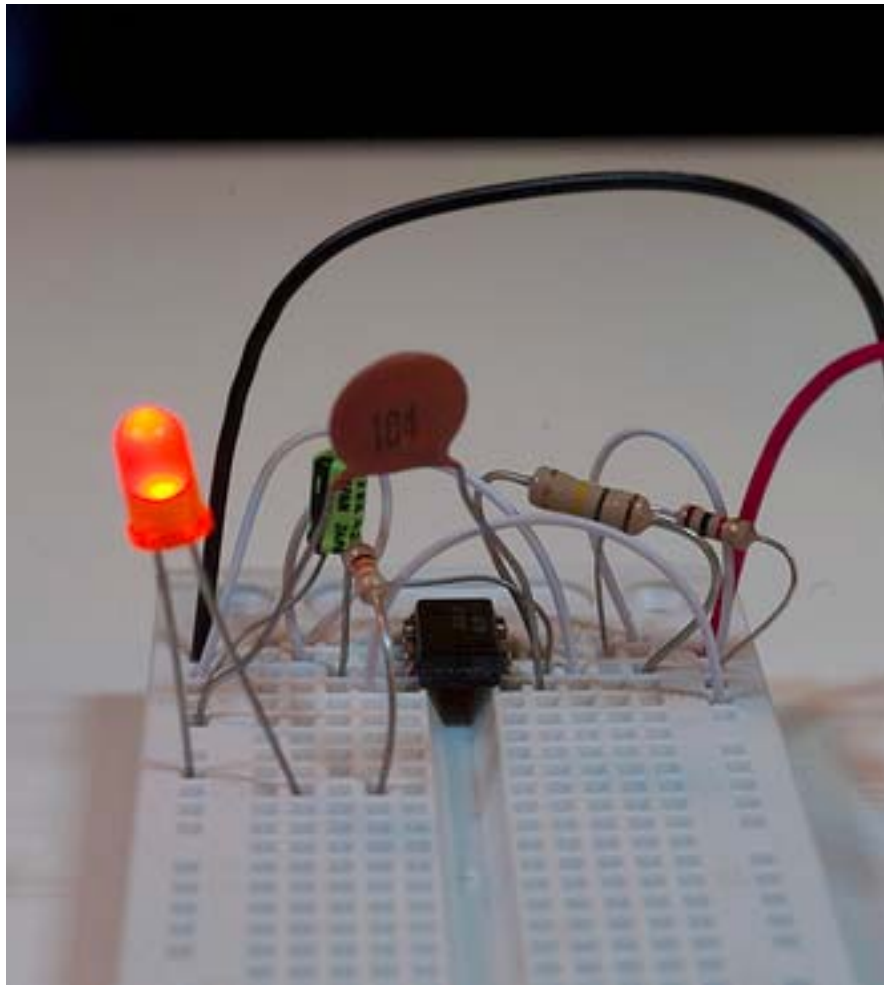


# Introduction to Electronics



Instructor:

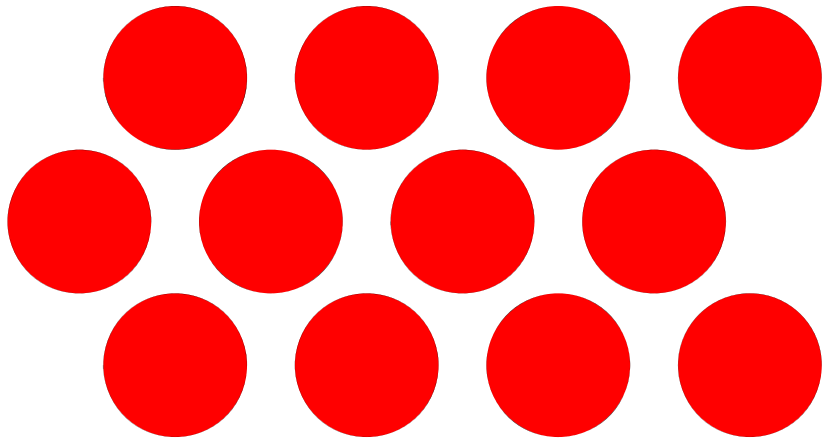
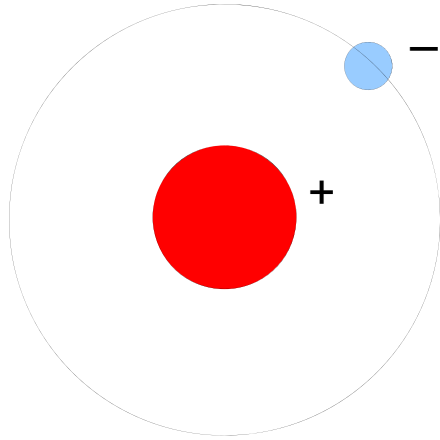
Plamena Milusheva

August 25, 2011

# Today we'll be covering:

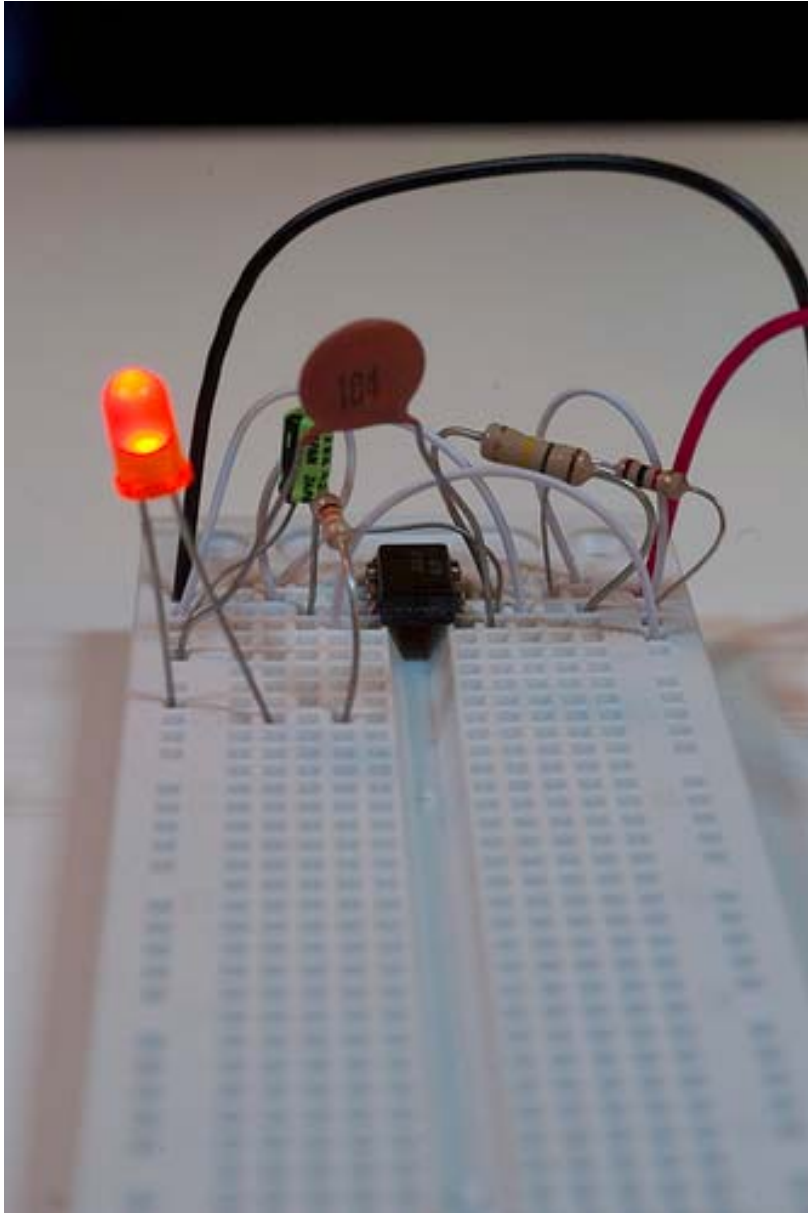
- .Voltage
- .Current
- .Simple electrical components
- .Circuit diagrams
- .Simple circuits and designs
- .Useful applications

# 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

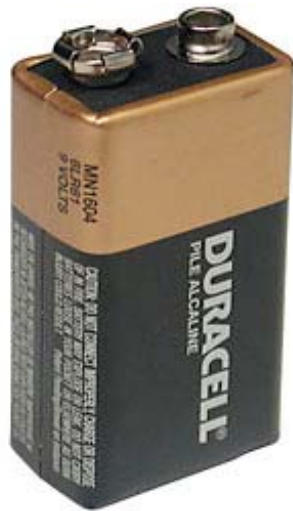
# Electricity: Voltage and Current



=

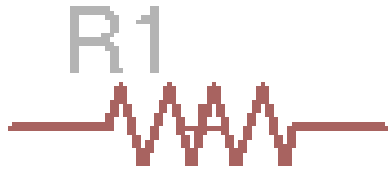


# Voltage Sources



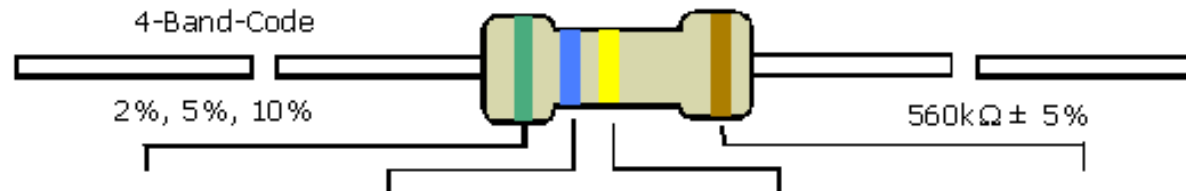
- Supply a constant voltage
- Current may vary
- Output has units of Volts

# 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)



# Your friend, the multimeter



Measures:

- DC current (DCA)
- DC voltage (DCV)
- AC voltage (ACV)
- Resistance ( $\Omega$ )
- and more!

# LEDS



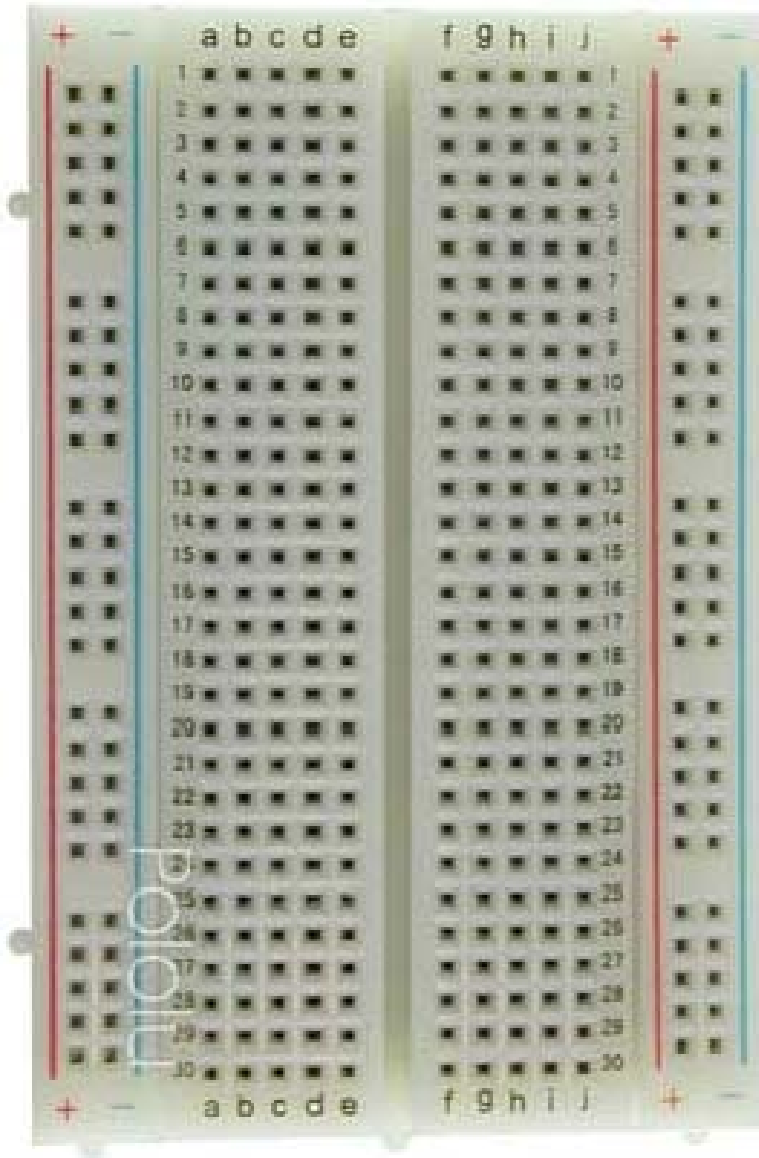
- Light Emitting Diodes
- Have a constant voltage drop
- Light is proportional to current
- Damaged by too much current

# What is GND?

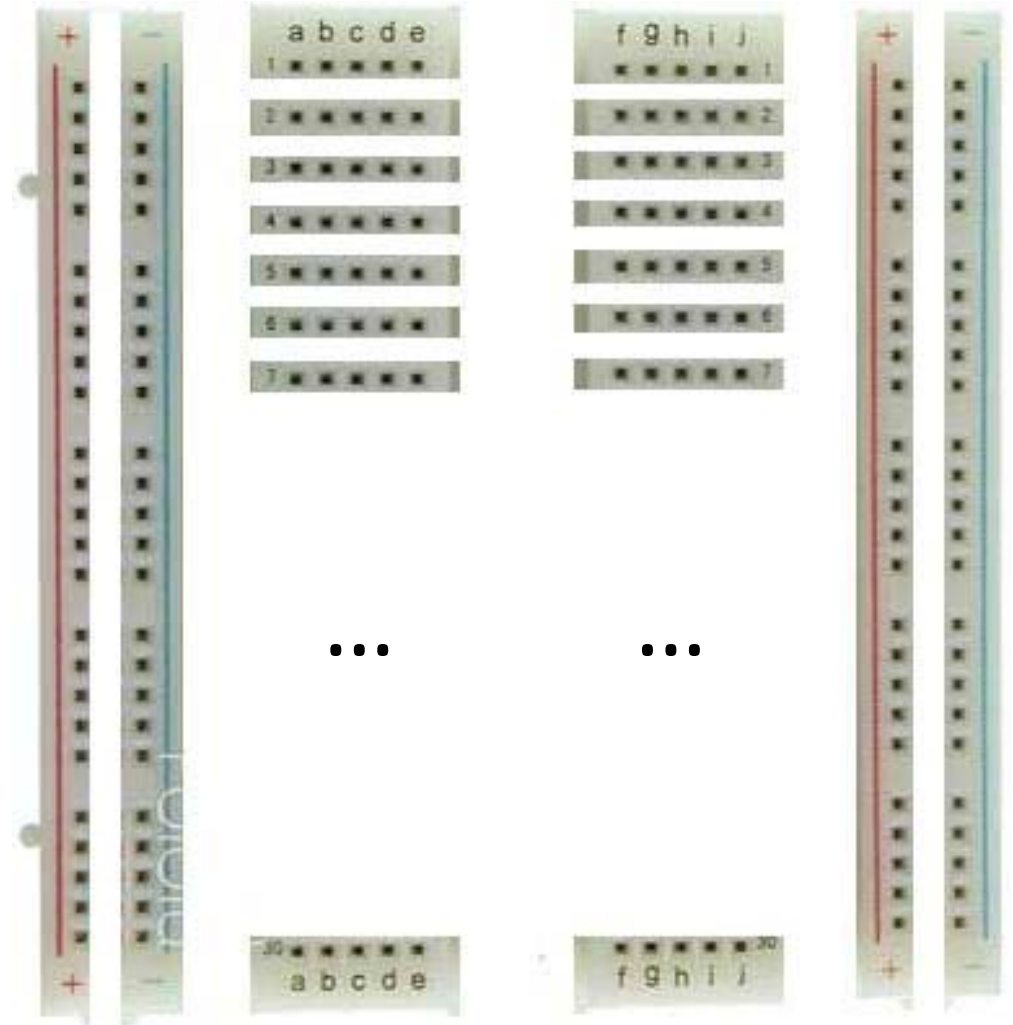


Voltage is always measured with respect to some zero. GND defines where zero is in the circuit.

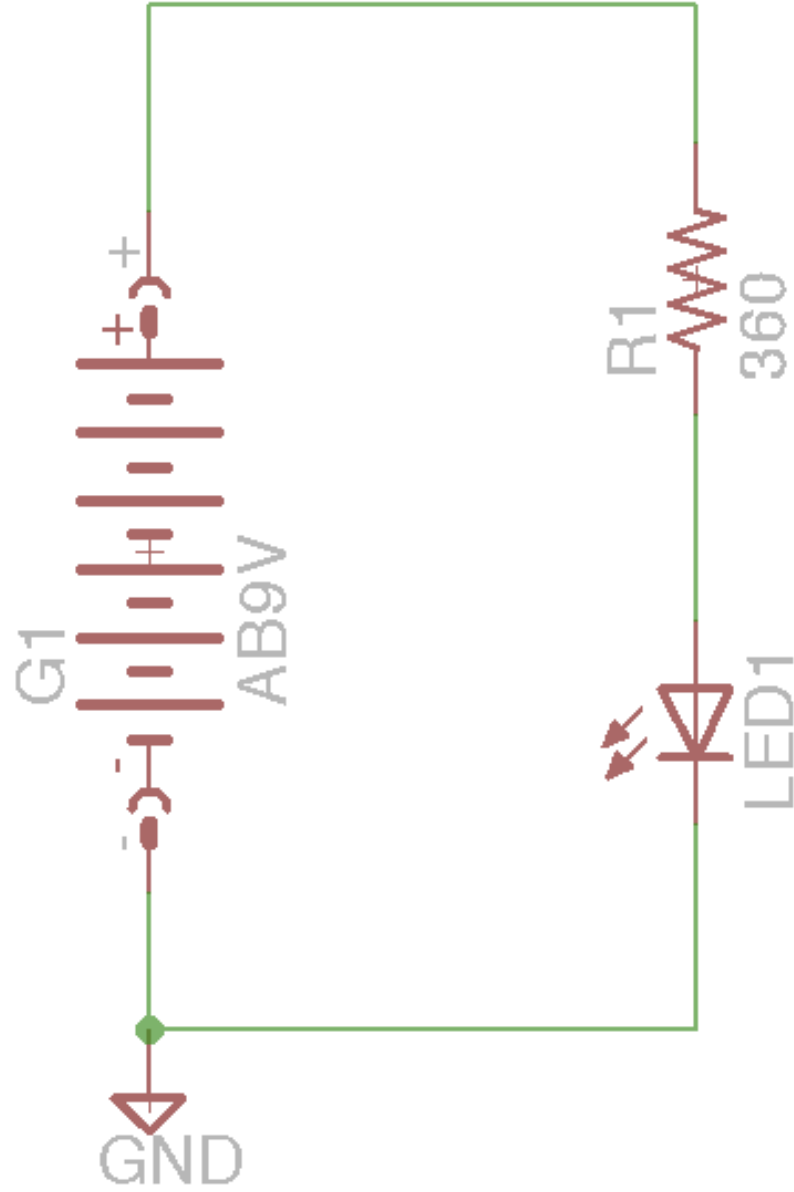
# Breadboards



=



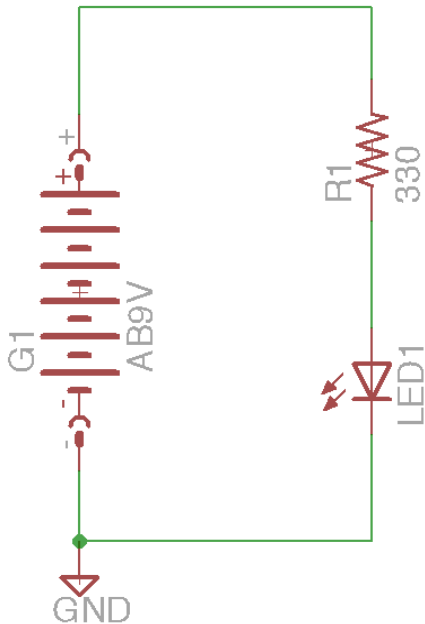
# Let there be light



# Kirchhoff and his laws

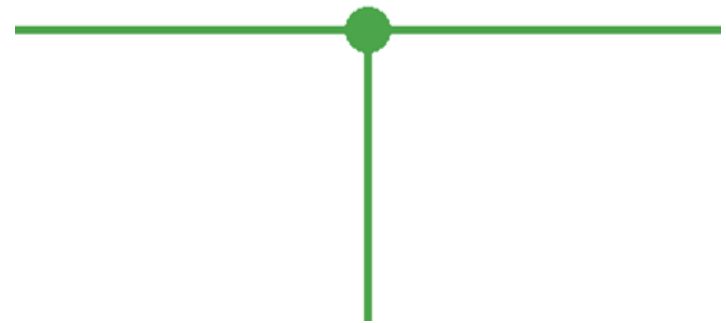
## The Voltage Law:

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



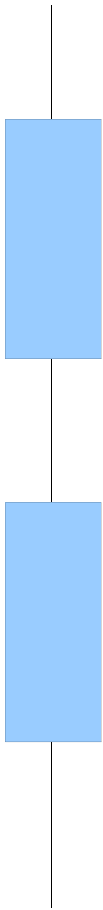
## The Current Law:

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

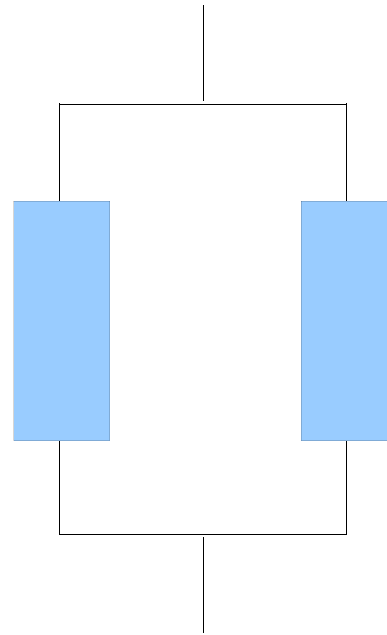


# Placing Components

Series



Parallel

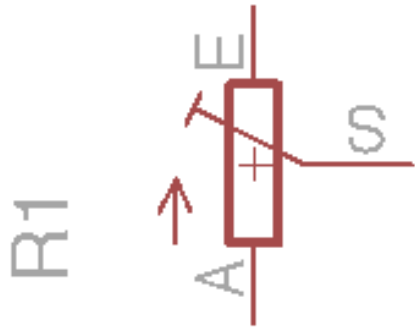


# Your friend, the multimeter



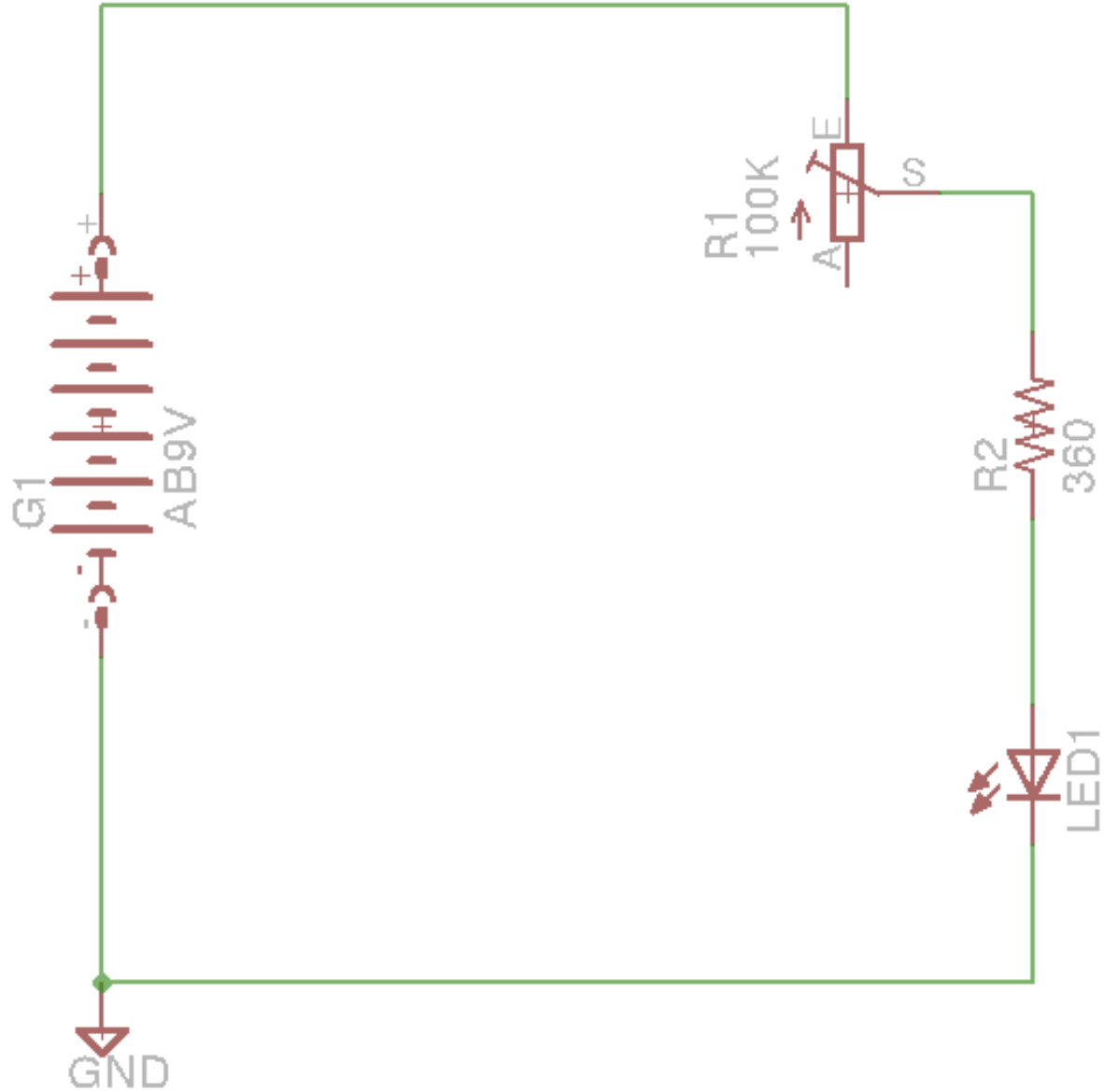
- Voltage: place probes in parallel
- Current: place probes in series

# Potentiometers

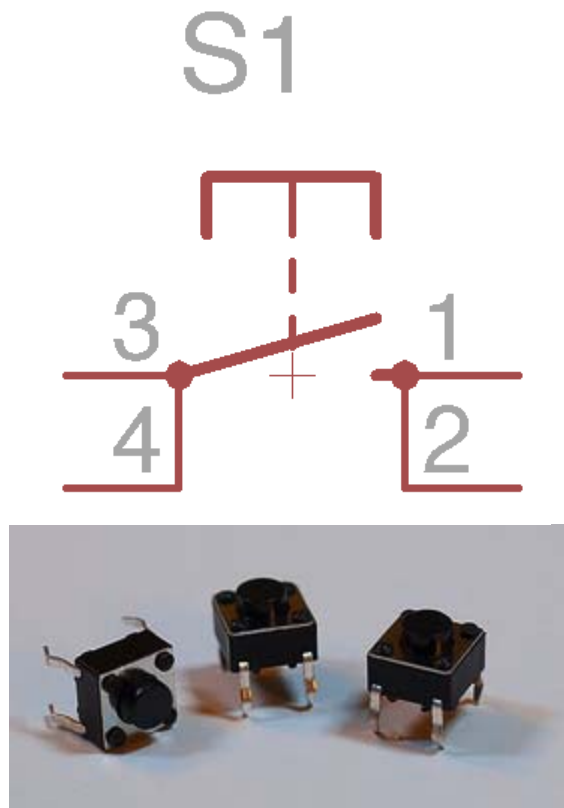


- Constant Resistance between outer leads
- Variable resistance between center lead and either outer lead.

# Change the brightness

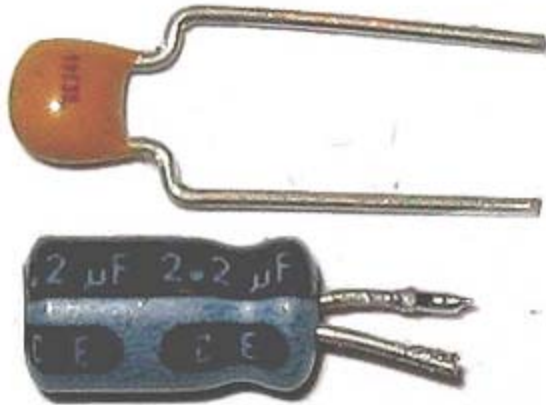
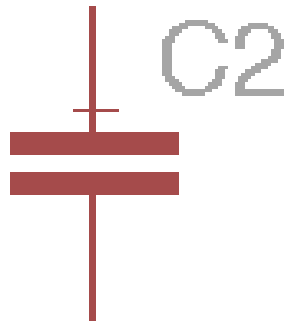


# Buttons and Switches



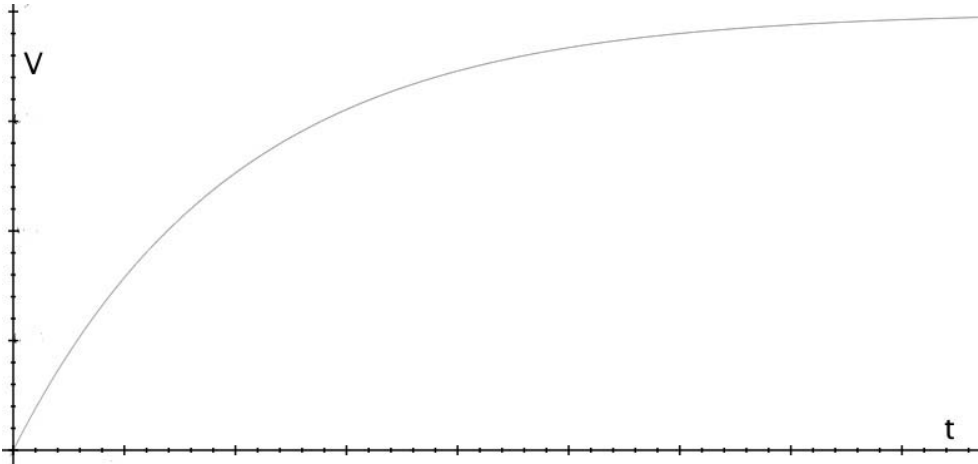
- Single Pole/Double Throw
- These are exactly what you think they are

# Capacitors

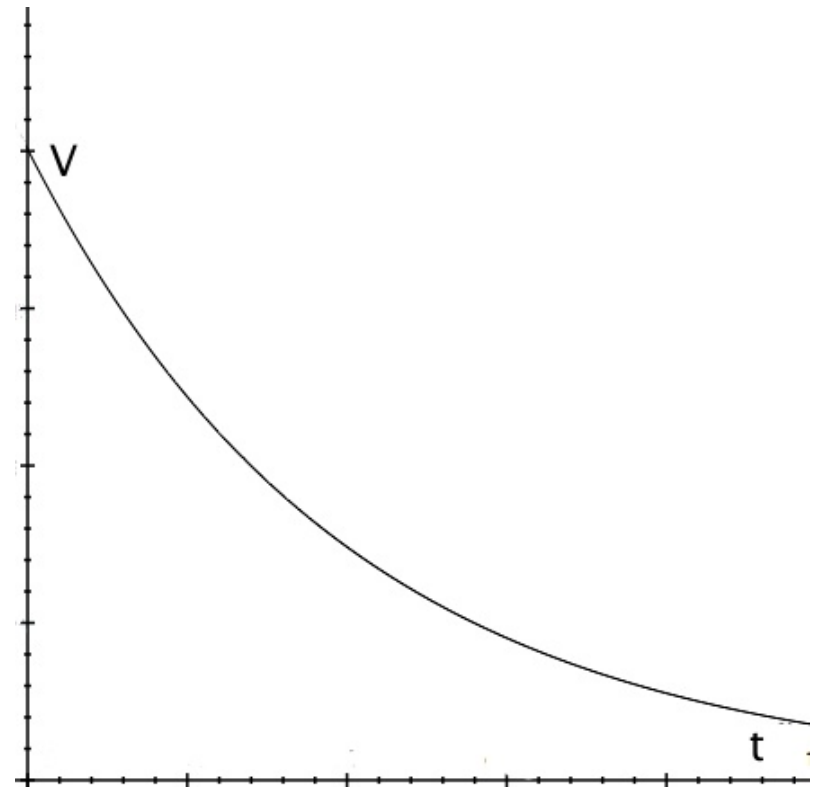


- Store voltage
- Has units of Farads
- Higher capacitance means more power can be stored
- 63% charge time is  $R \times C$

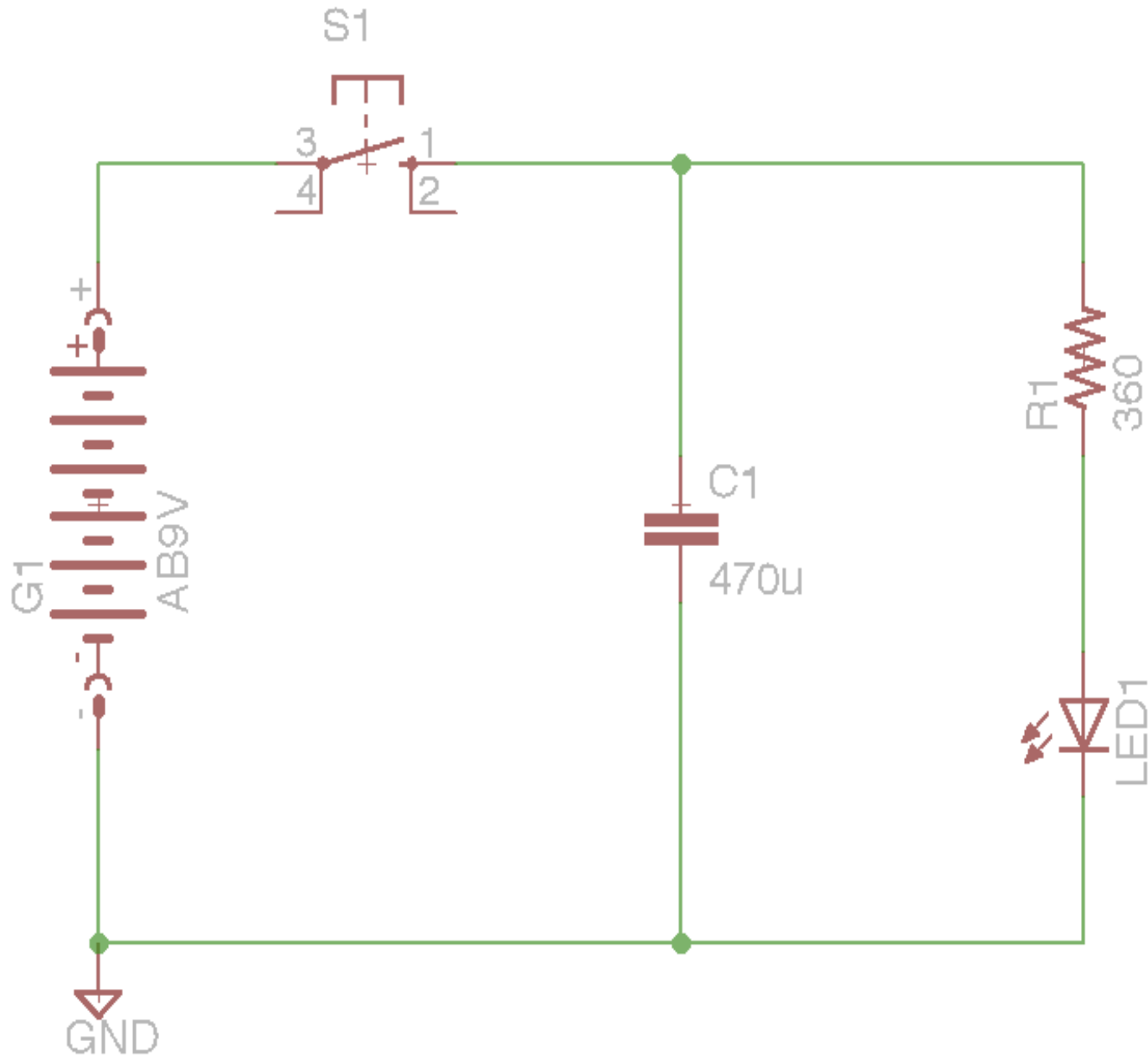
# Charge and Discharge Capacitors



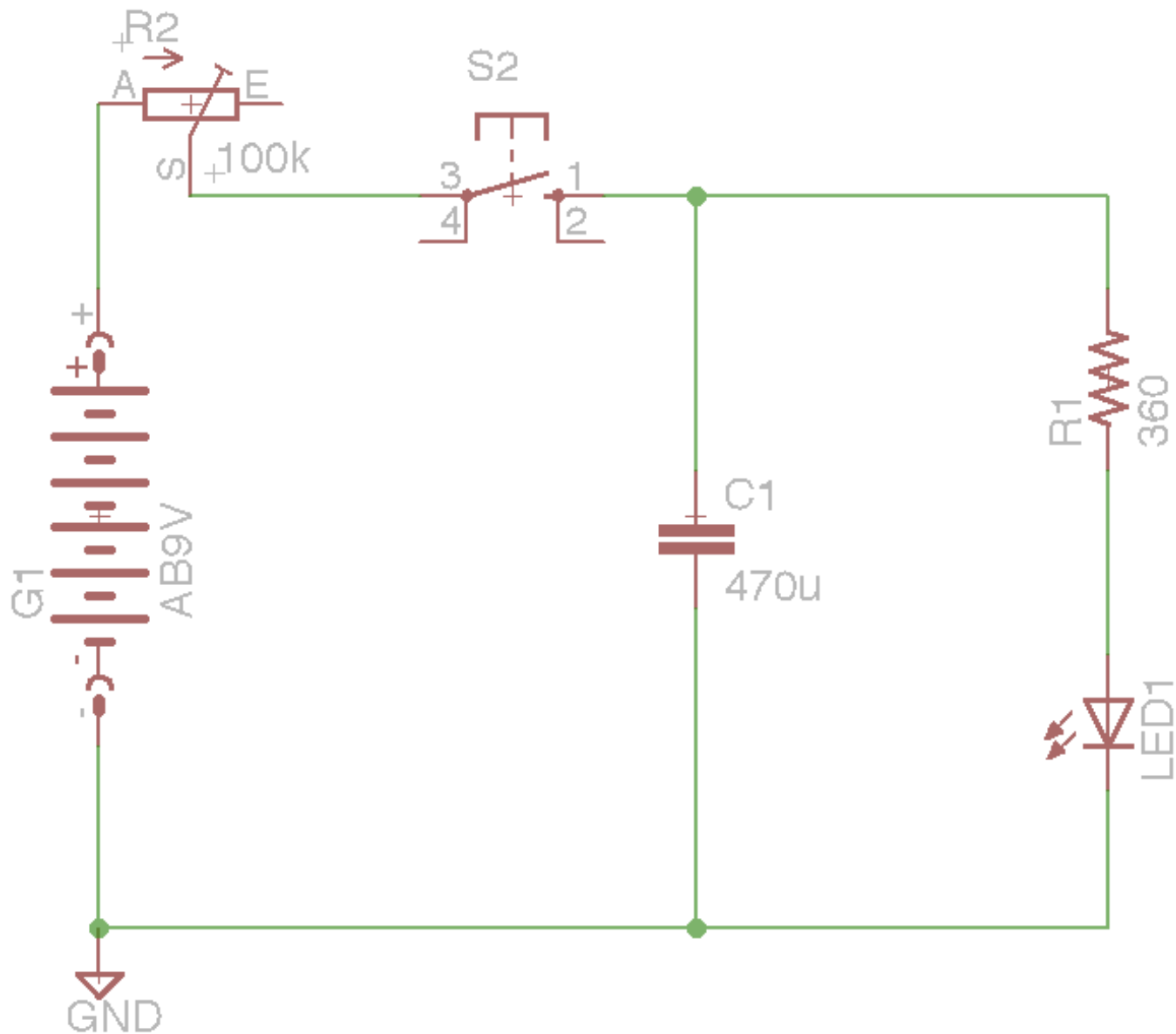
Capacitors charge and discharge asymptotically



# Fading the brightness



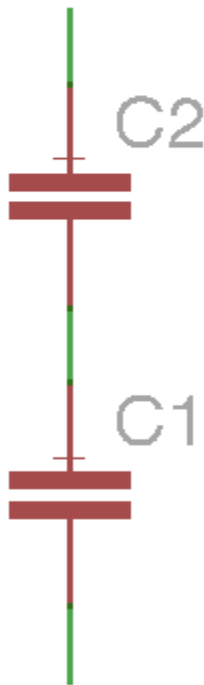
# Fading in and out



# Series Components

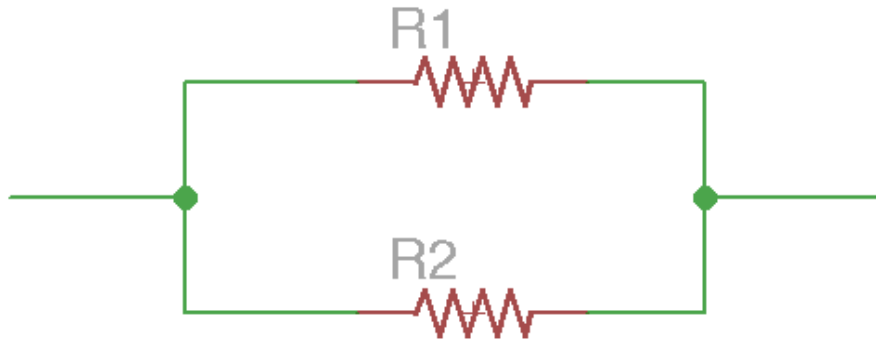


$$R_t = R_1 + R_2$$

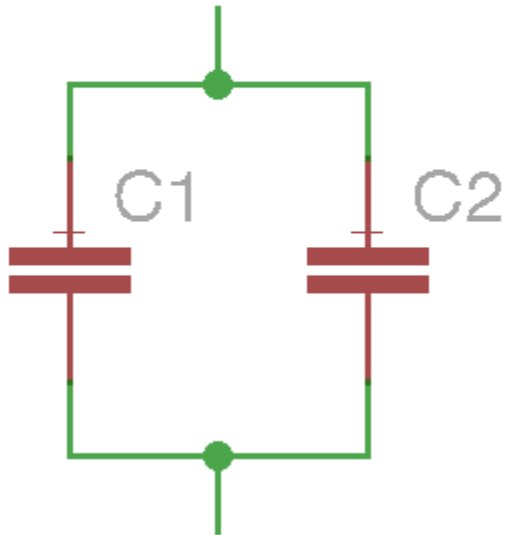


$$C_t = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2}}$$

# Parallel Components

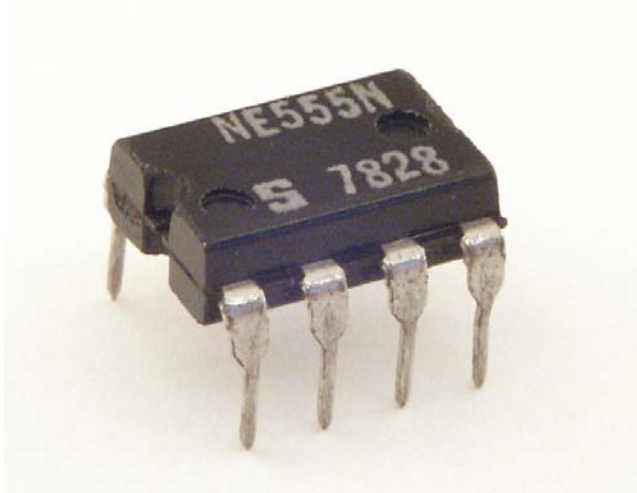
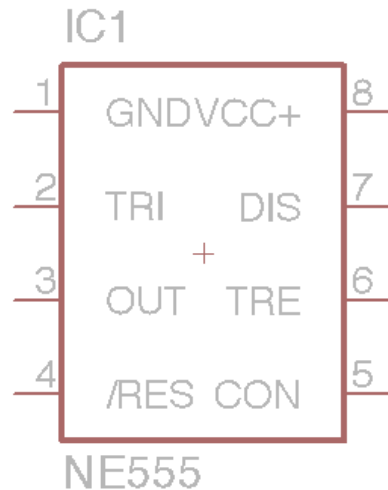


$$R_t = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$



$$C_t = C_1 + C_2$$

# Integrated Circuits (the 555 timer)

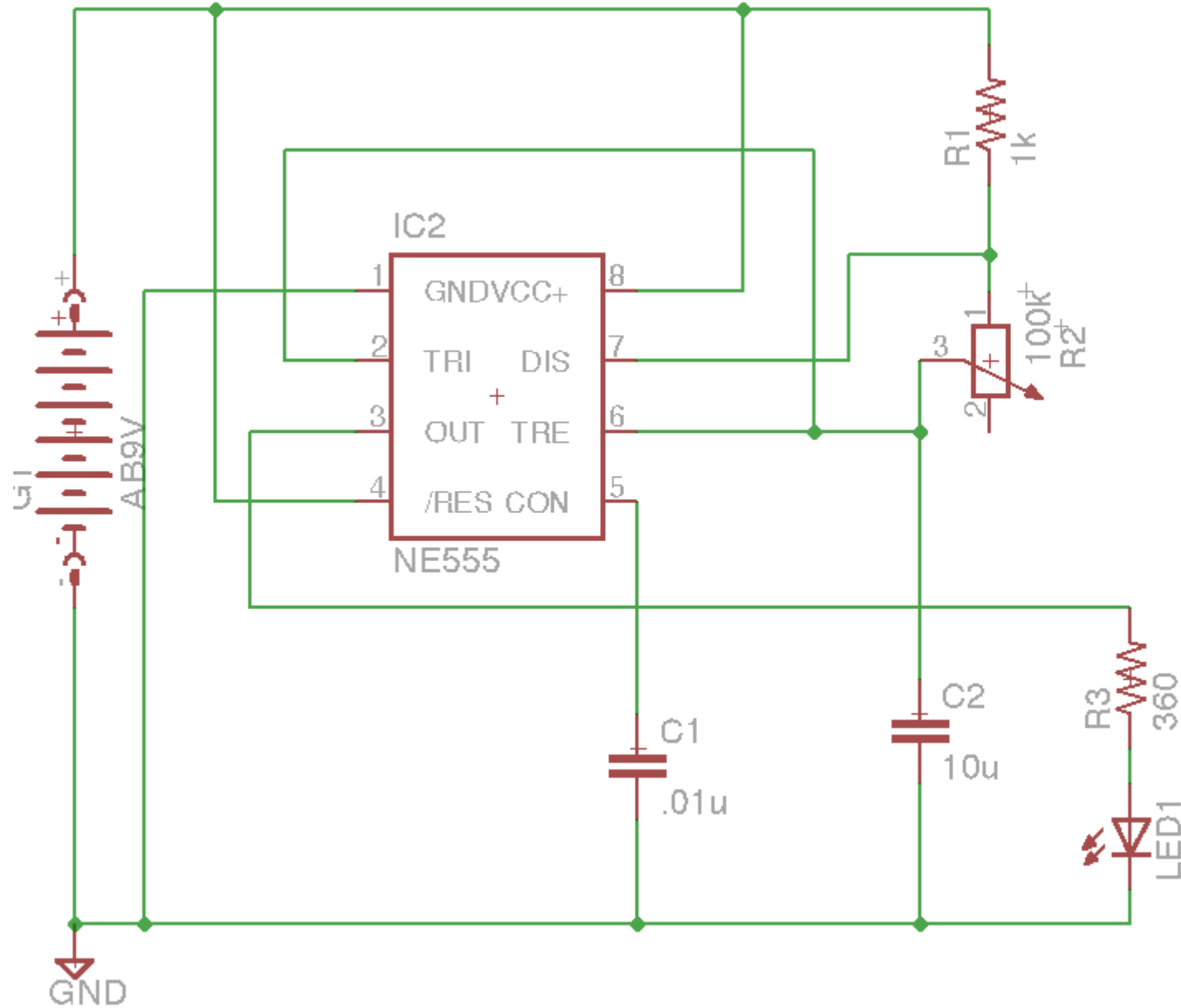


- Adjustable oscillator
- Controlled by connecting resistors and capacitors to input pins
- Choose DIP for breadboard use

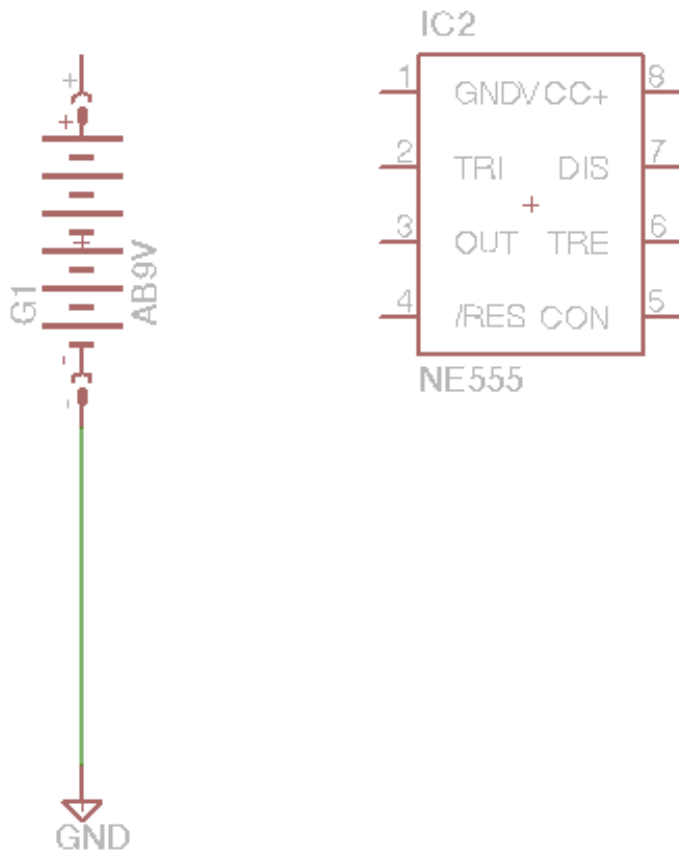
# Datasheets

- 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

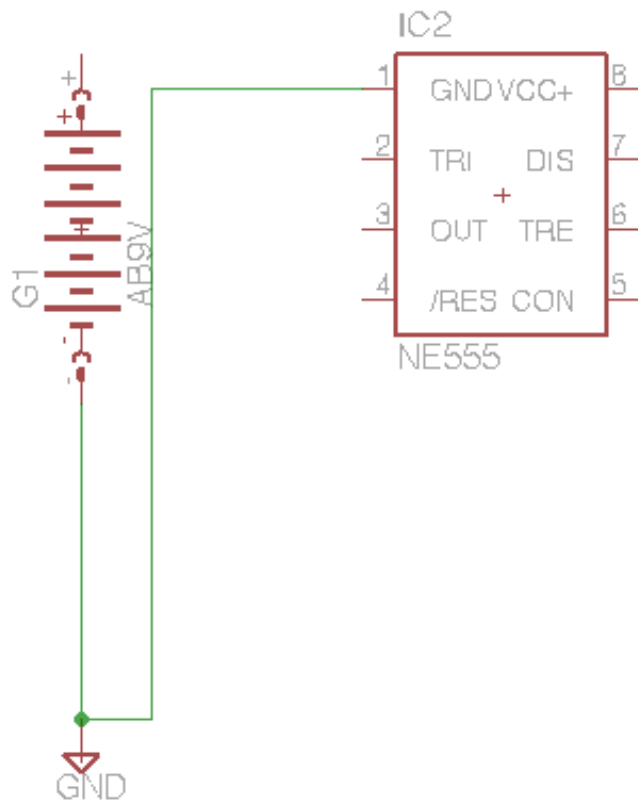
# Blinking an LED



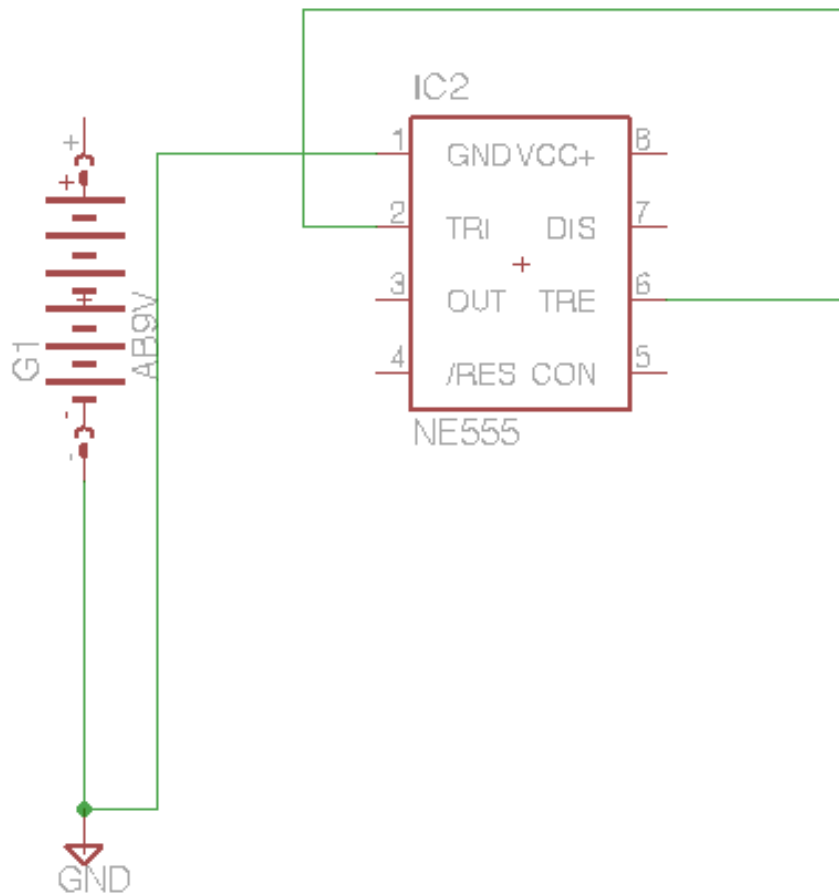
# Blinking an LED



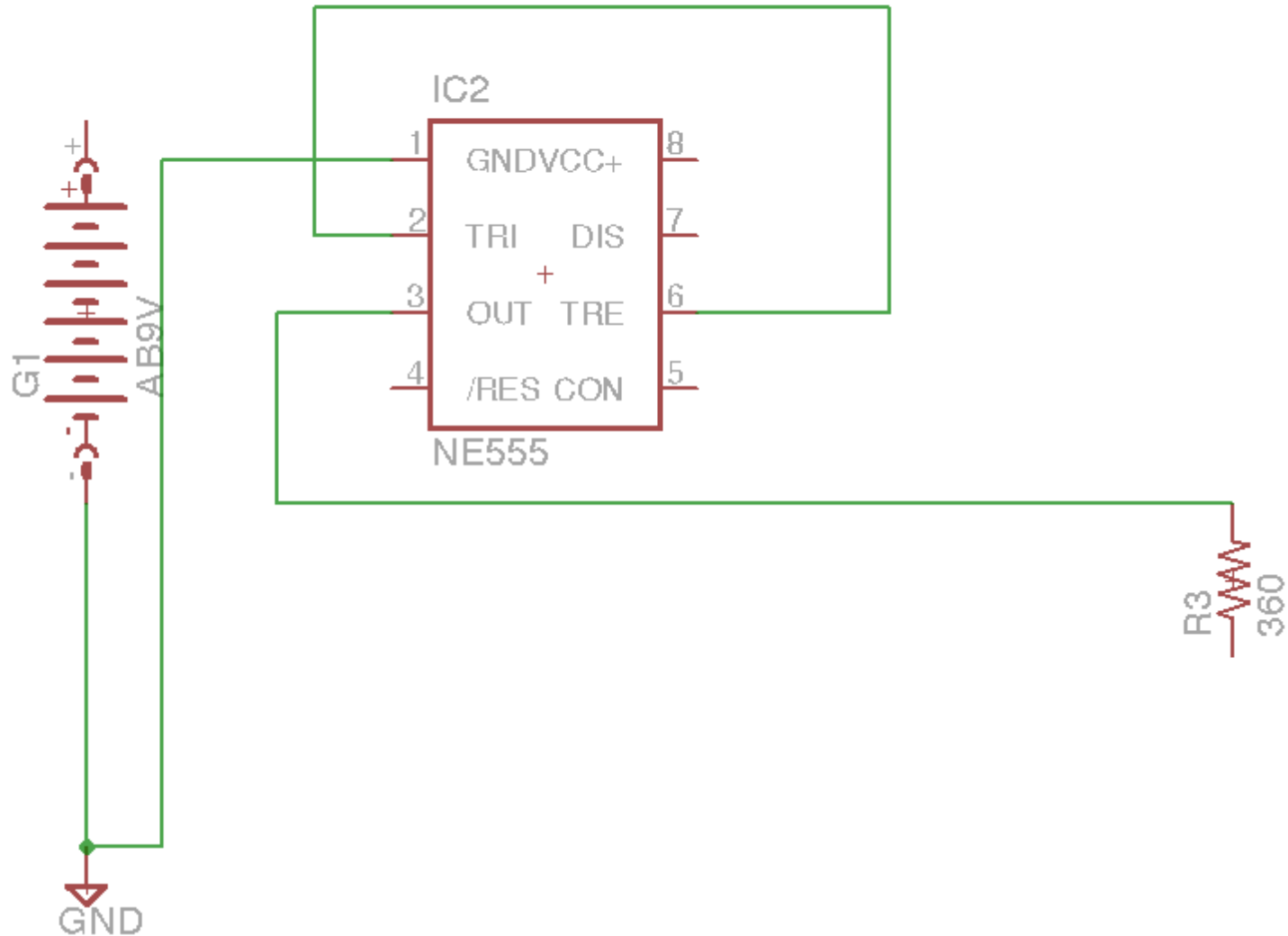
# Blinking an LED



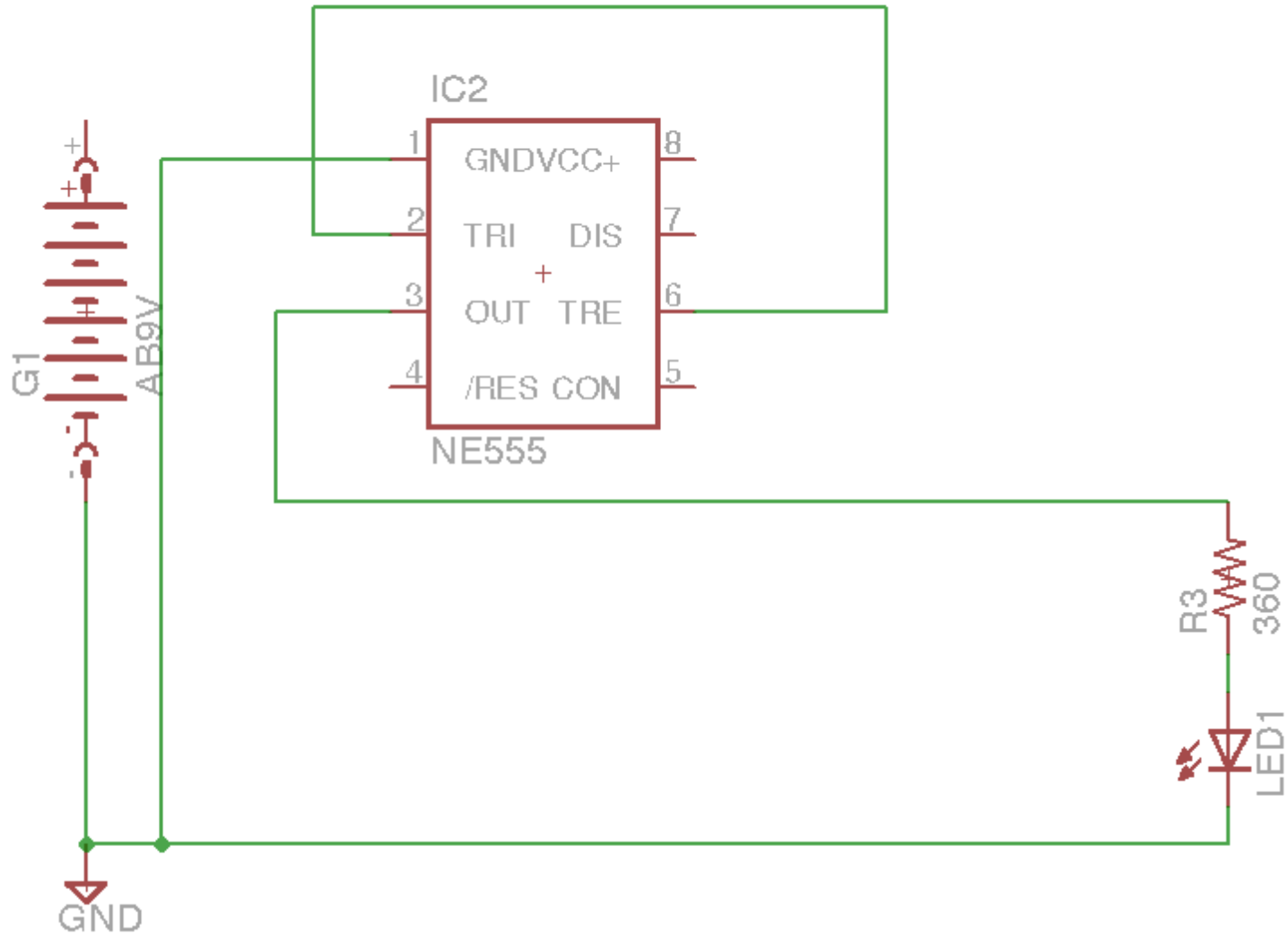
# Blinking an LED



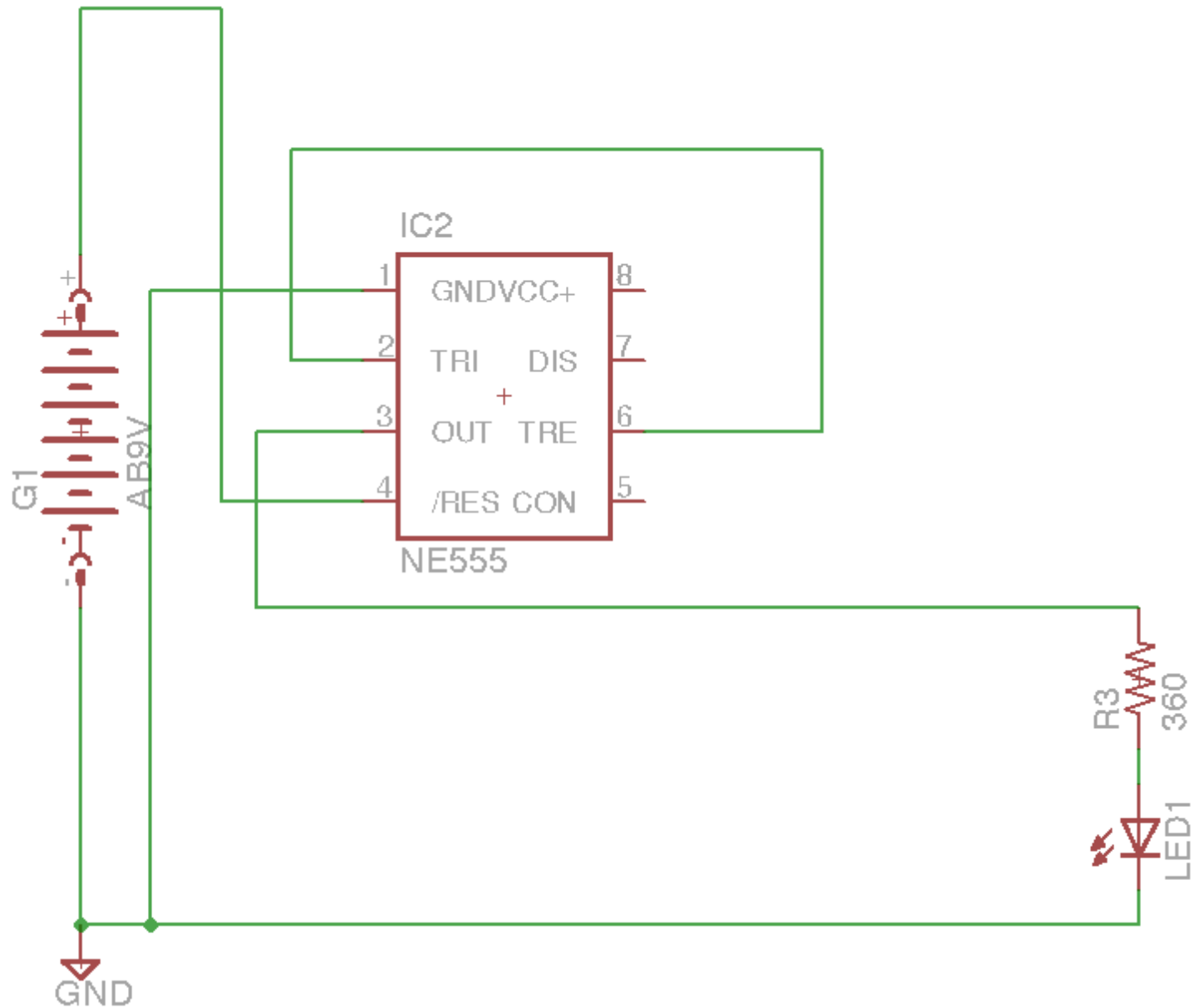
# Blinking an LED



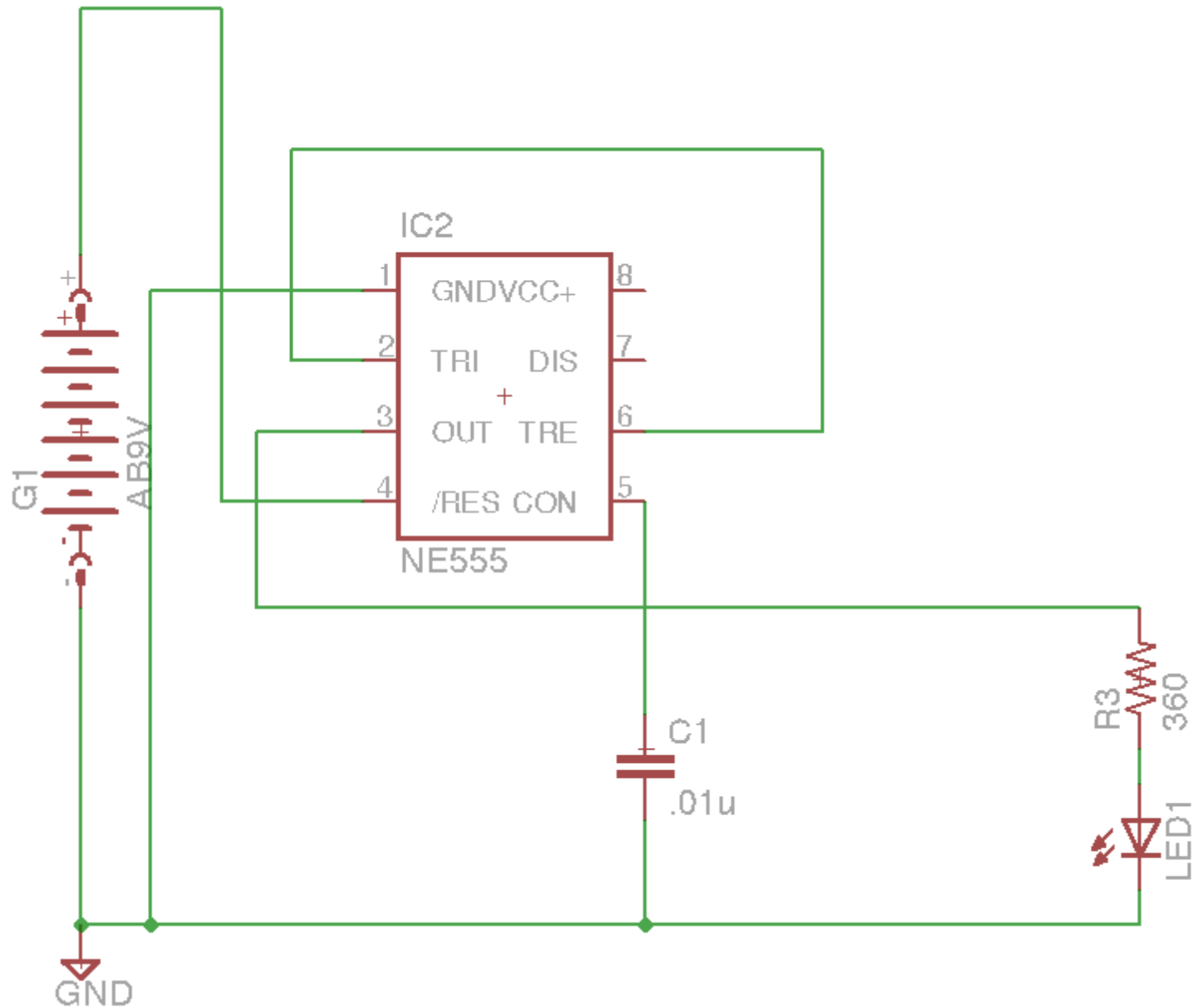
# Blinking an LED



# Blinking an LED

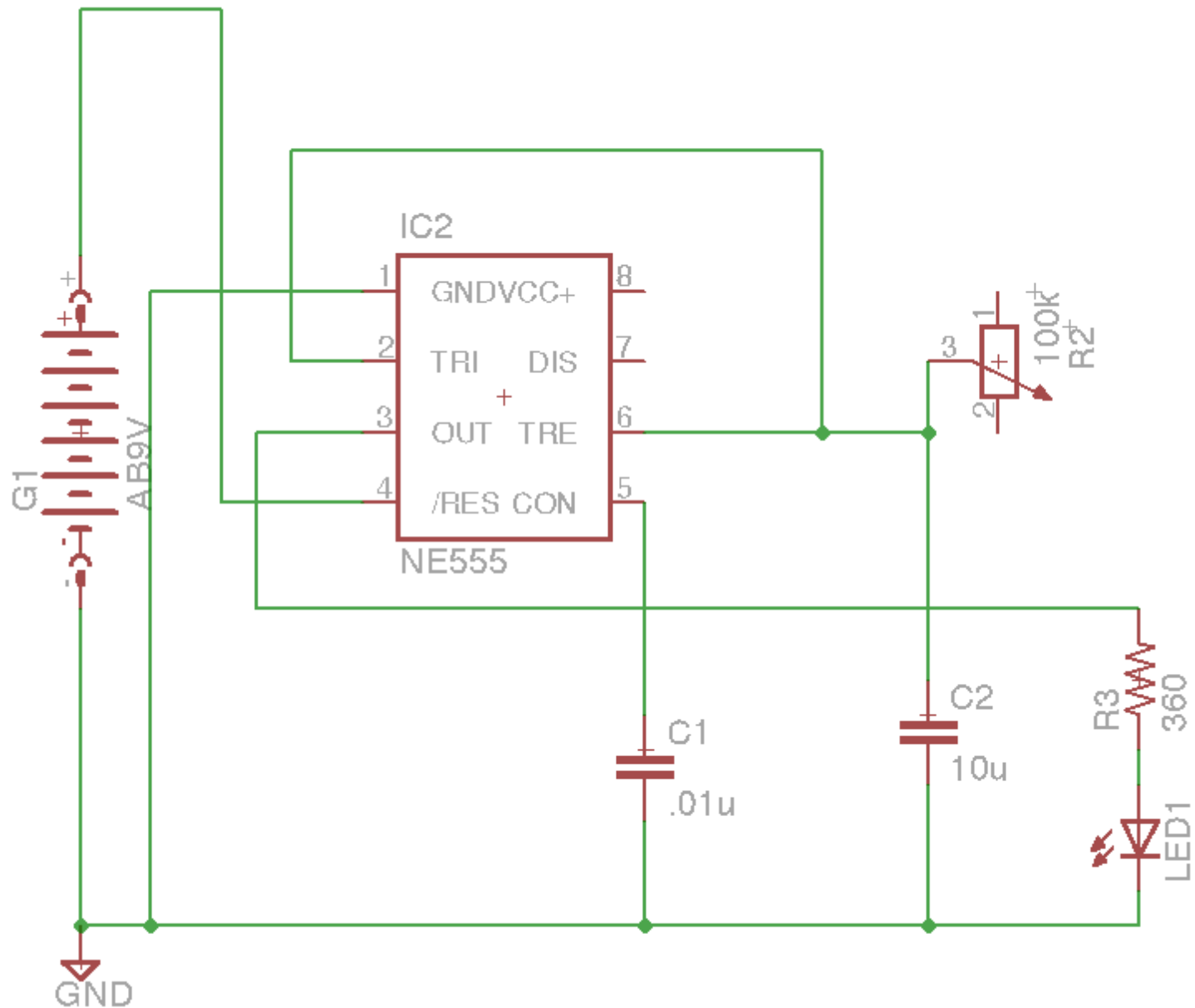


# Blinking an LED

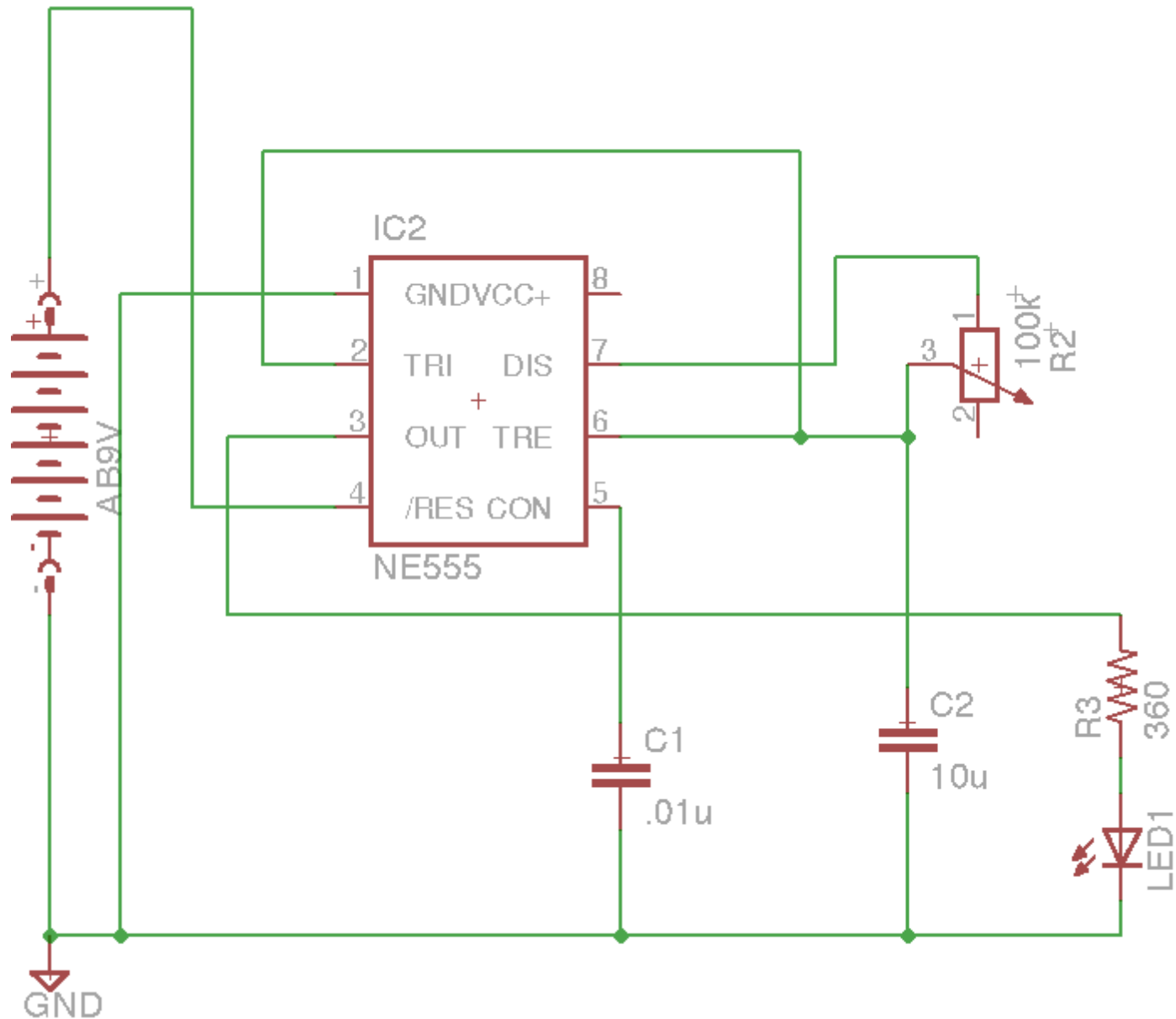




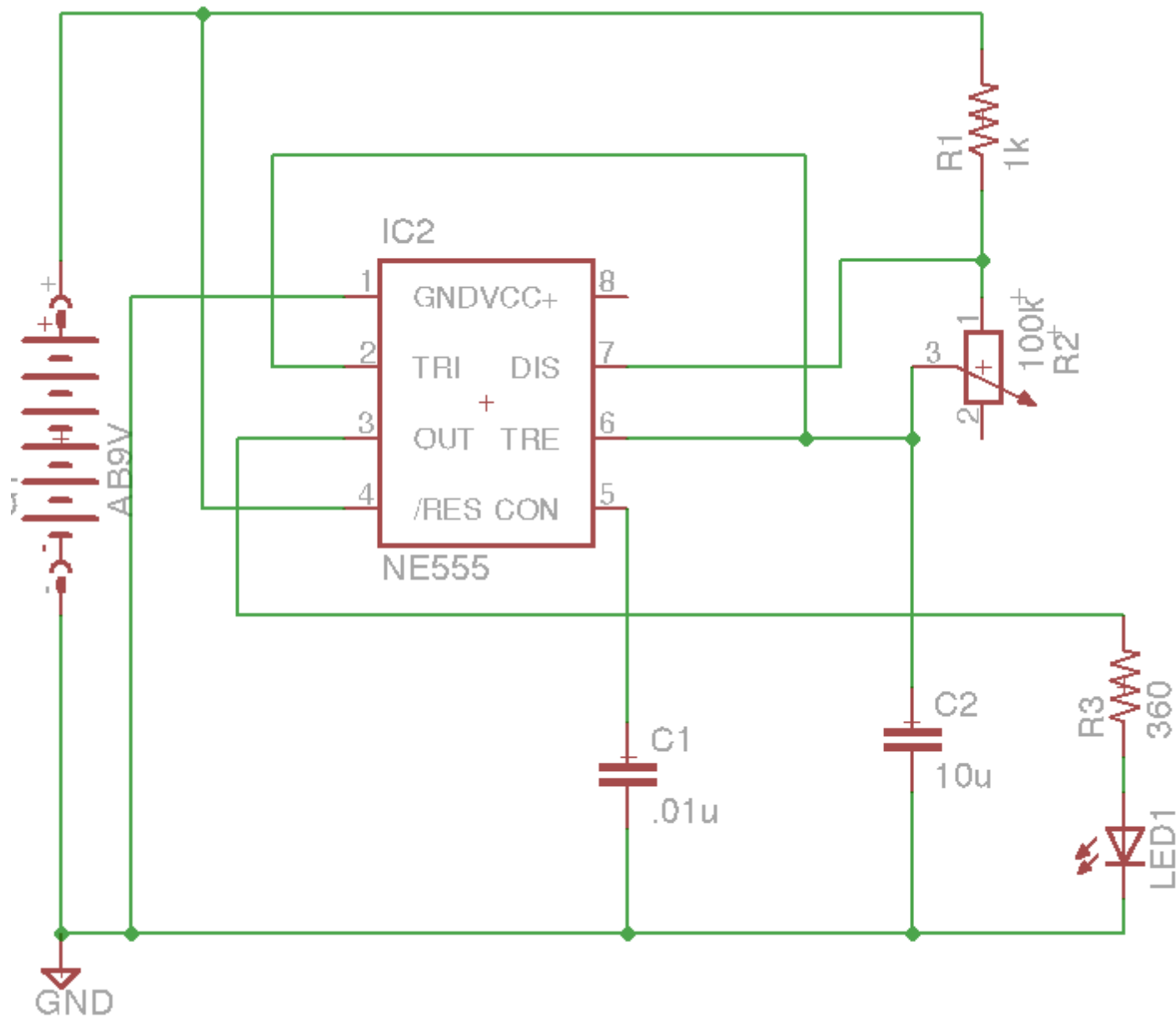
# Blinking an LED



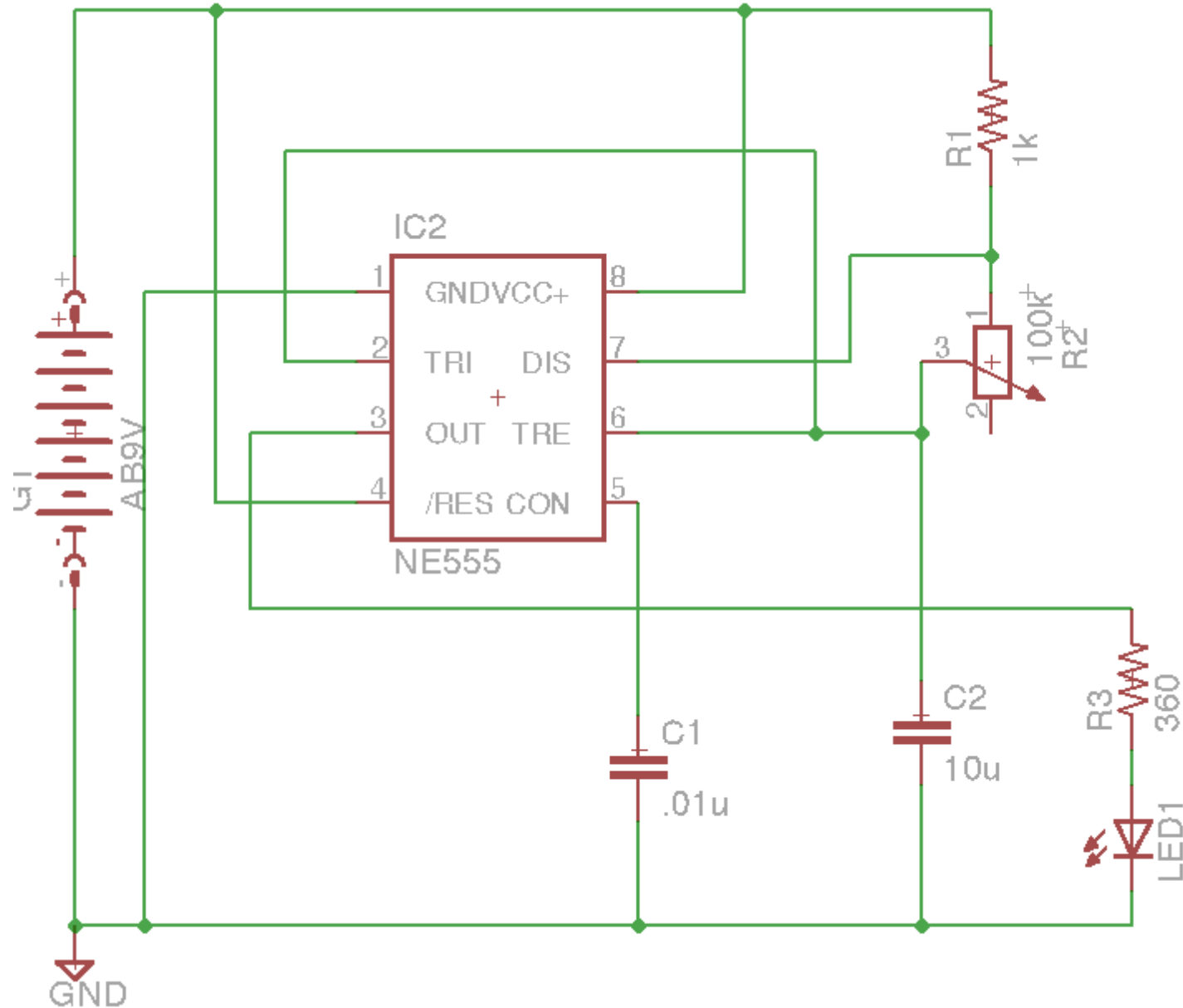
# Blinking an LED



# Blinking an LED



# Blinking an LED (it works!)



# Where do I go next?

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