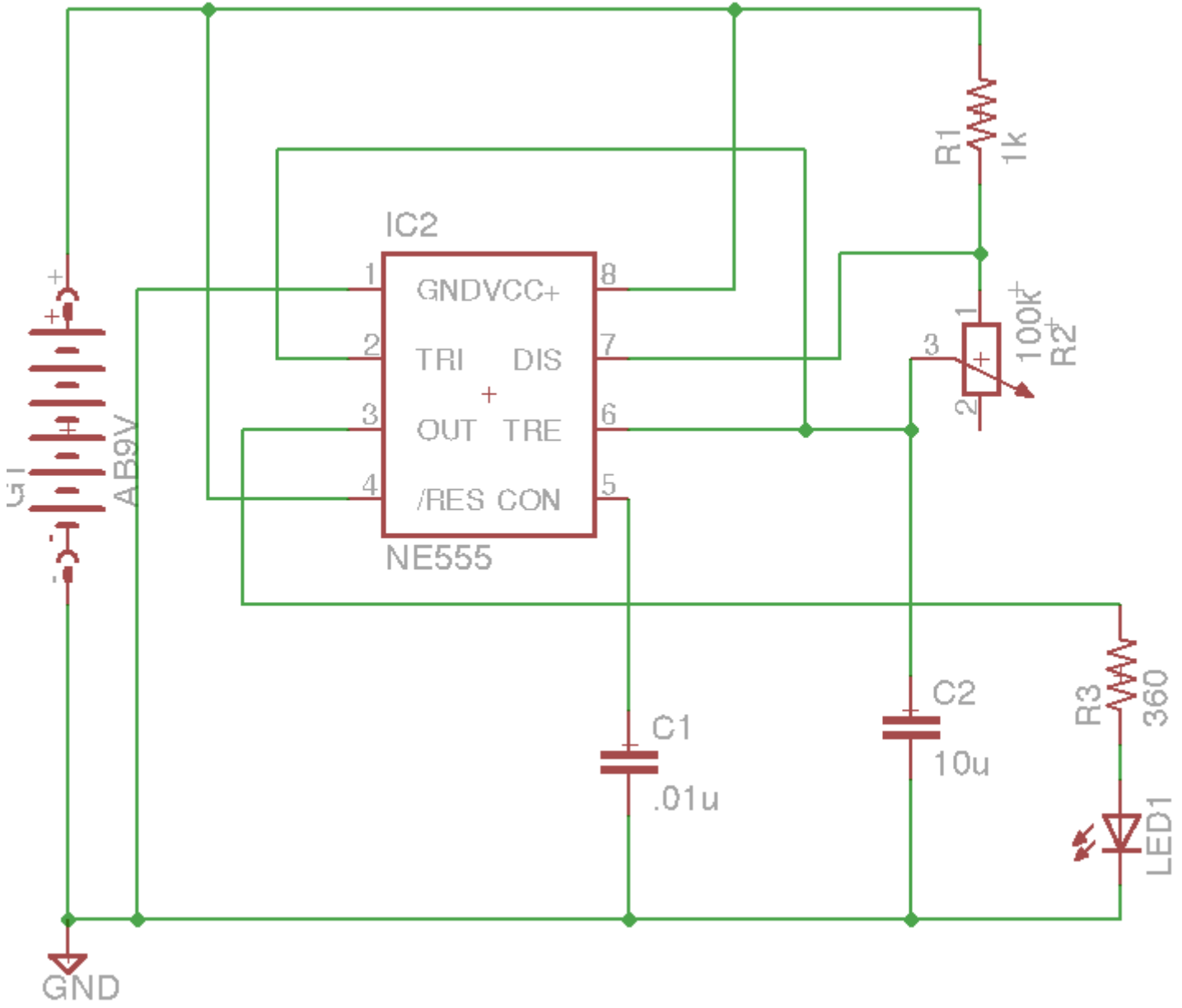


- Adjustable oscillator
- Controlled by connecting resistors and capacitors to input pins
- Choose DIP for breadboard use

Datasheets

- Almost all components have a datasheet
- Will tell you how to use a component
- Example circuits can let you cheat
- Be sure to check:
  - Pinouts
  - Max values

Blinking an LED



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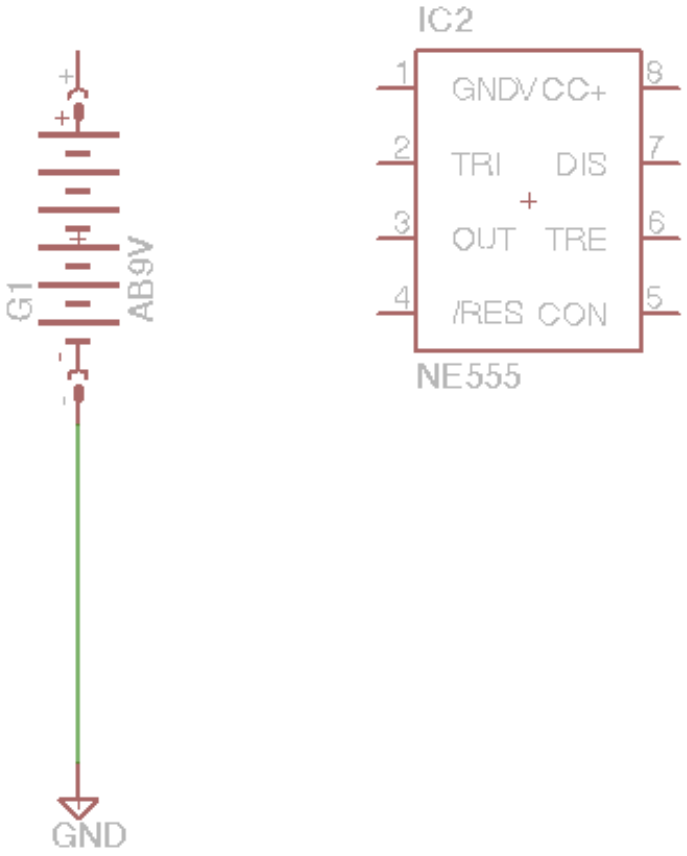

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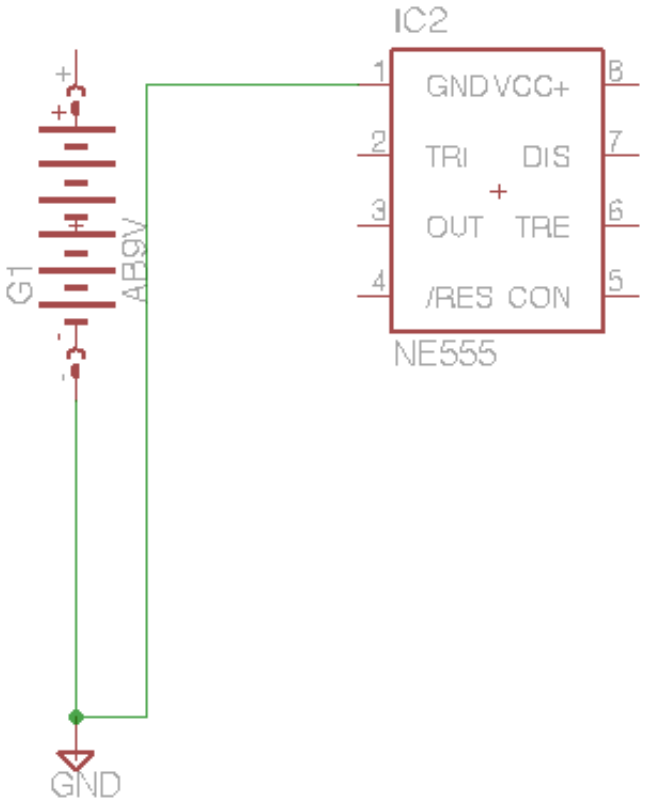
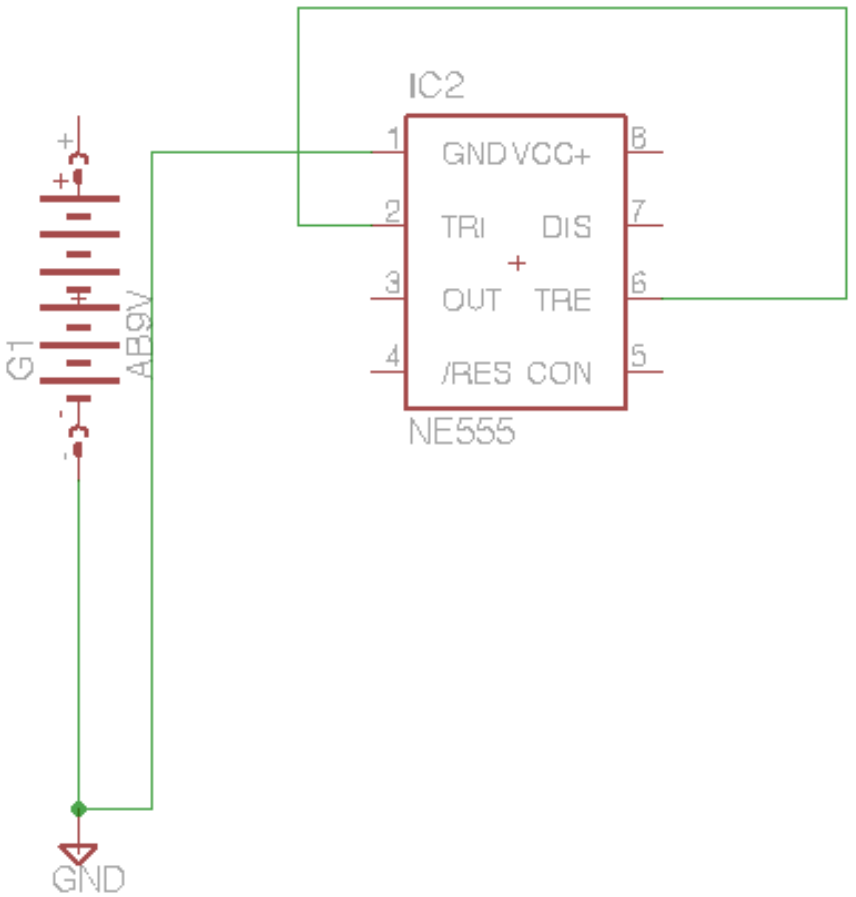
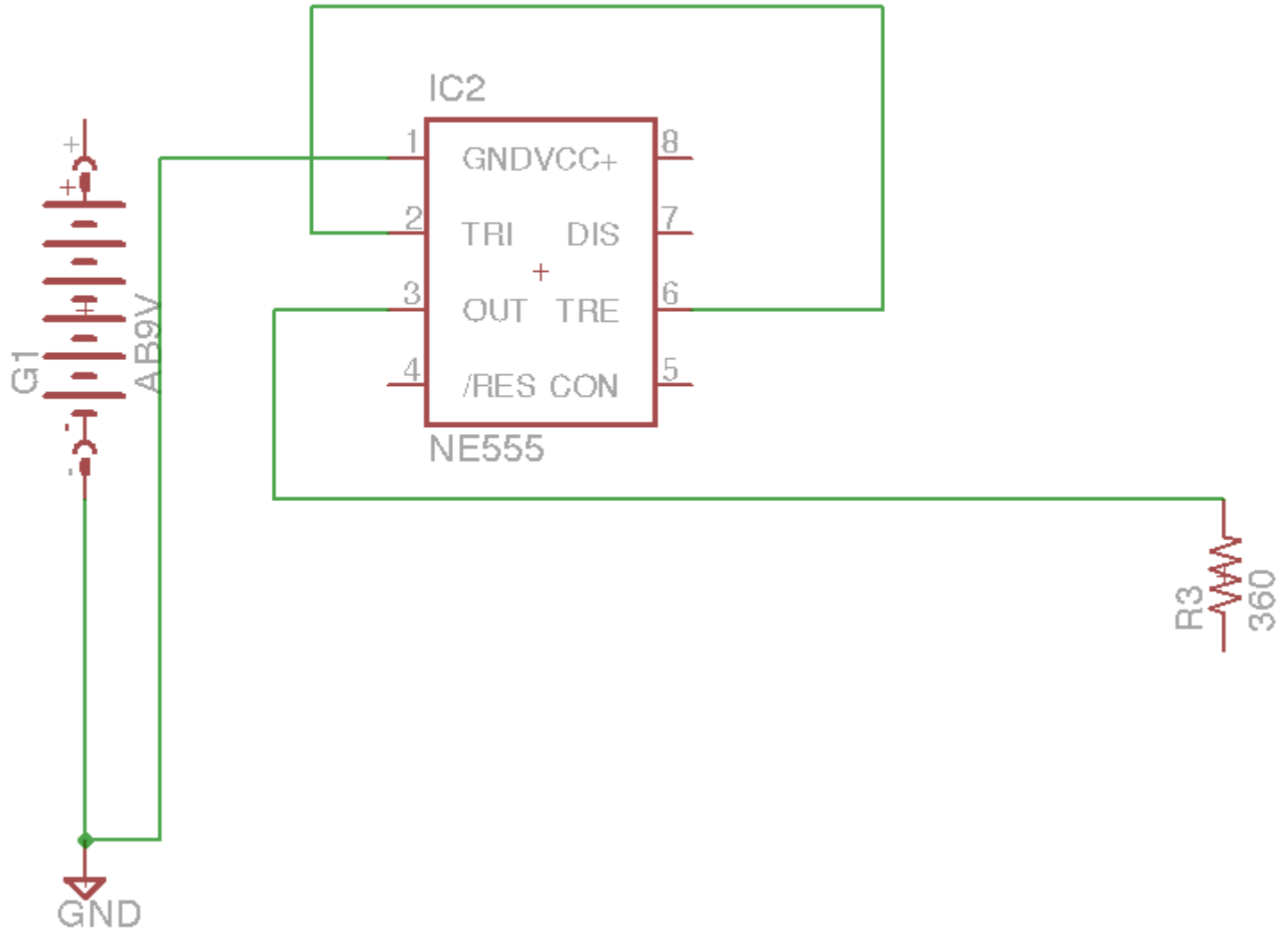


Blinking an LED



Blinking an LED



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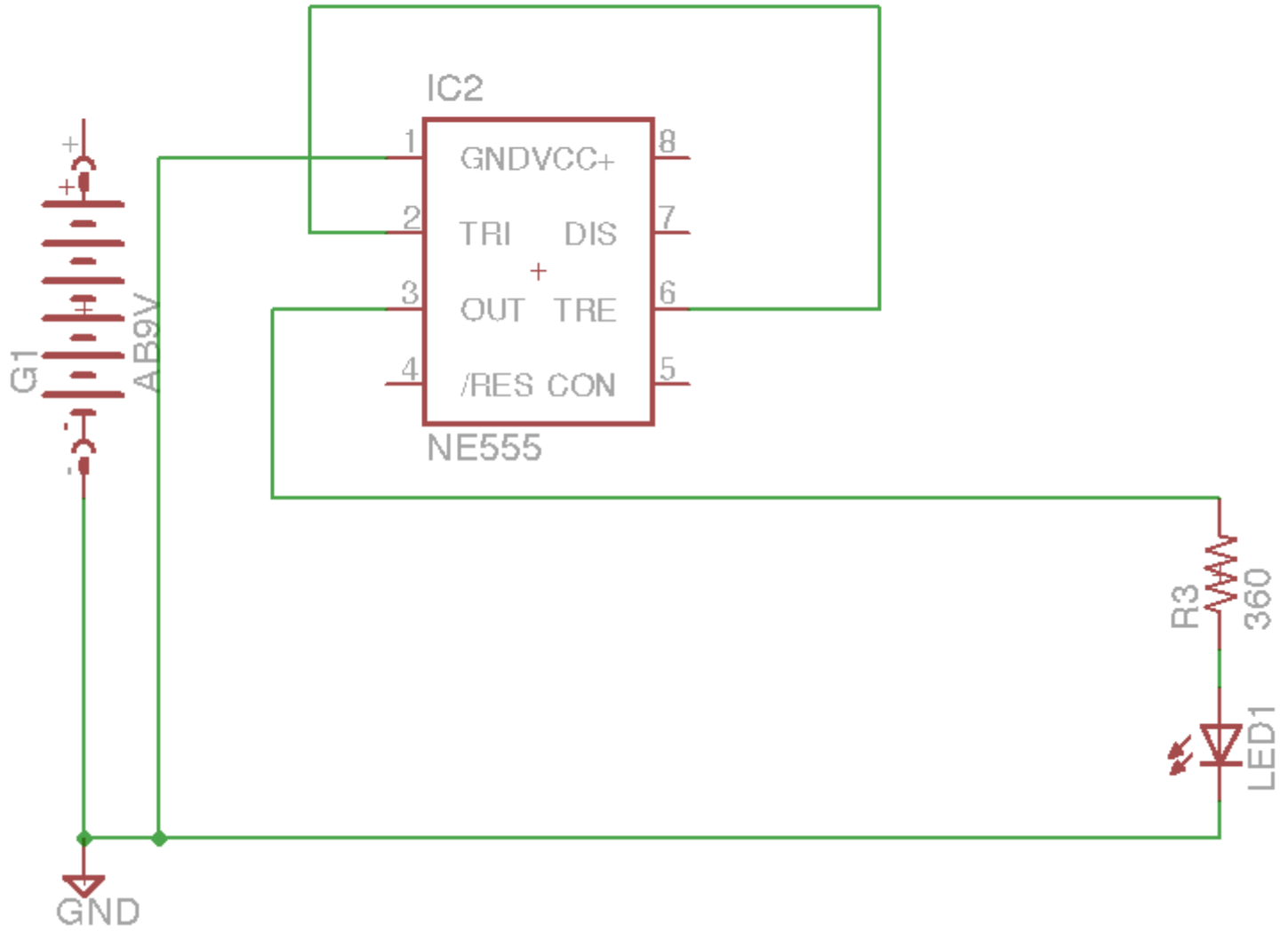

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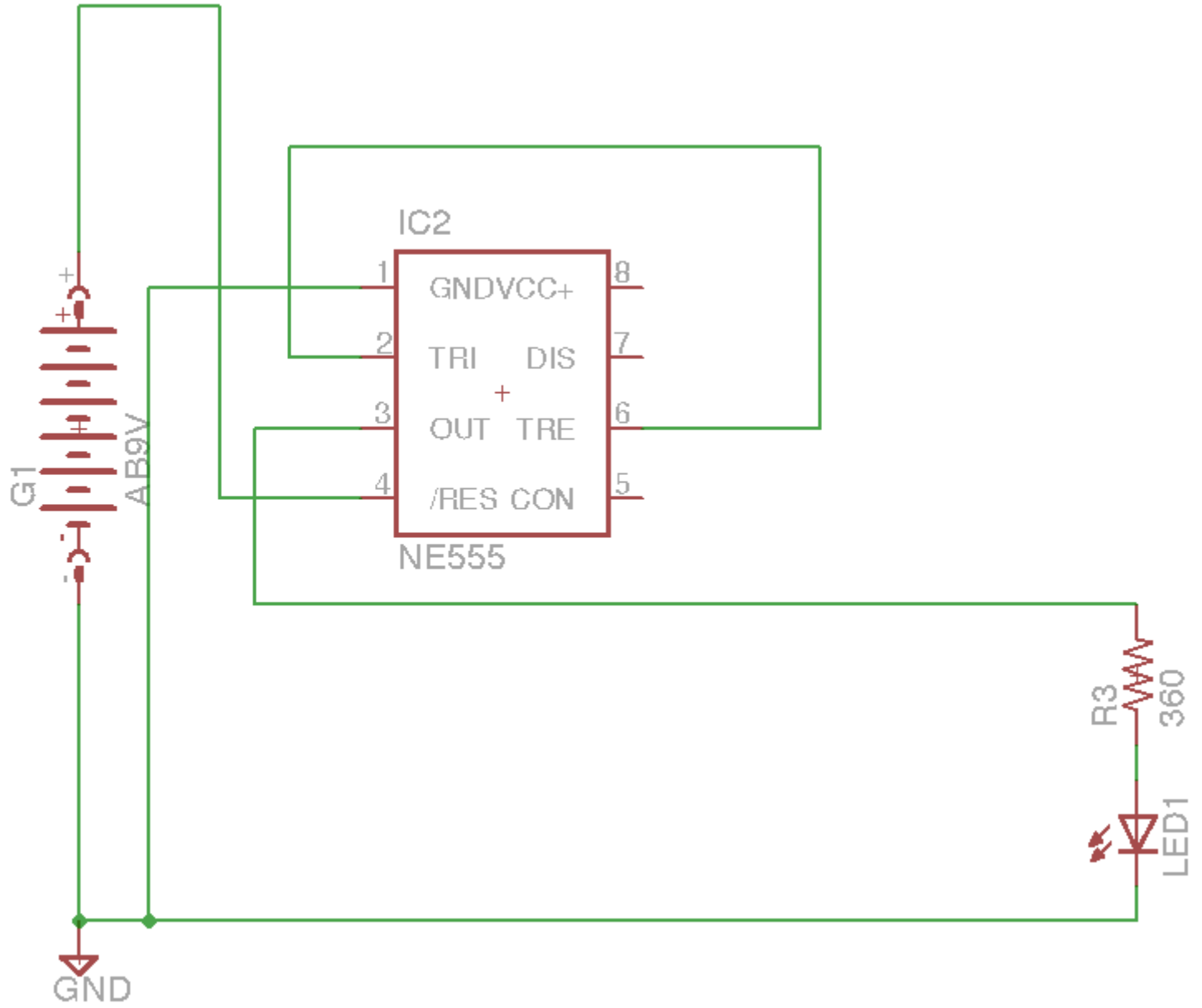
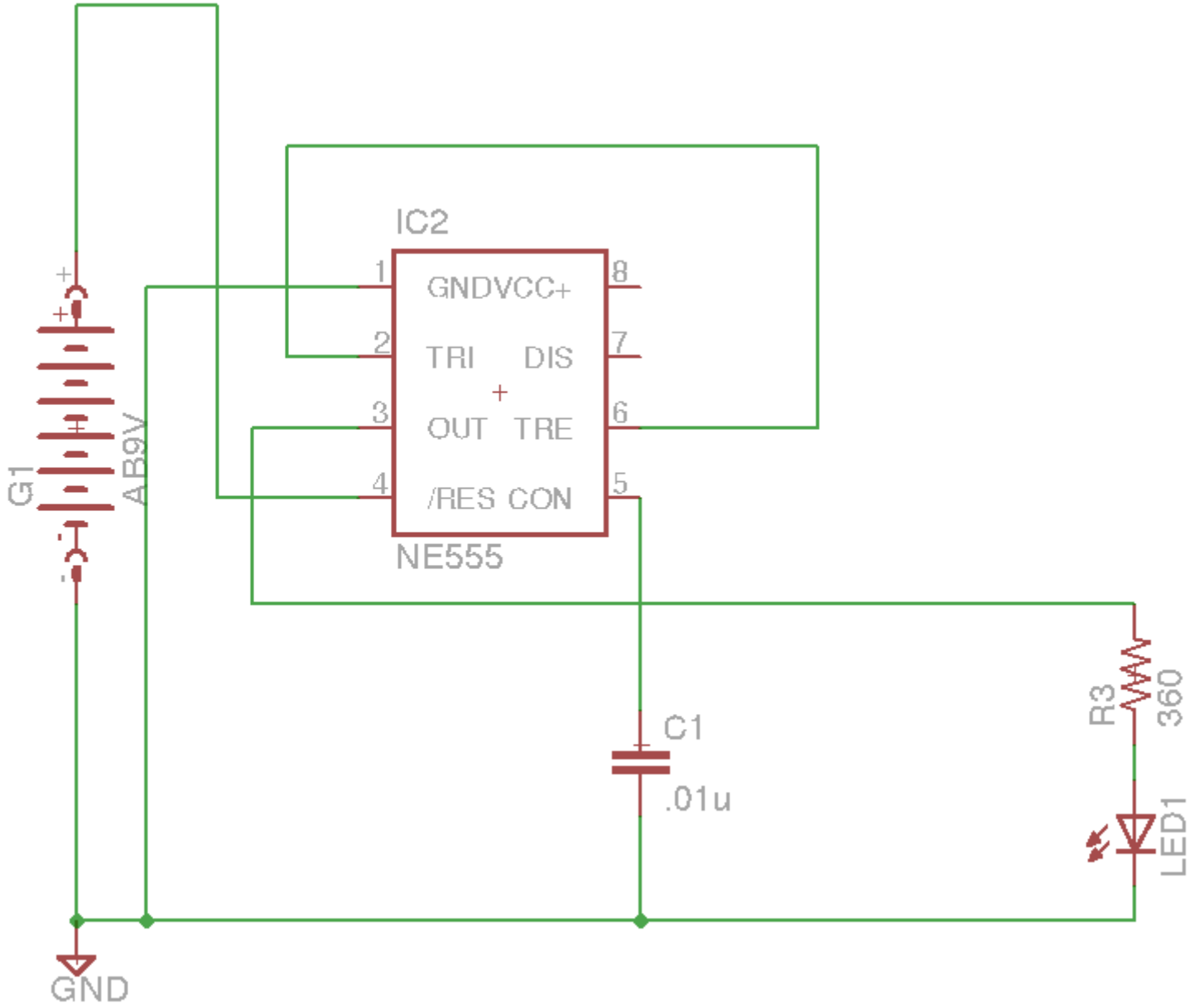
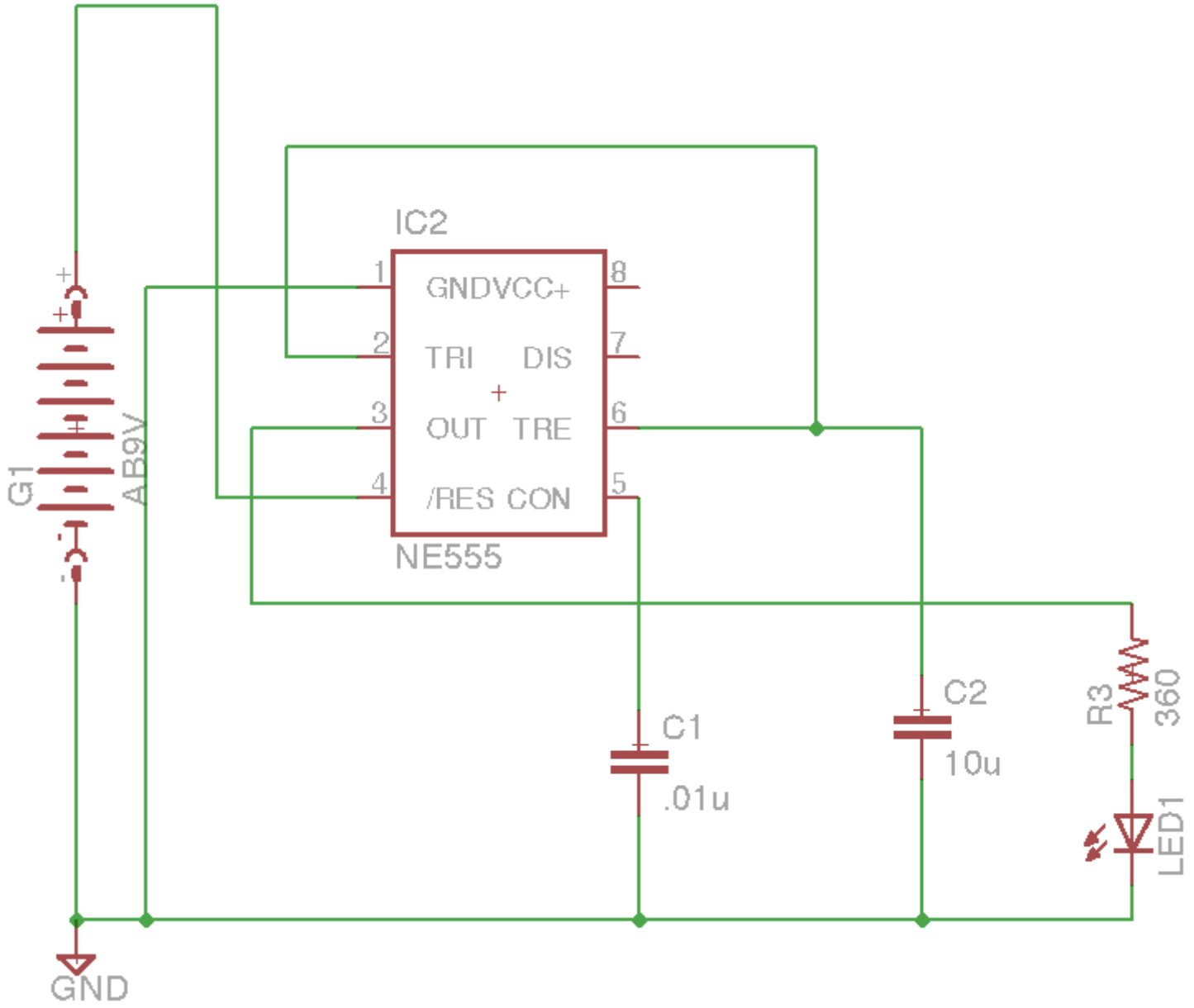


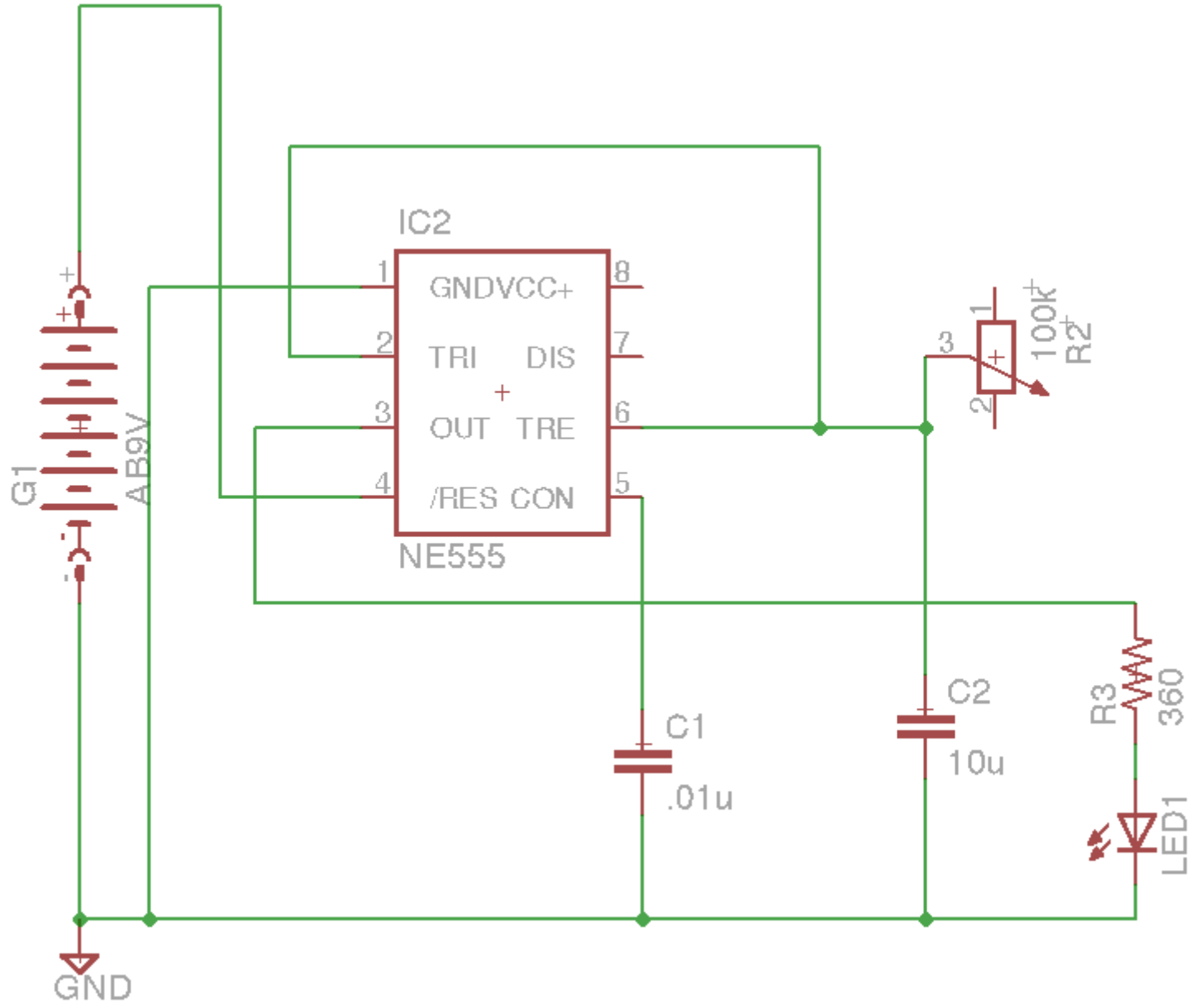
Blinking an LED



Blinking an LED



Blinking an LED



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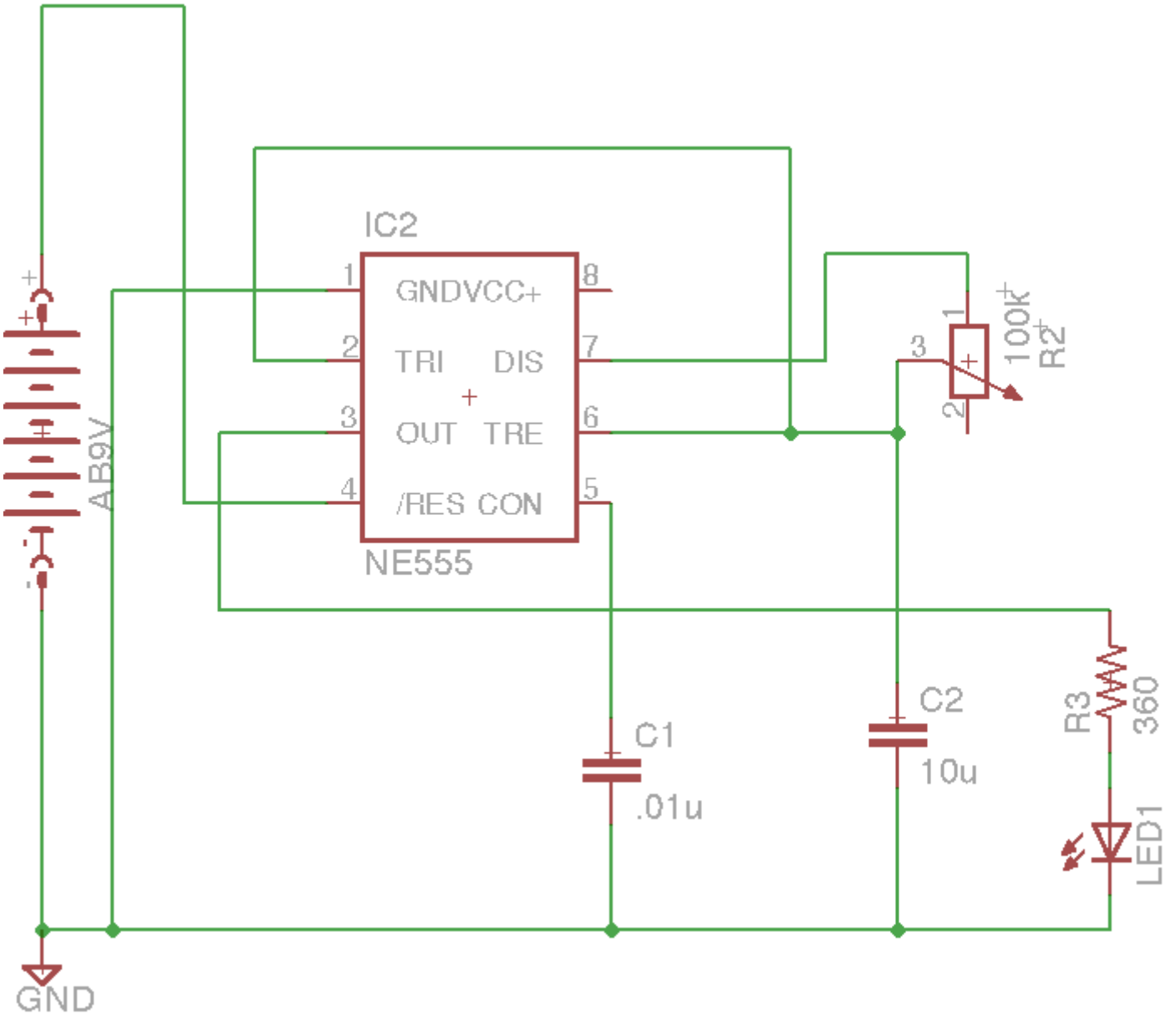

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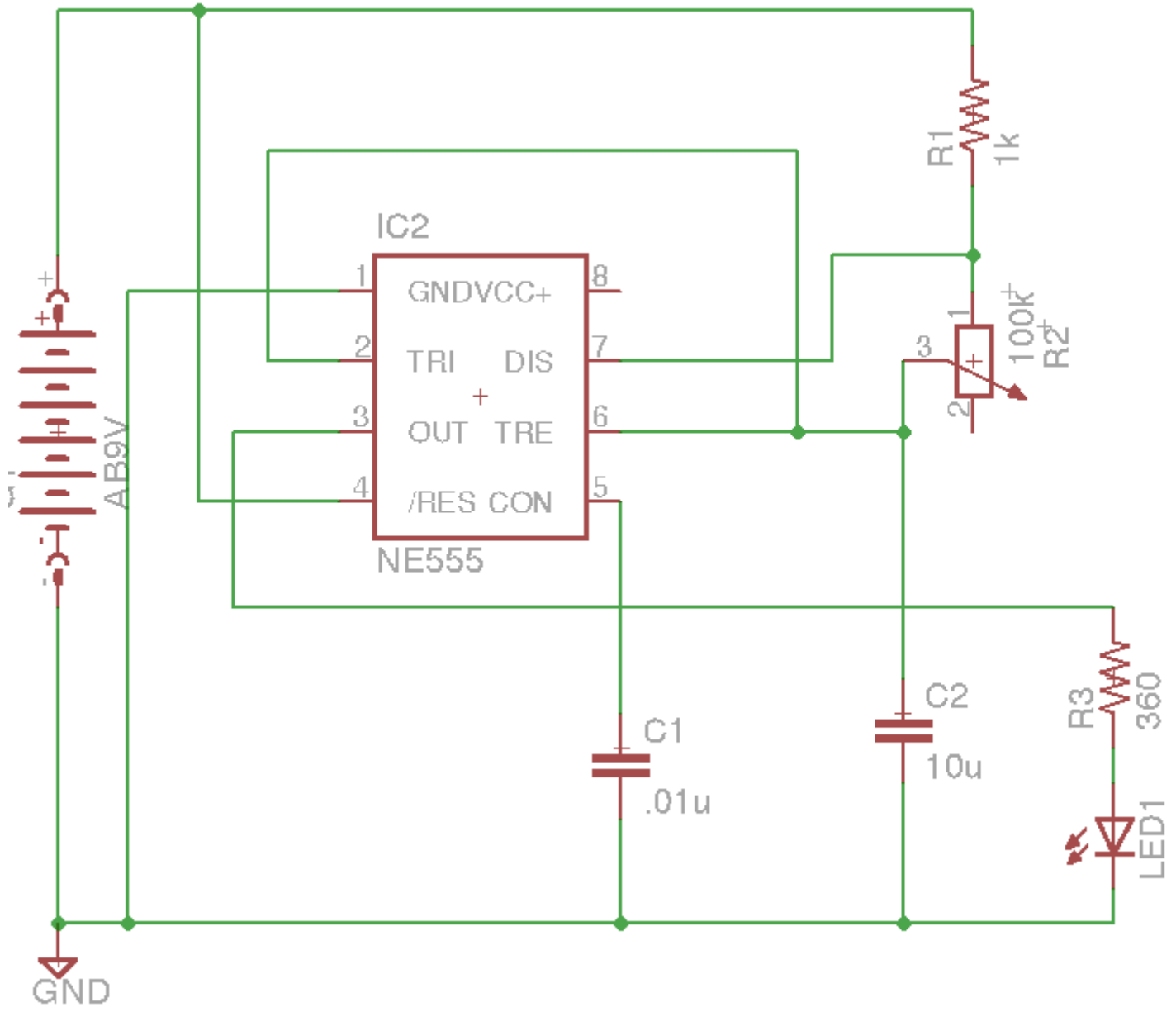
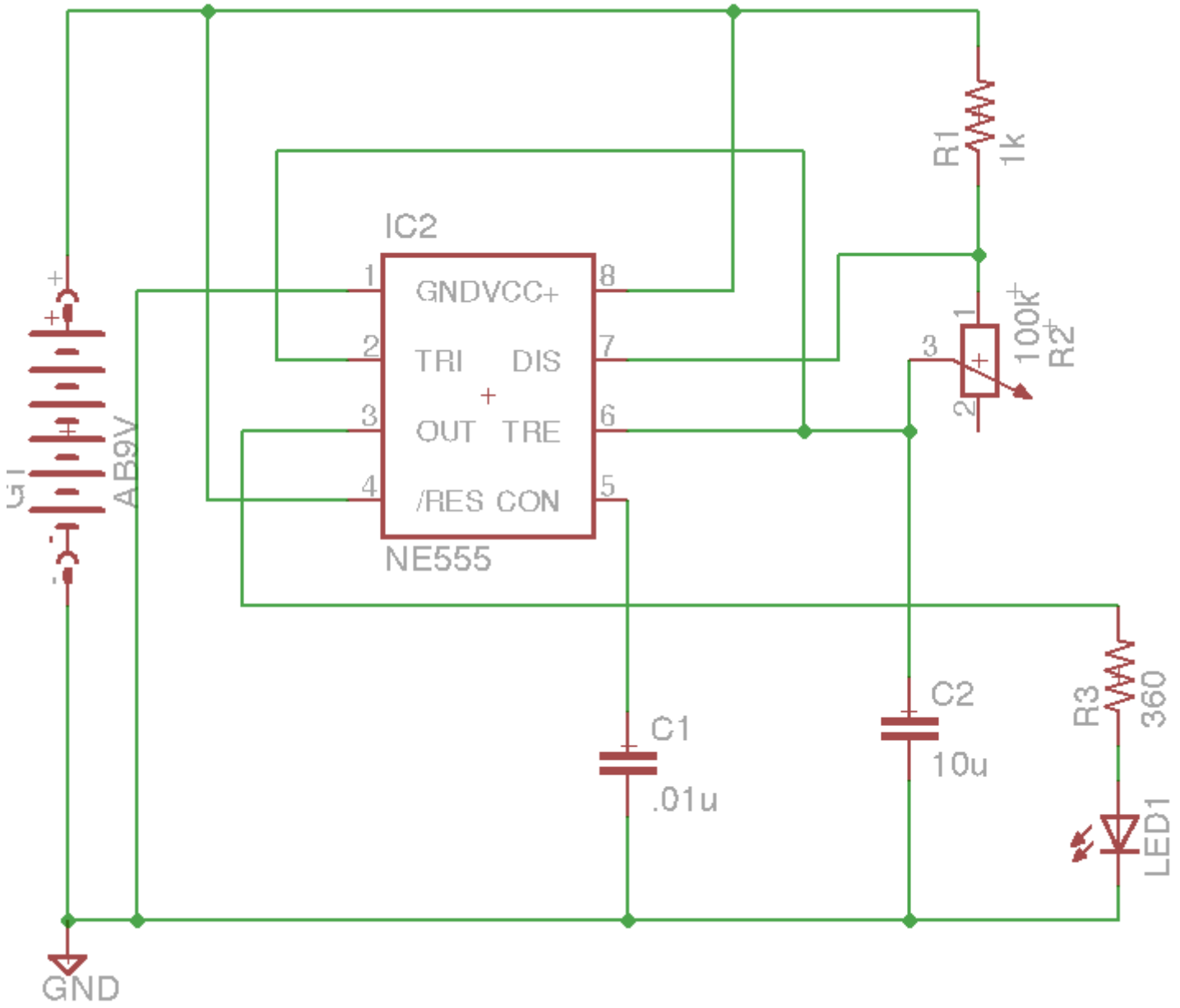


Blinking an LED (it works!)



Where do I go next?

- Metrix Create:Space
- Take apart your toys
- Forrest M. Mims III
- Make magazine
- SPICE
- Make your own things:
  - Analog electronics
  - Digital logic
  - Whatever you can imagine