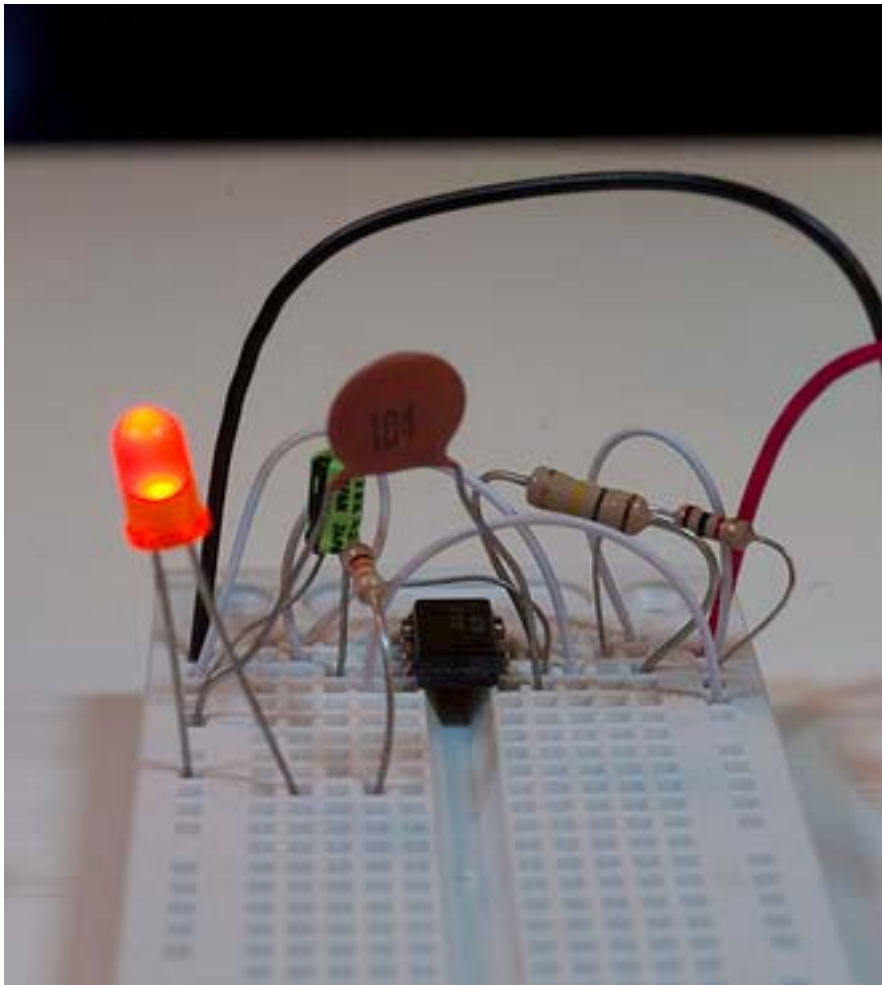


Introduction to Electronics



Instructor:

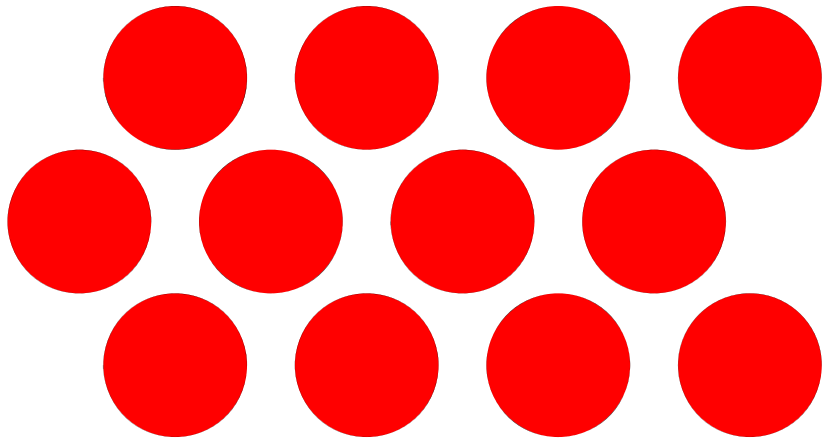
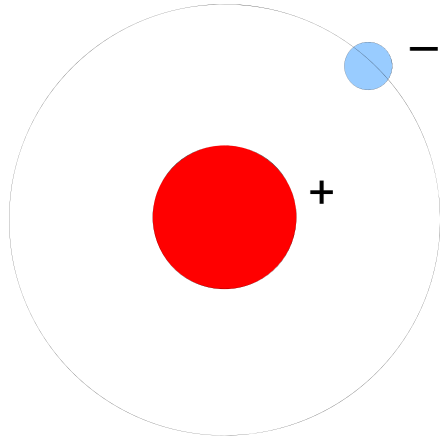
Plamena Milusheva

August 25, 2011

Today we'll be covering:

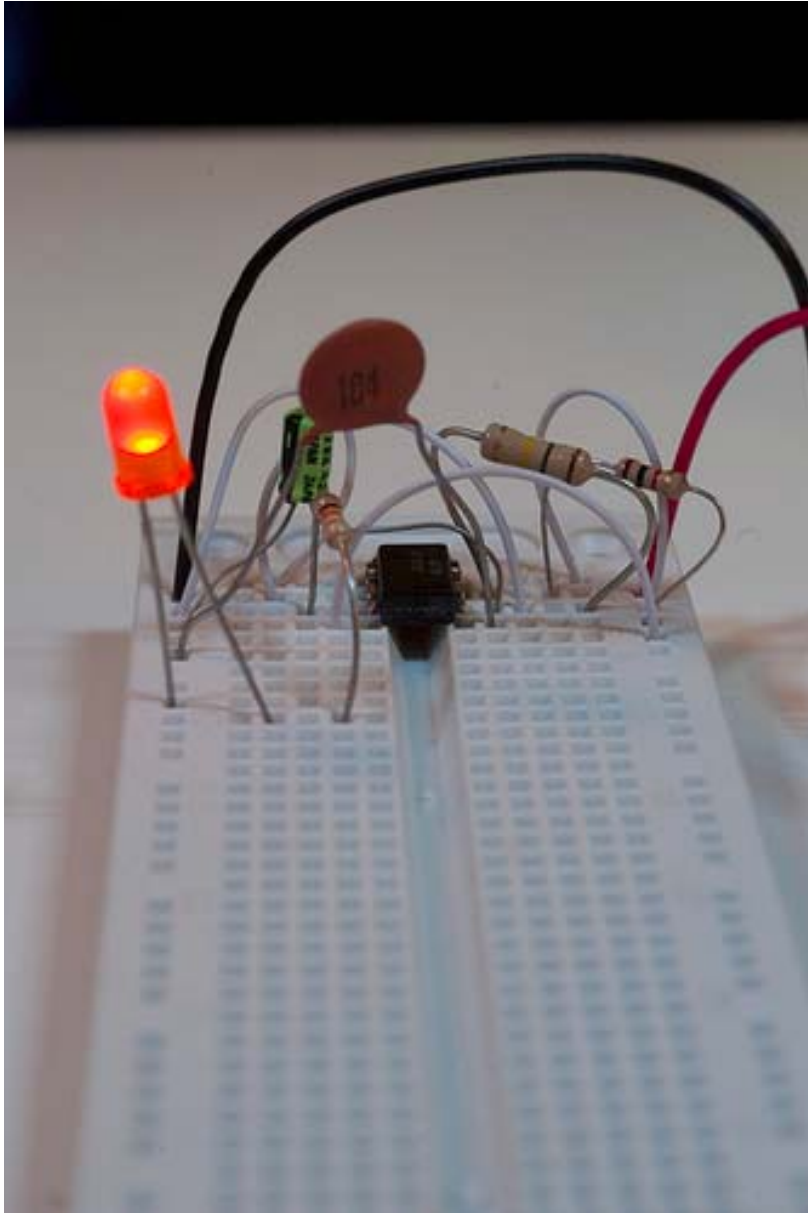
- .Voltage
- .Current
- .Simple electrical components
- .Circuit diagrams
- .Simple circuits and designs
- .Useful applications

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



=

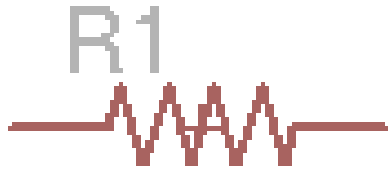


Voltage Sources



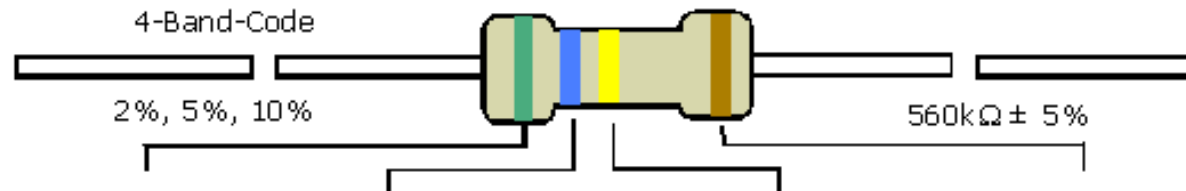
- Supply a constant voltage
- Current may vary
- Output has units of Volts

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 (Ω)
- and more!

LEDS



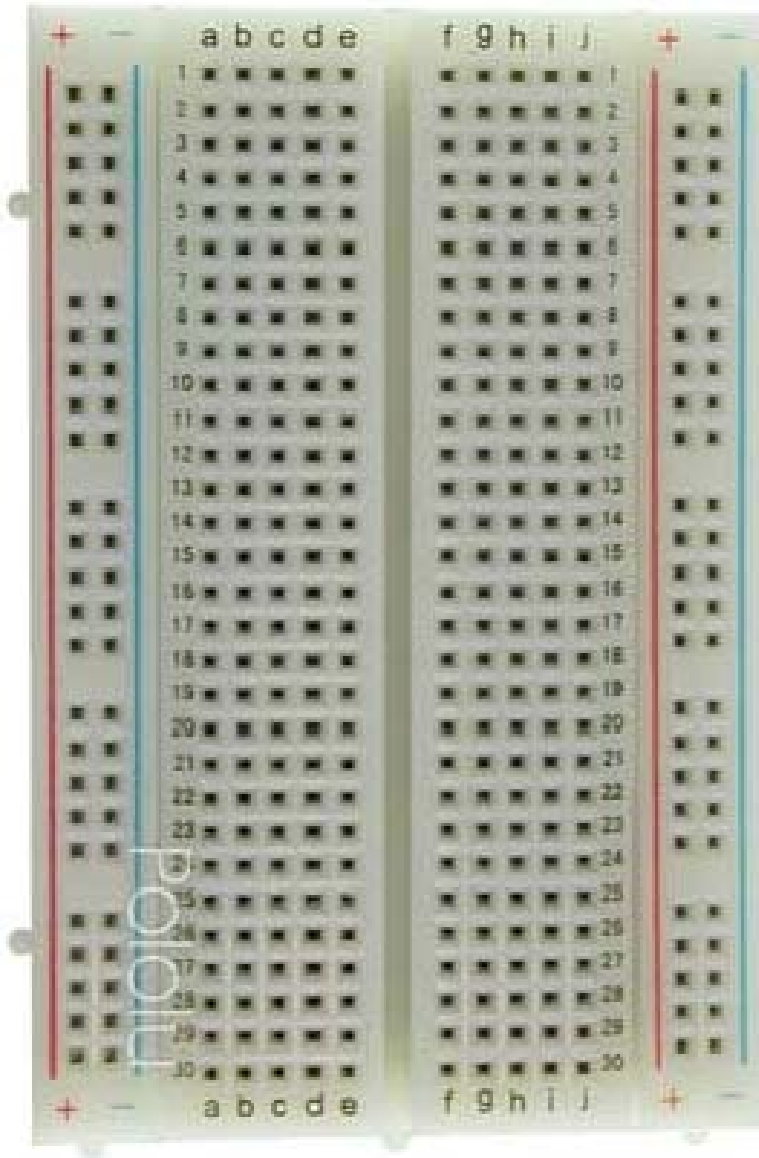
- Light Emitting Diodes
- Have a constant voltage drop
- Light is proportional to current
- Damaged by too much current

What is GND?

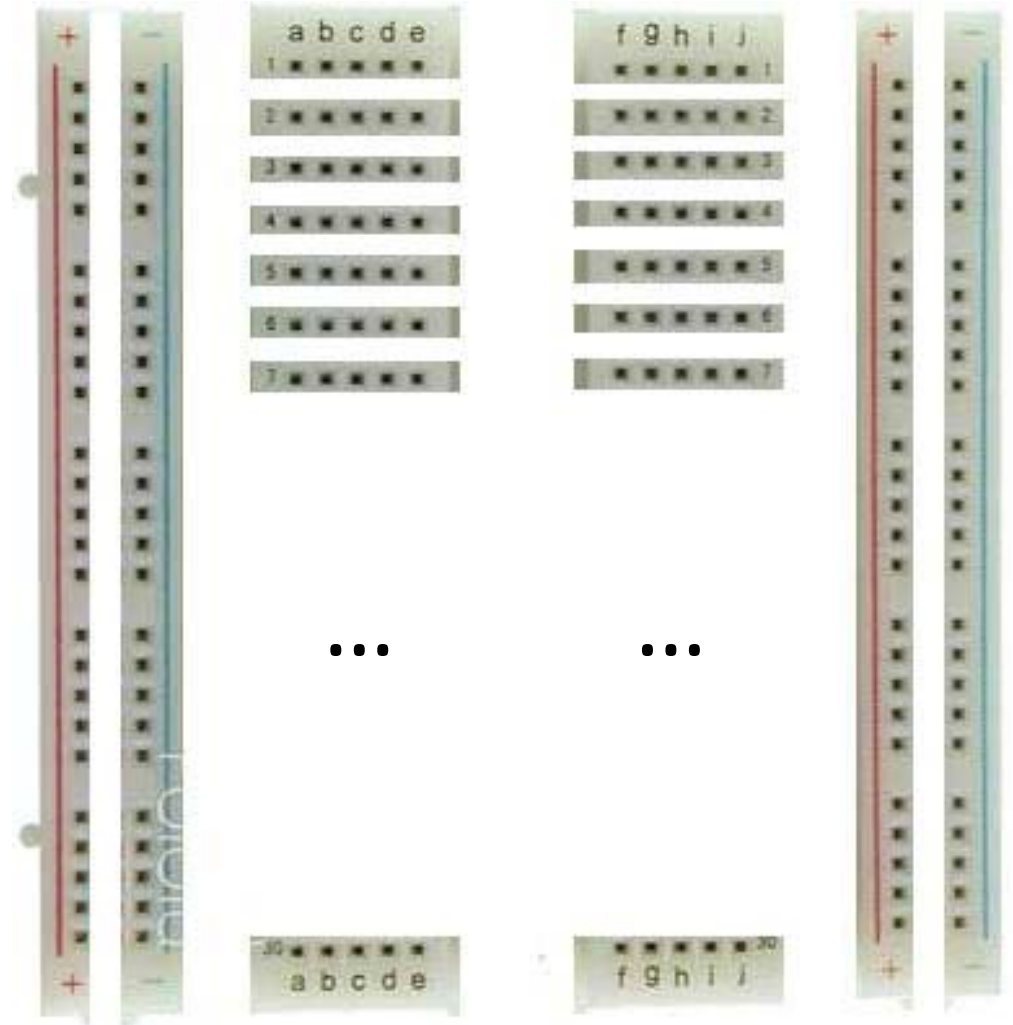


Voltage is always measured with respect to some zero. GND defines where zero is in the circuit.

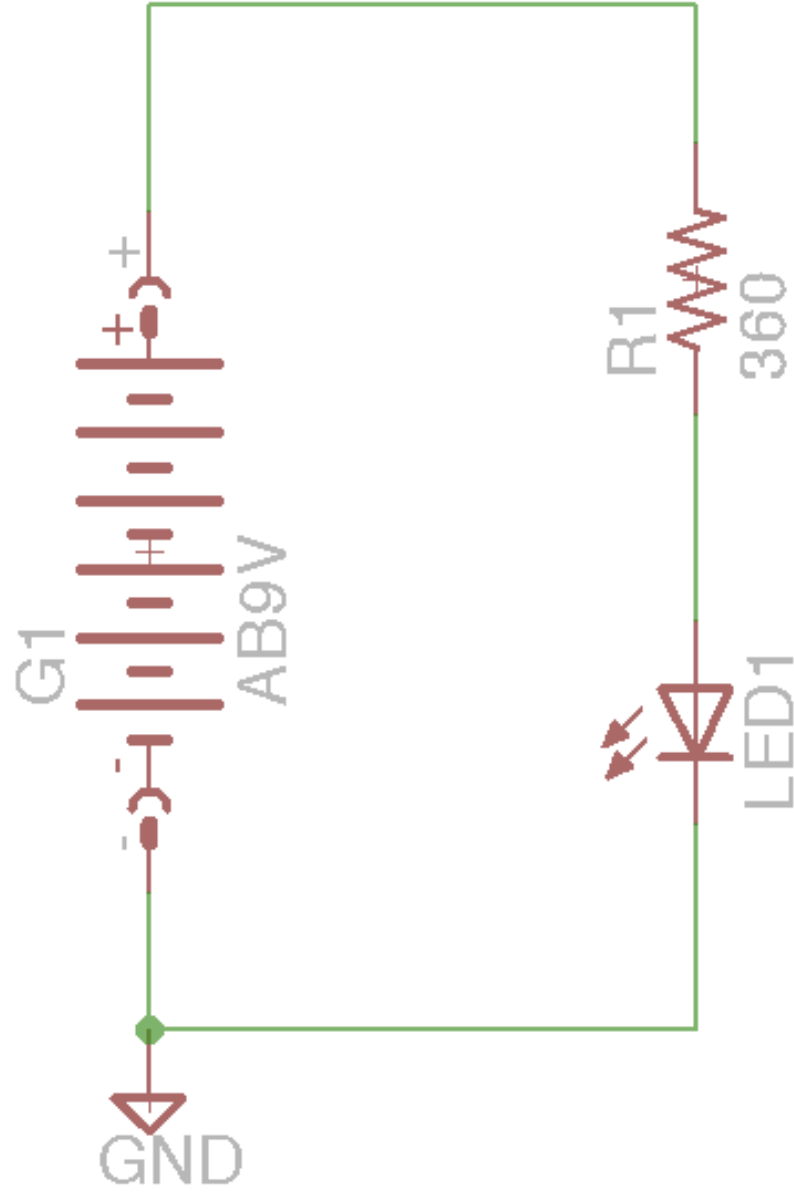
Breadboards



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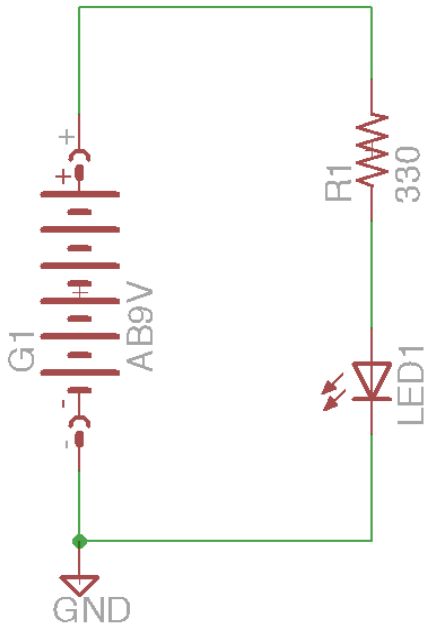
Let there be light



Kirchhoff and his laws

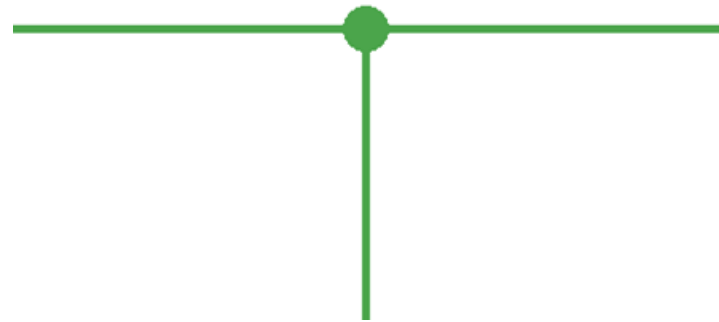
The Voltage Law:

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



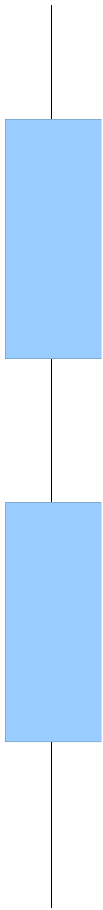
The Current Law:

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

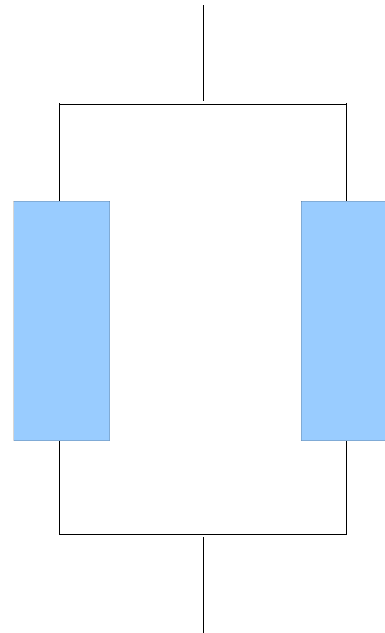


Placing Components

Series



Parallel

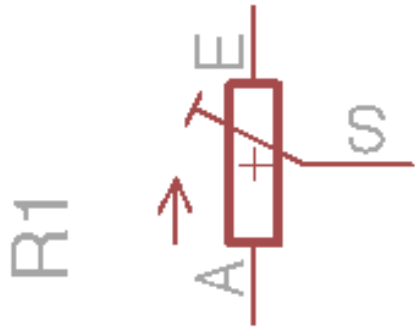


Your friend, the multimeter



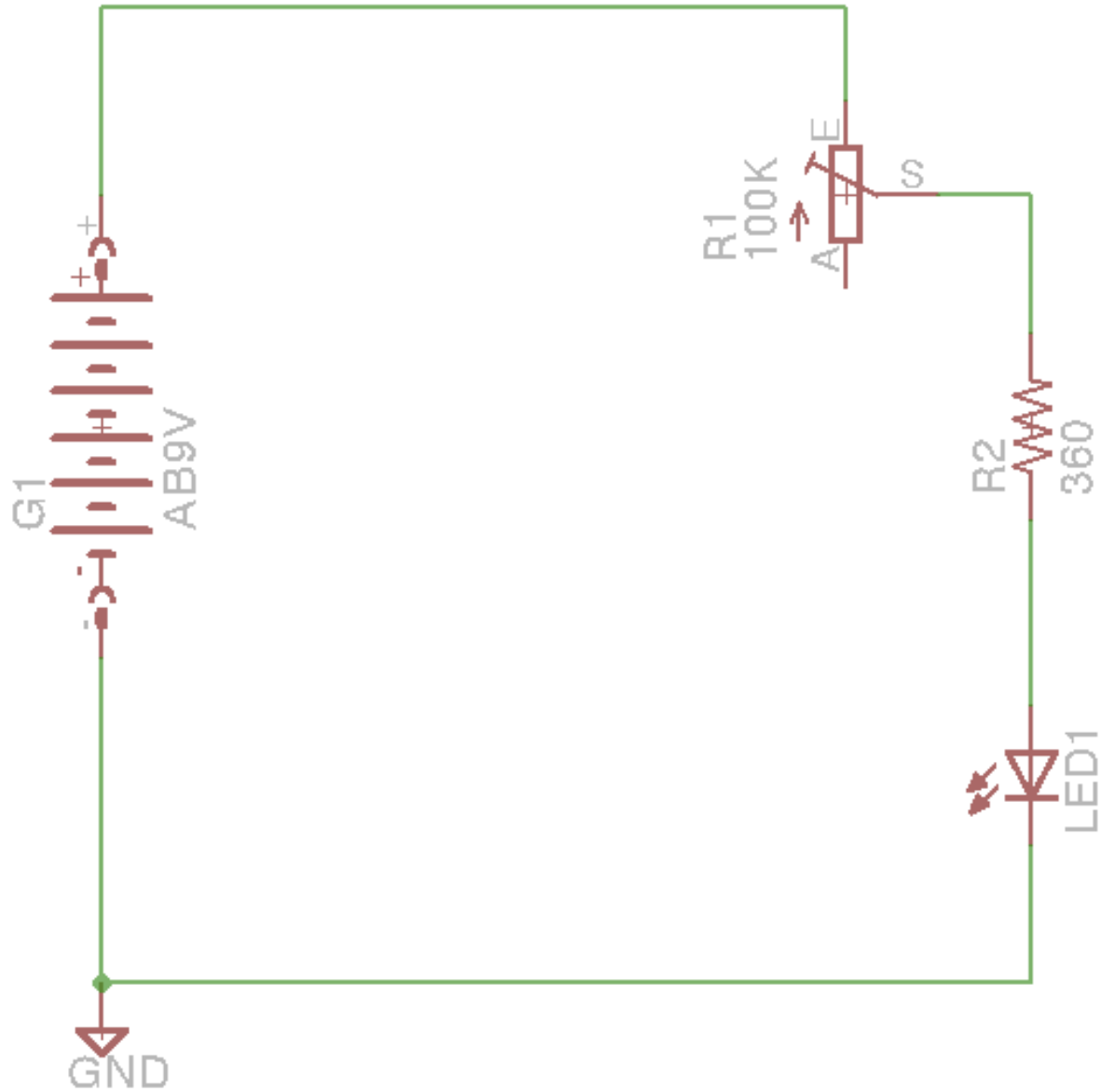
- Voltage: place probes in parallel
- Current: place probes in series

Potentiometers

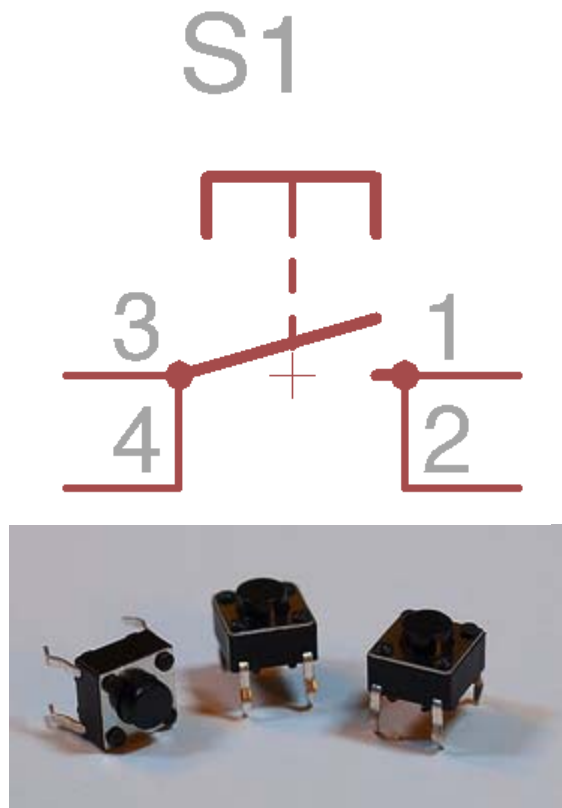


- Constant Resistance between outer leads
- Variable resistance between center lead and either outer lead.

Change the brightness

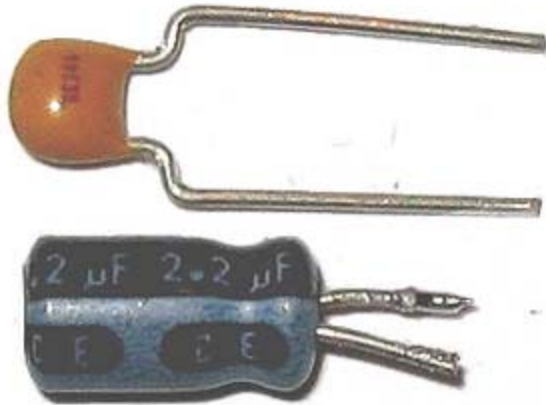
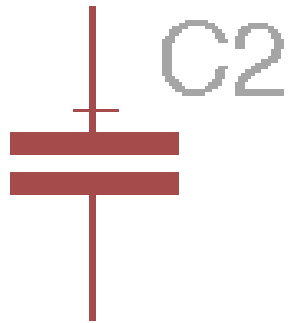


Buttons and Switches



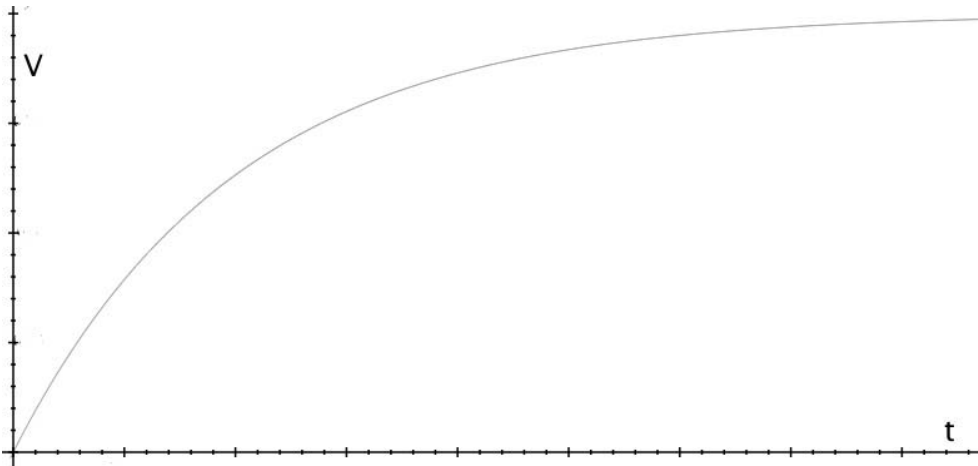
- Single Pole/Double Throw
- These are exactly what you think they are

Capacitors

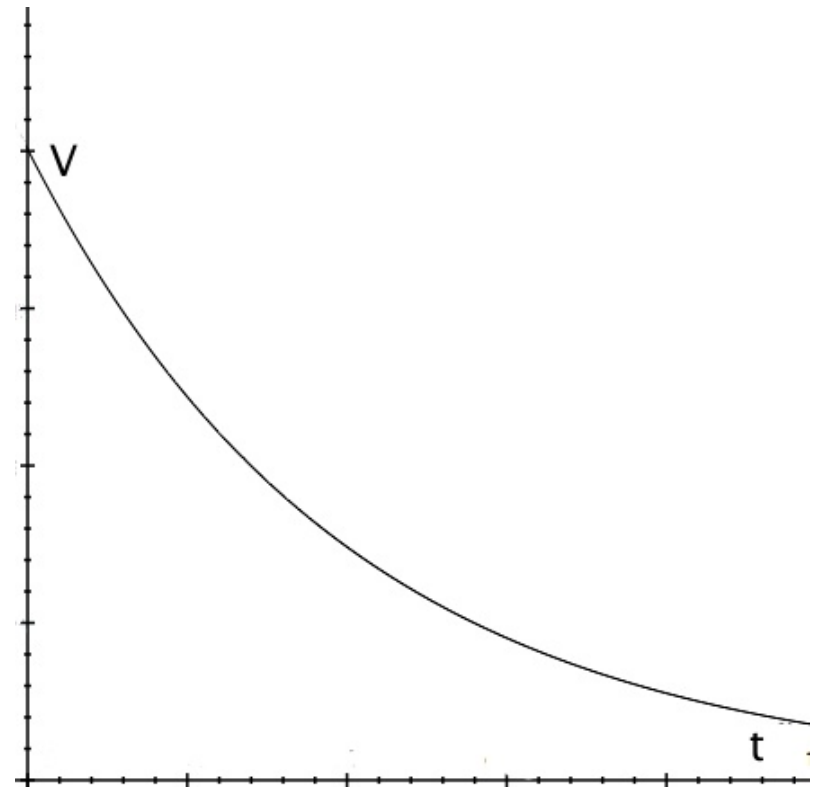


- Store voltage
- Has units of Farads
- Higher capacitance means more power can be stored
- 63% charge time is $R \times C$

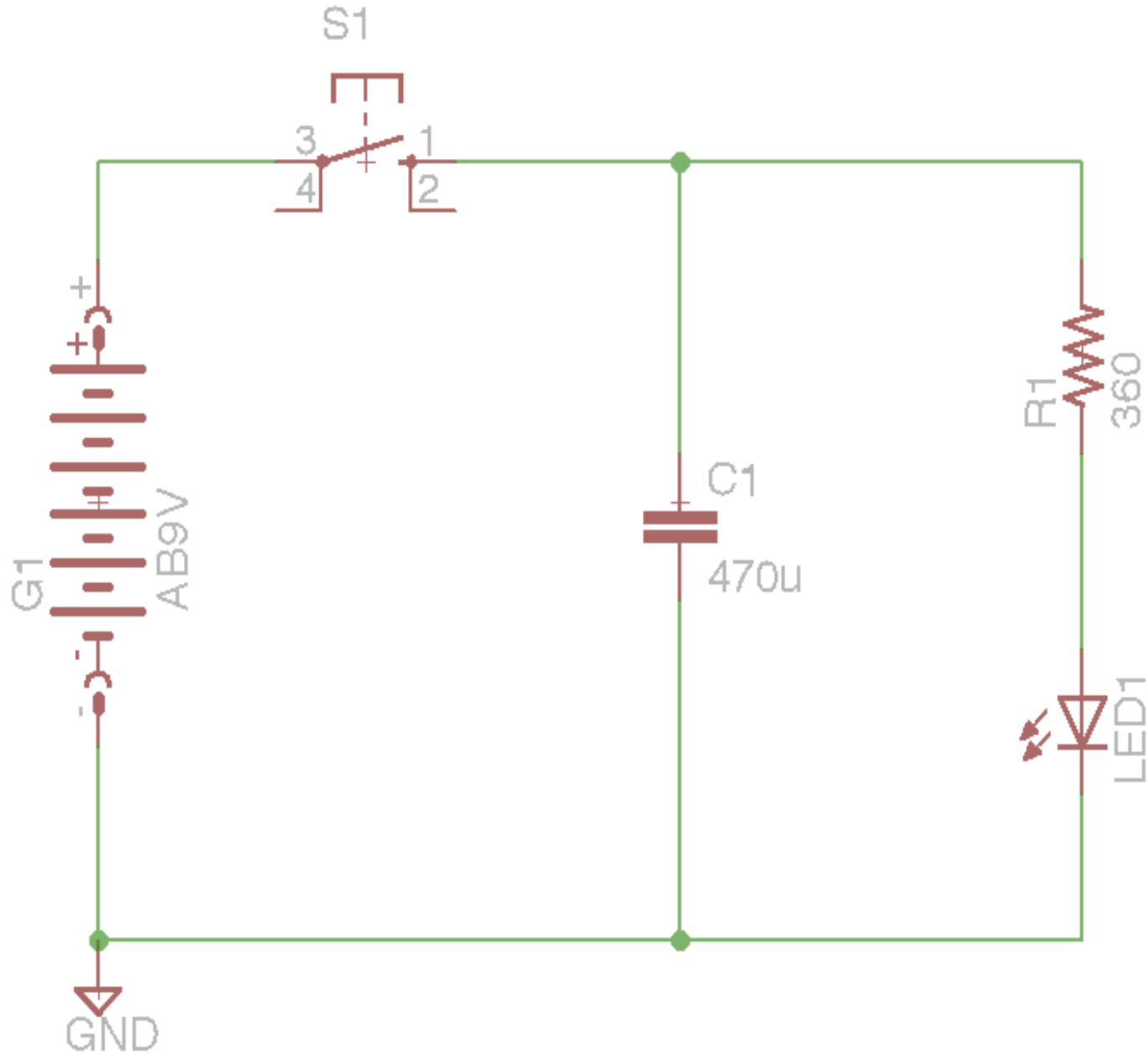
Charge and Discharge Capacitors



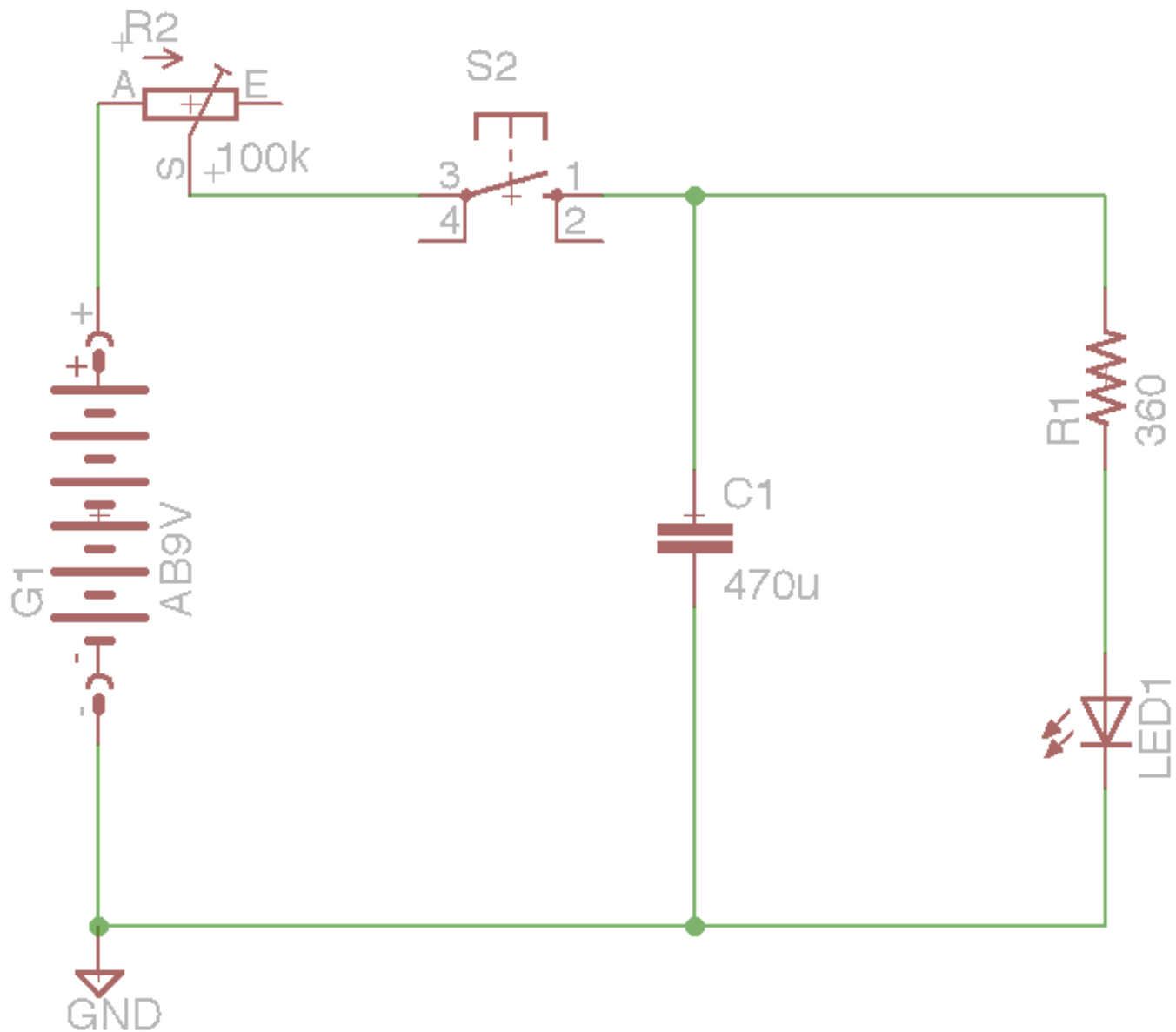
Capacitors charge and discharge asymptotically



Fading the brightness



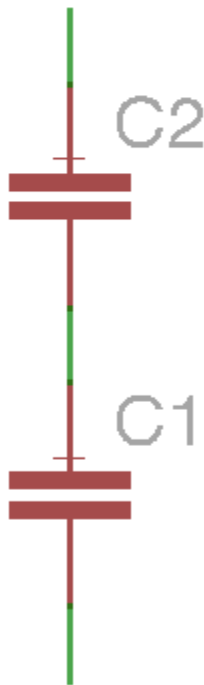
Fading in and out



Series Components

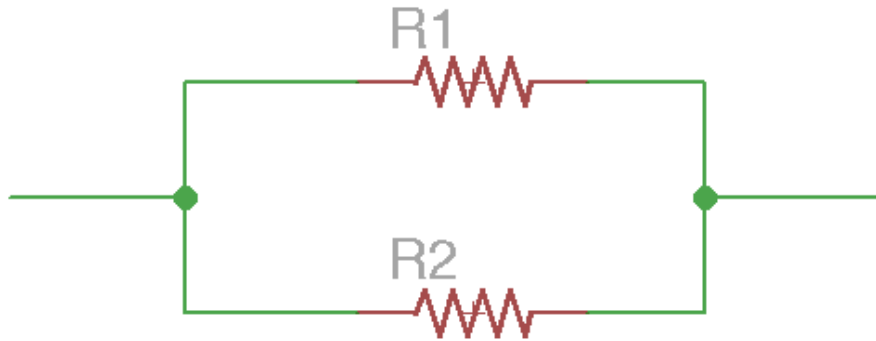


$$R_t = R_1 + R_2$$

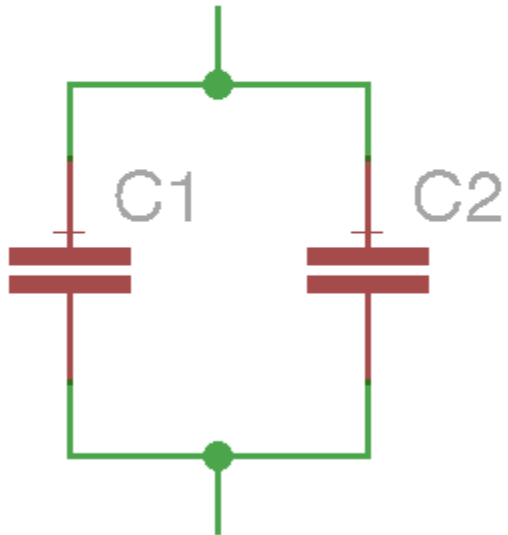


$$C_t = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2}}$$

Parallel Components

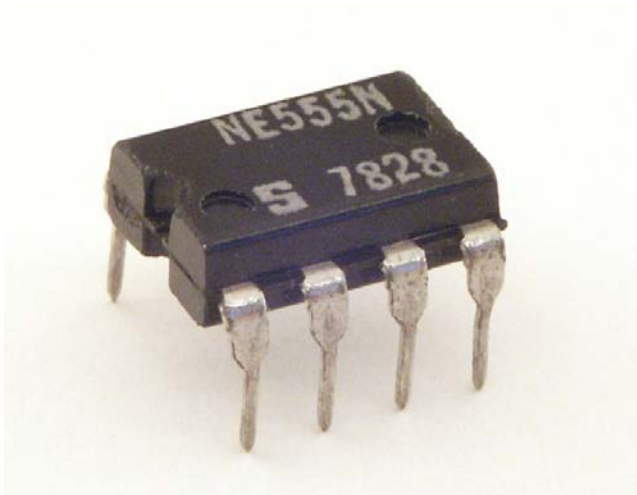
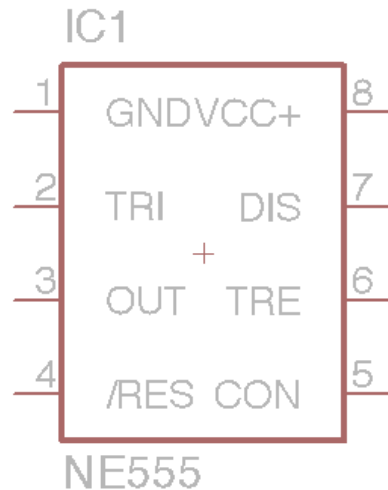


$$R_t = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$



$$C_t = C_1 + C_2$$

Integrated Circuits (the 555 timer)

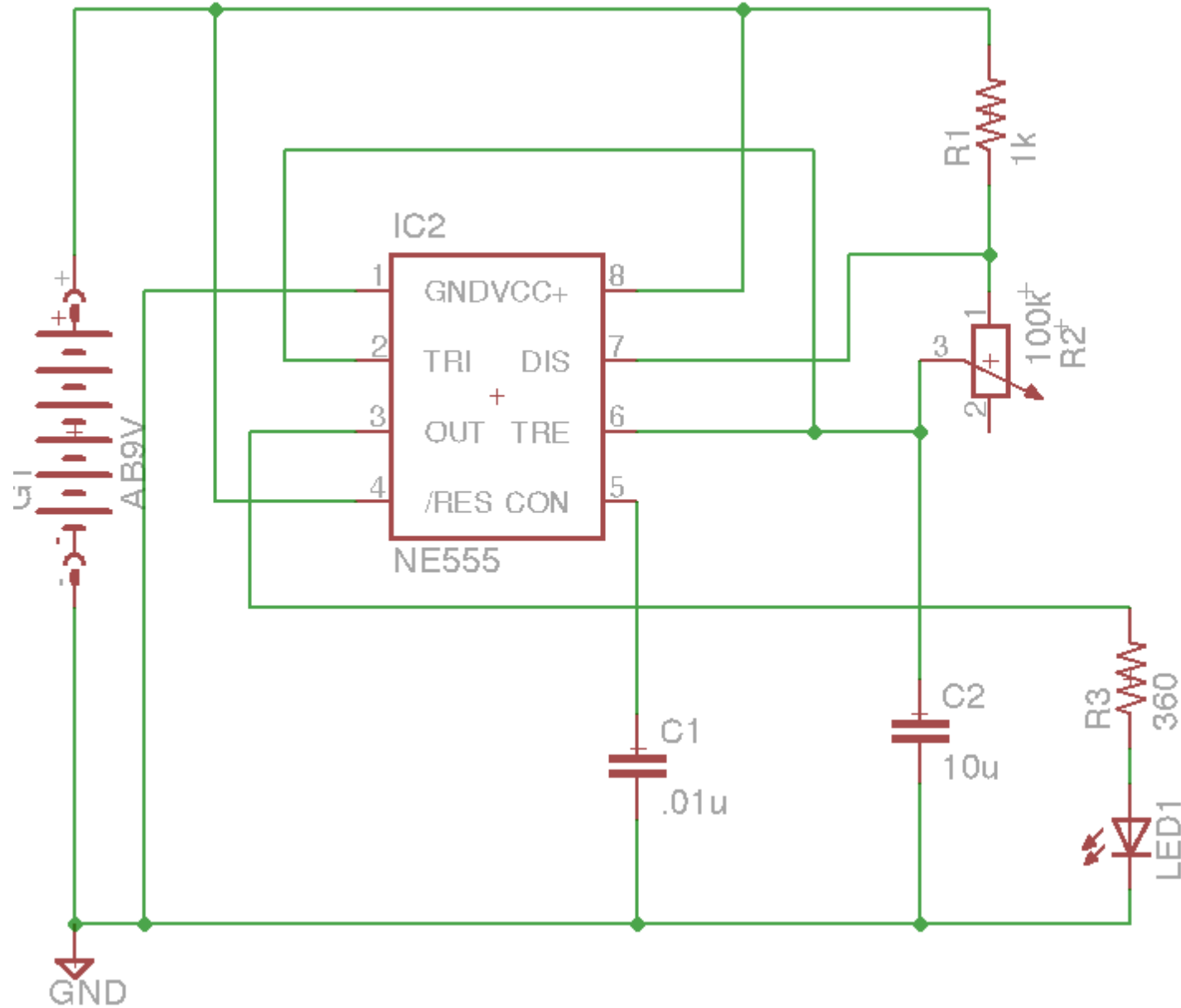


- Adjustable oscillator
- Controlled by connecting resistors and capacitors to input pins
- Choose DIP for breadboard use

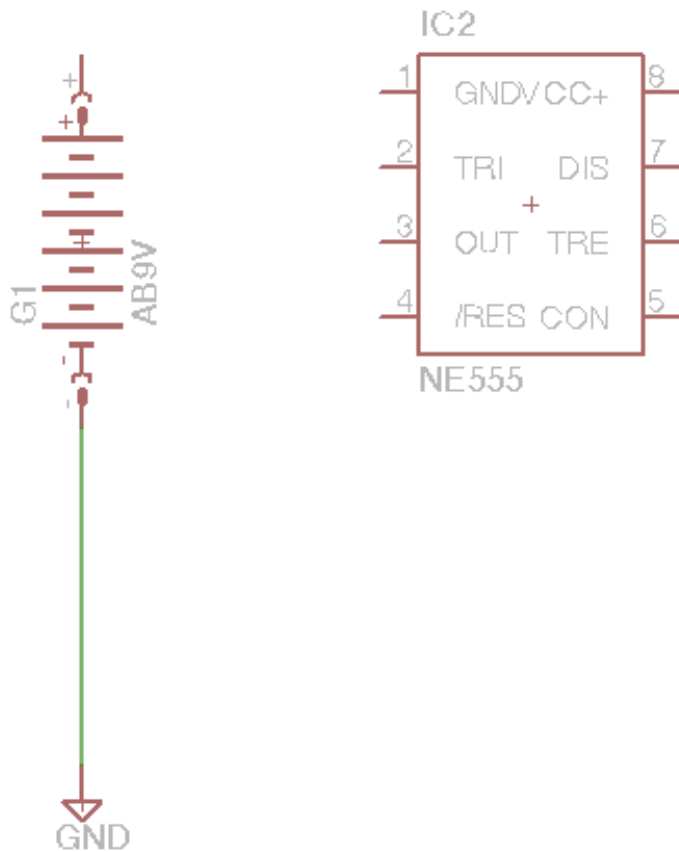
Datasheets

- 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

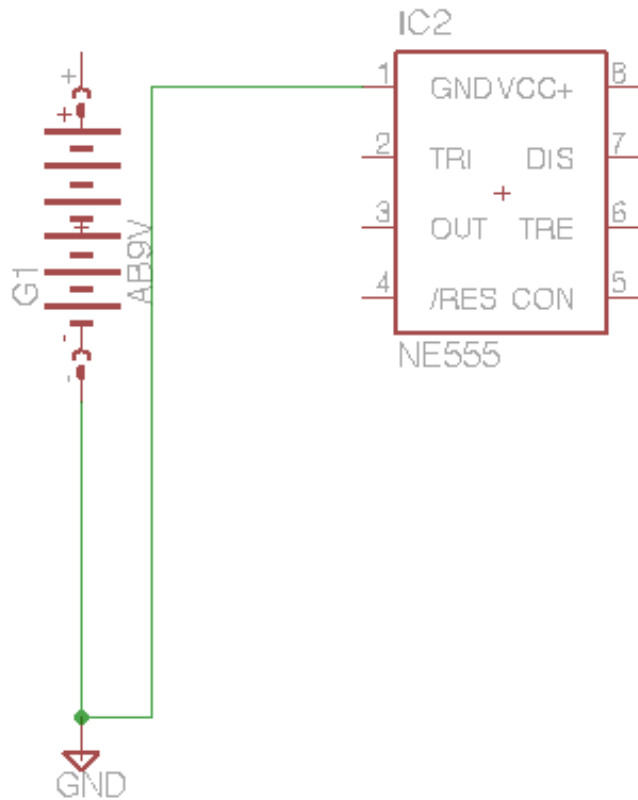
Blinking an LED



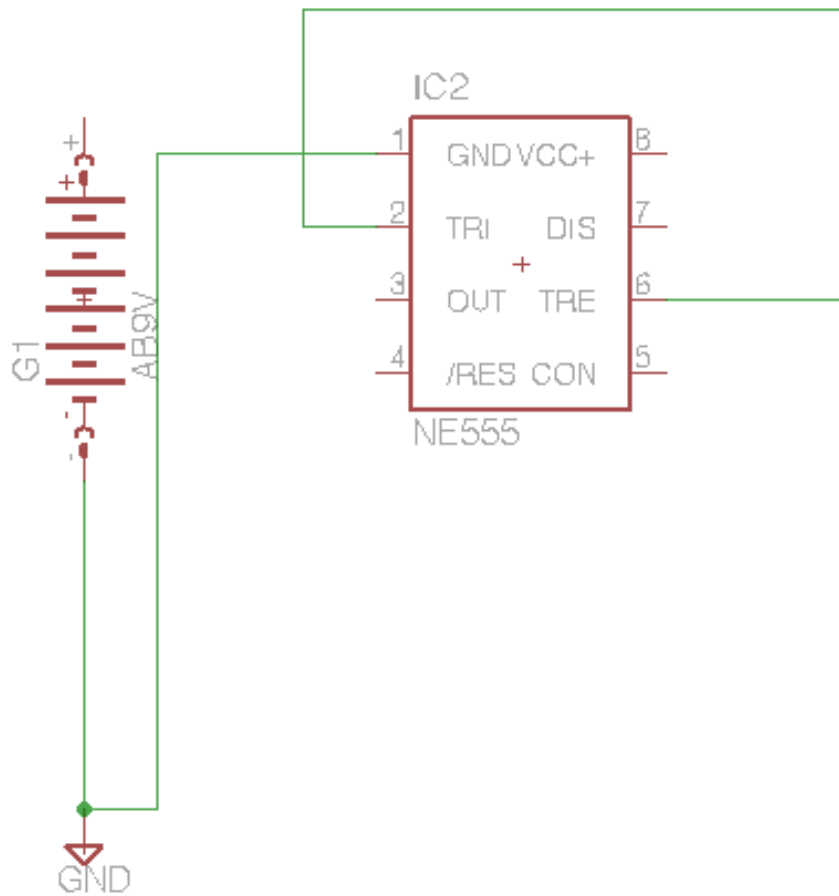
Blinking an LED



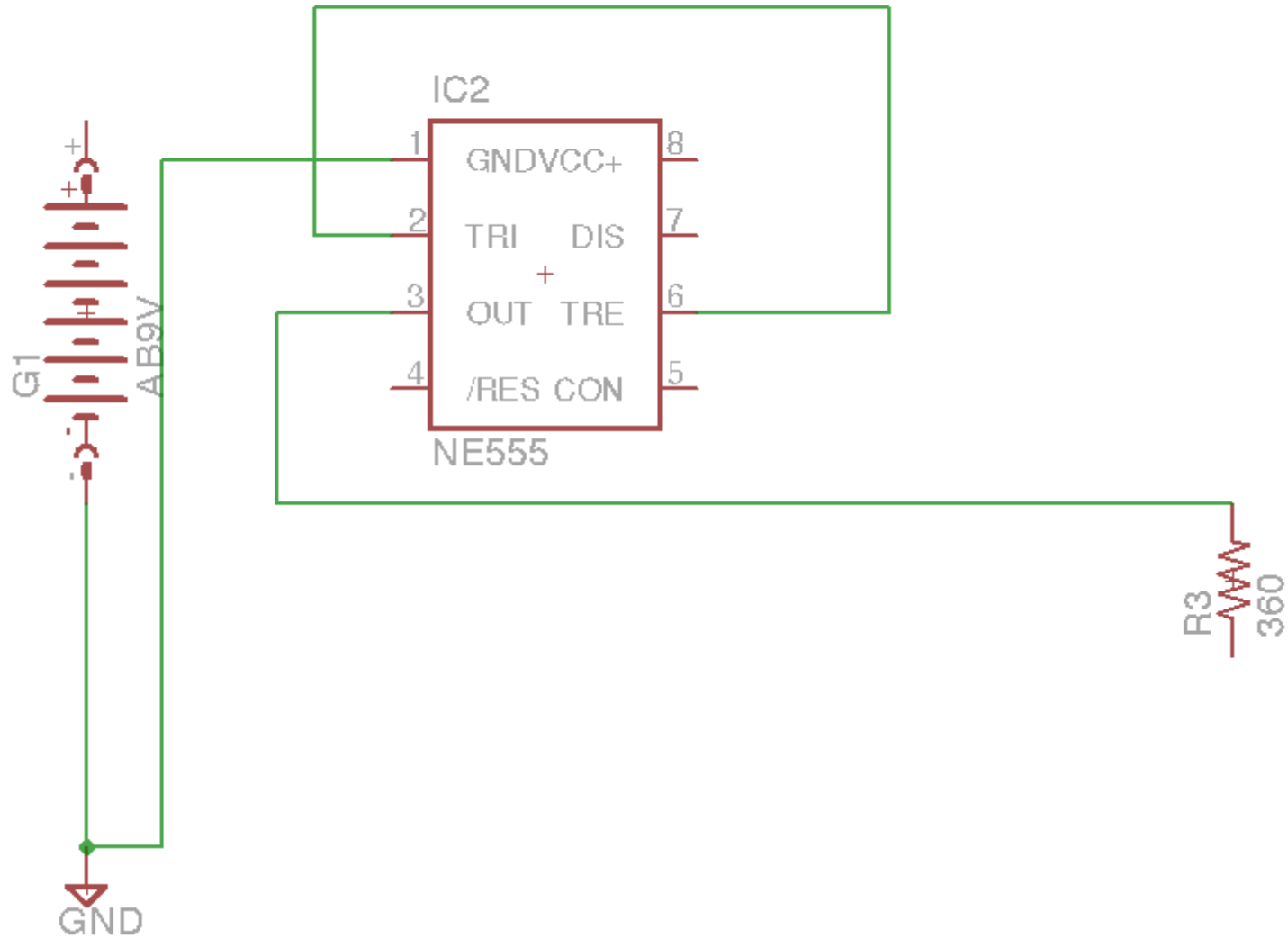
Blinking an LED



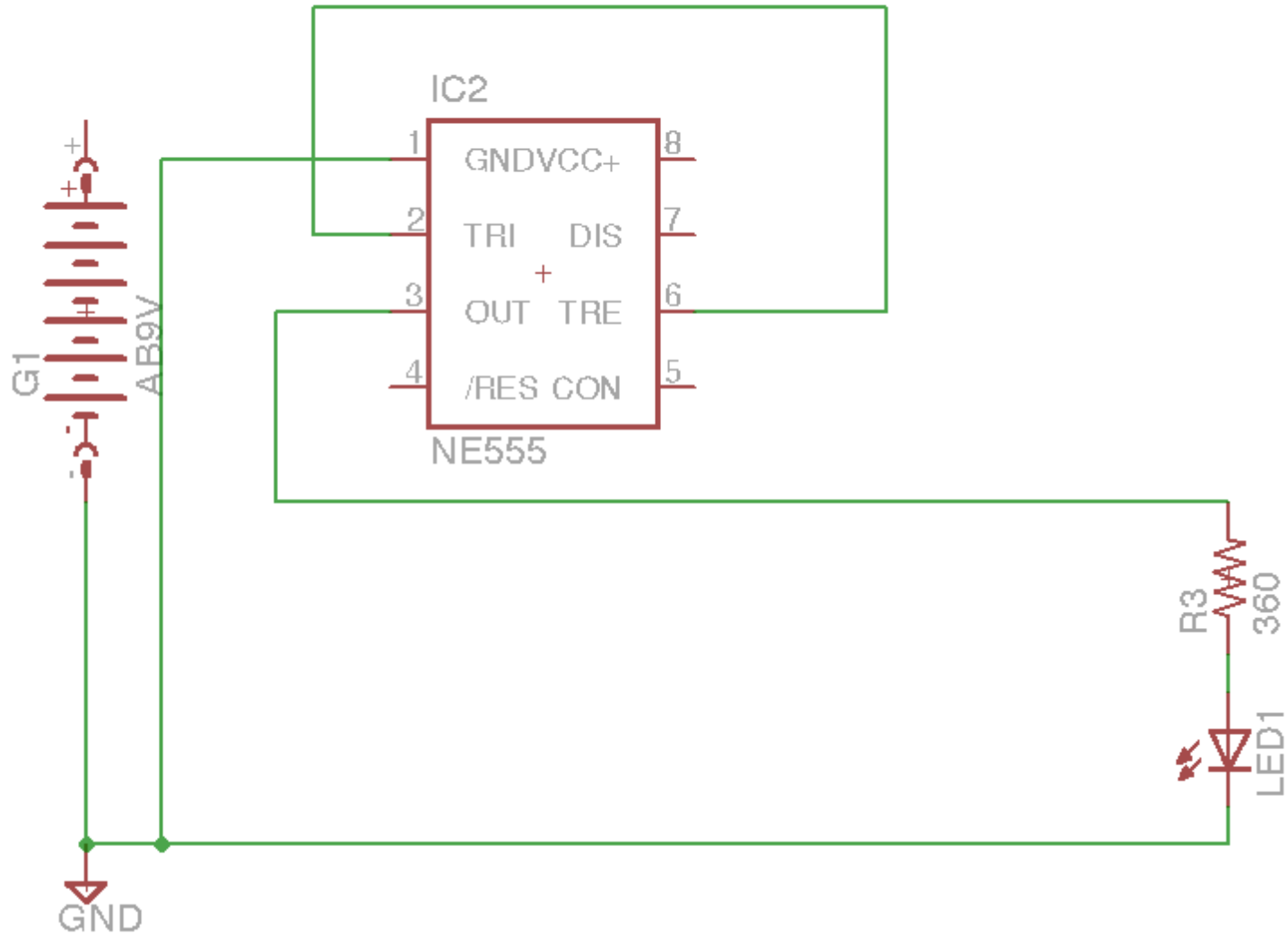
Blinking an LED



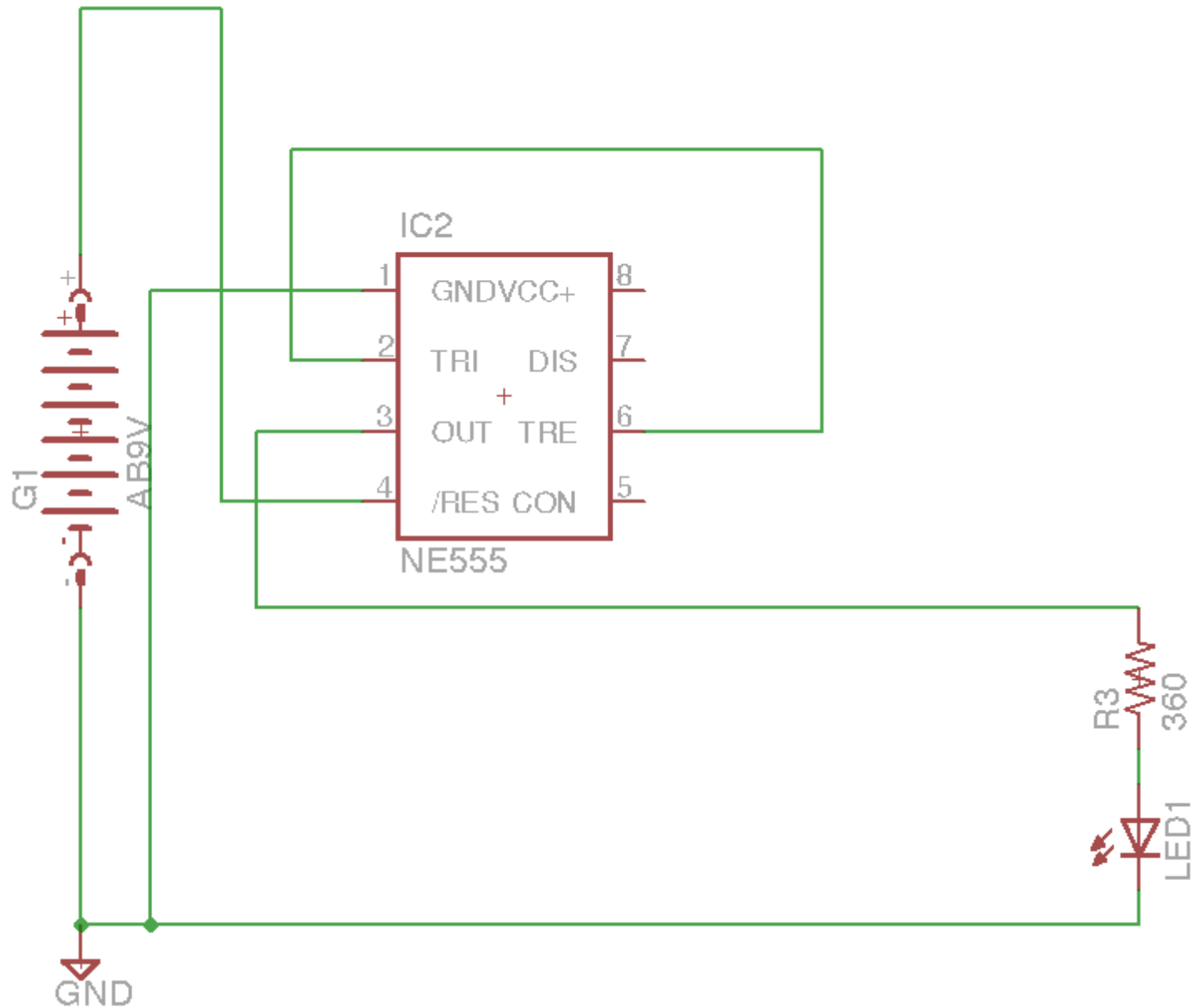
Blinking an LED



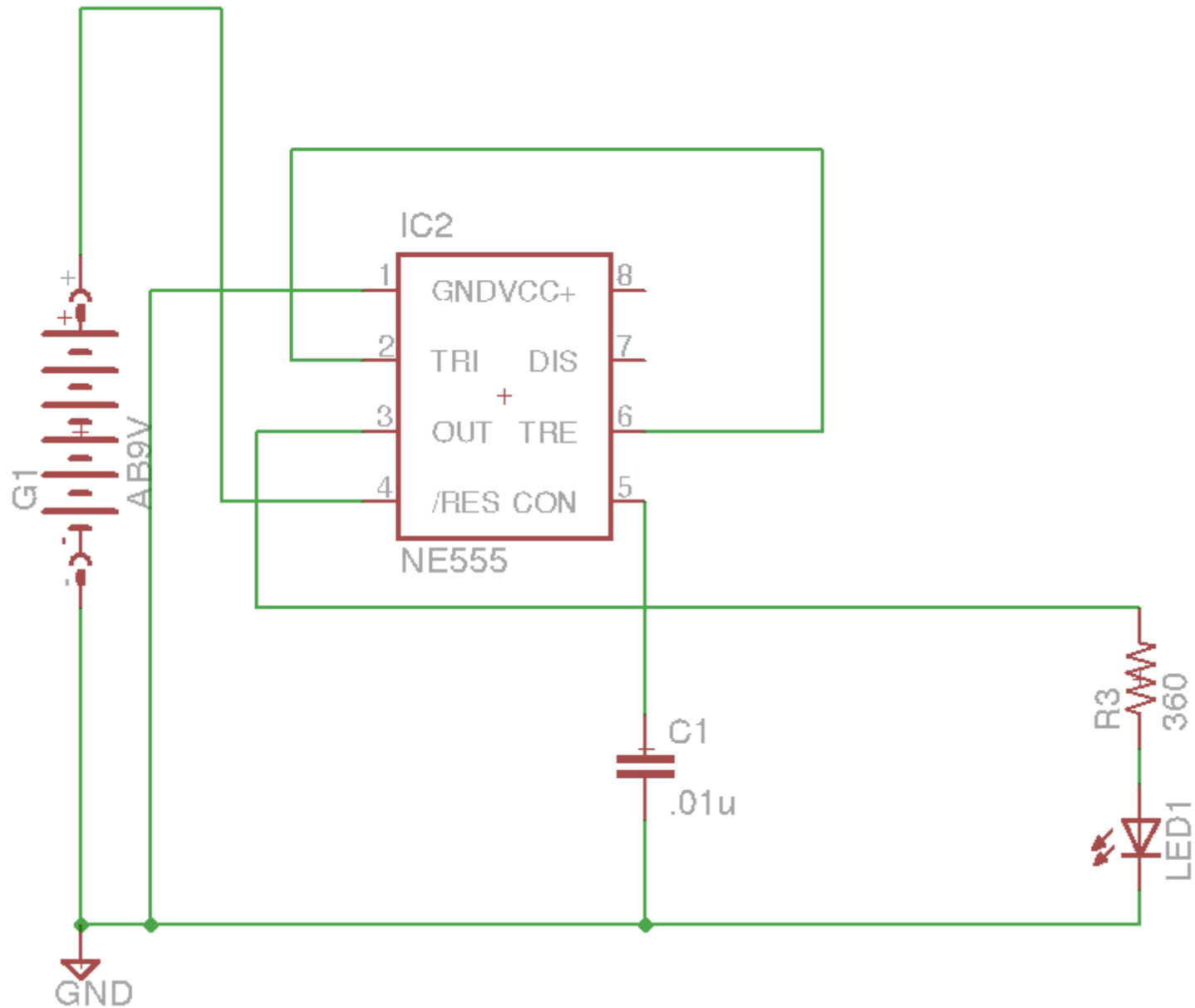
Blinking an LED



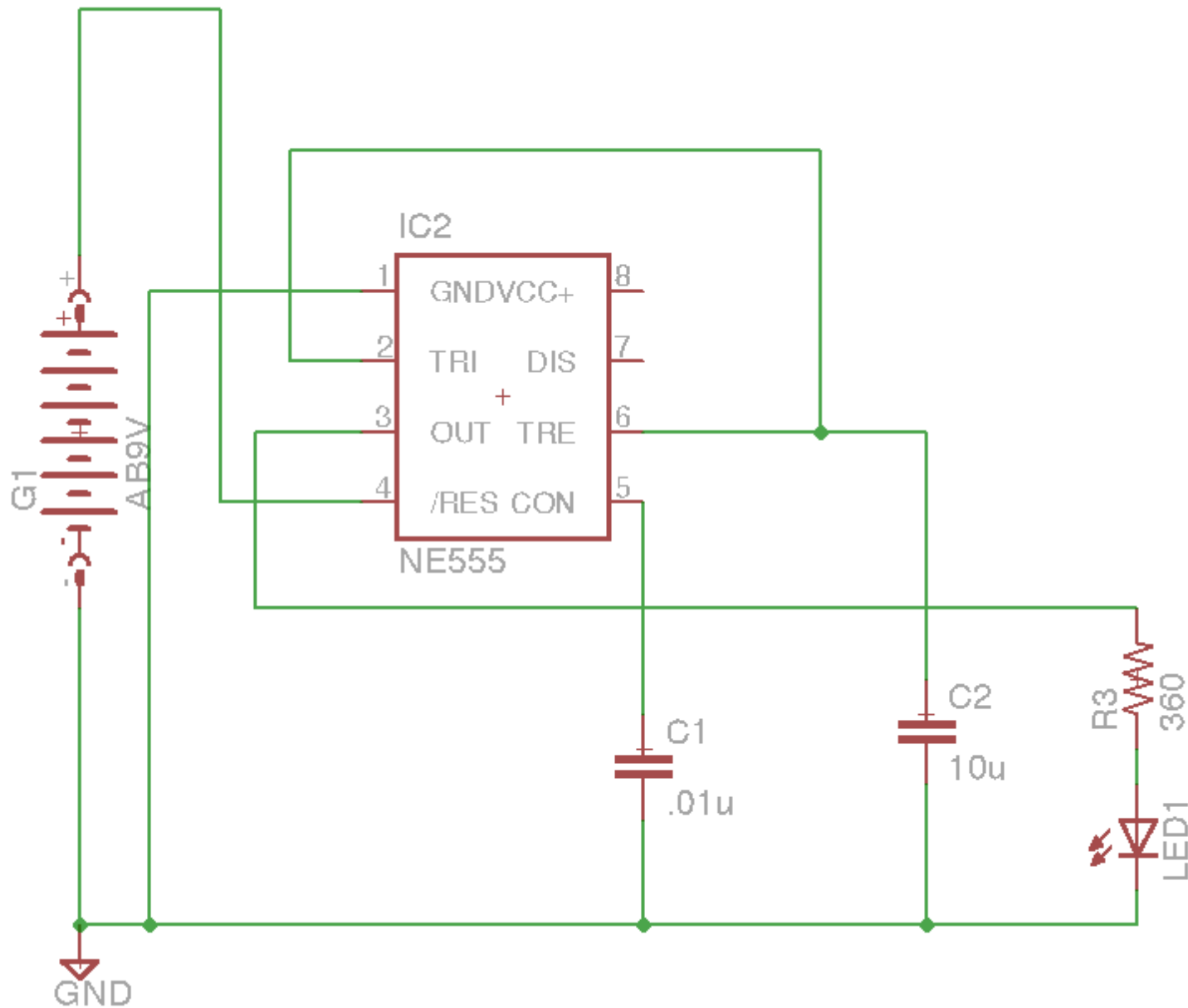
Blinking an LED



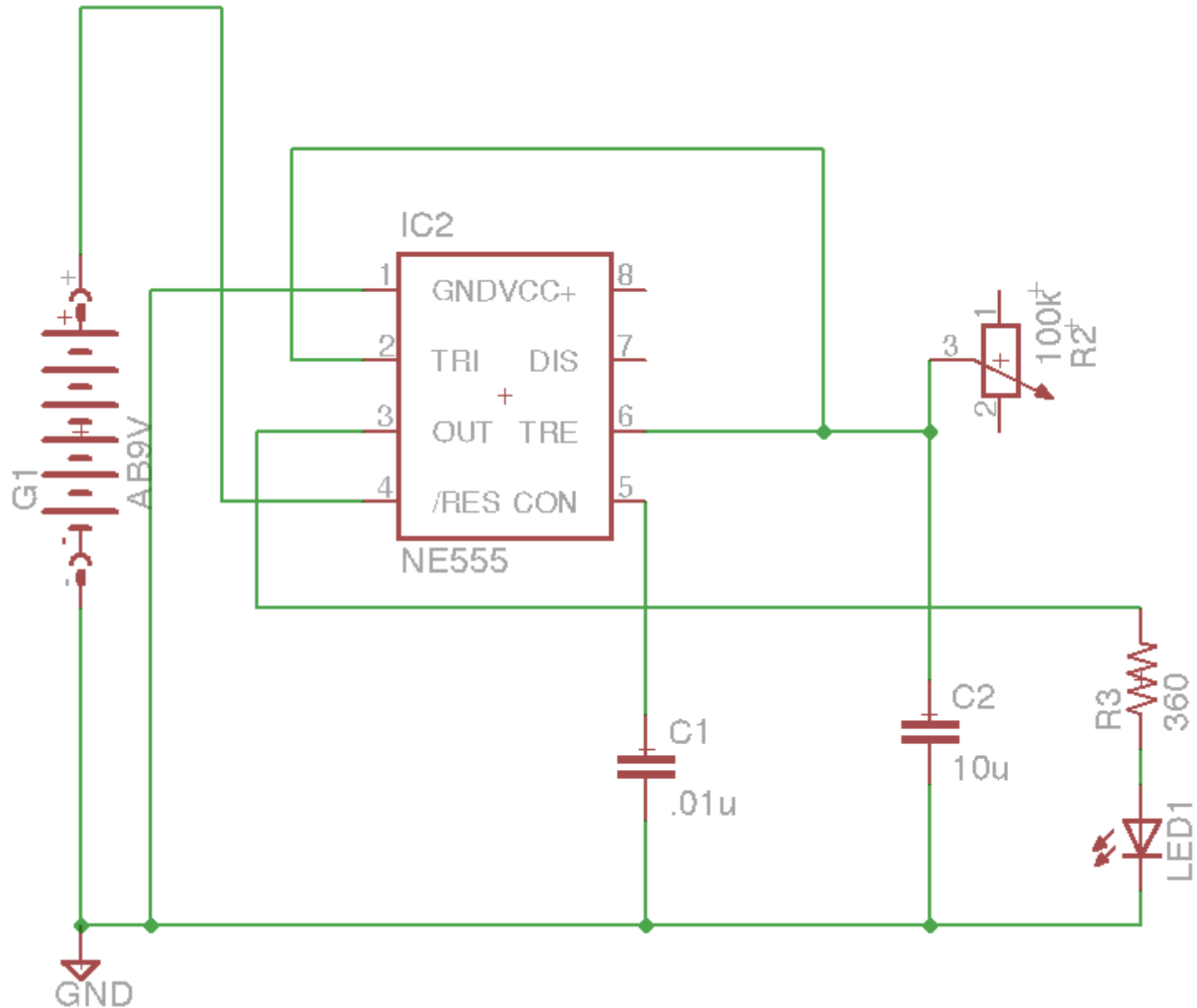
Blinking an LED



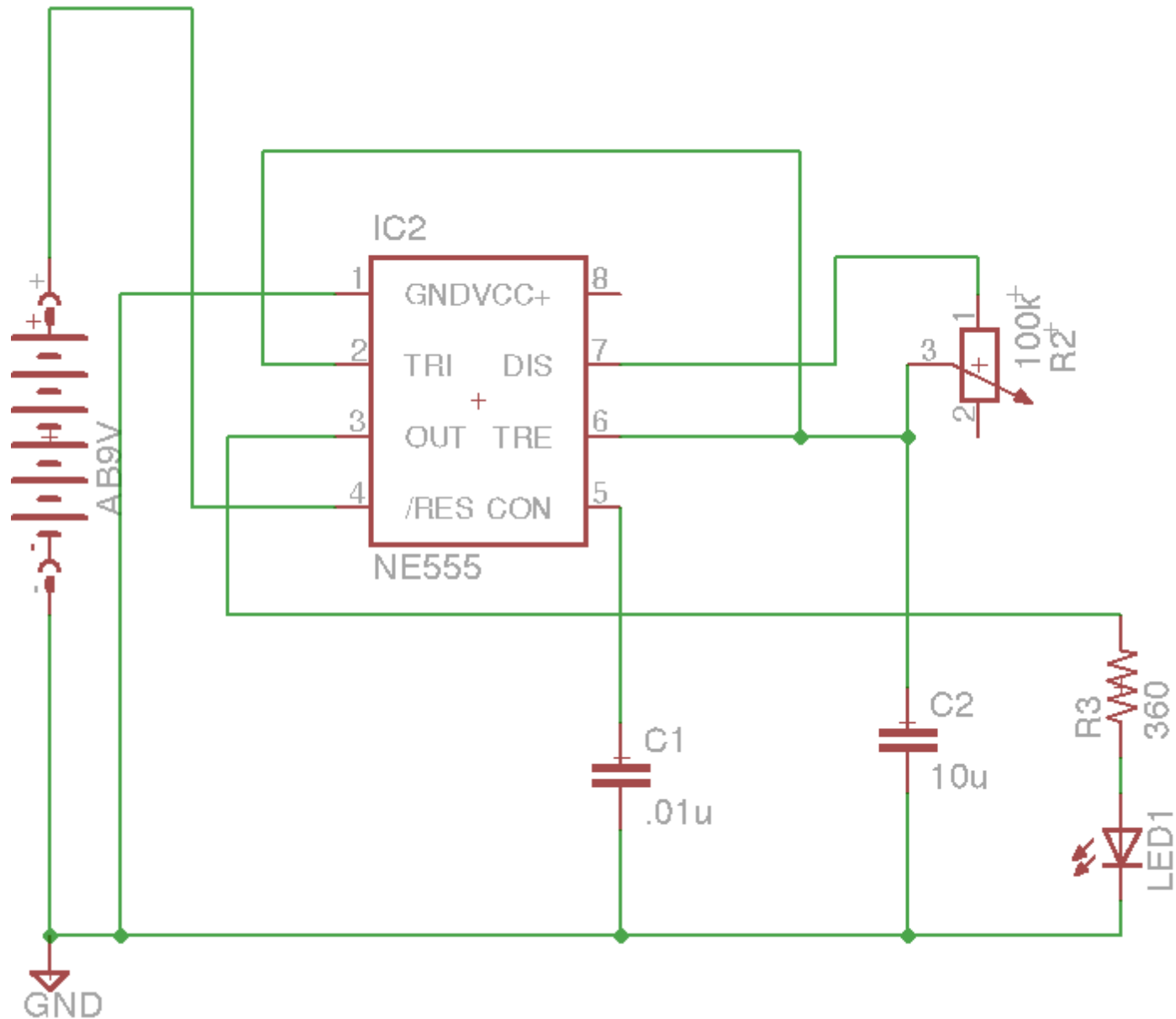
Blinking an LED



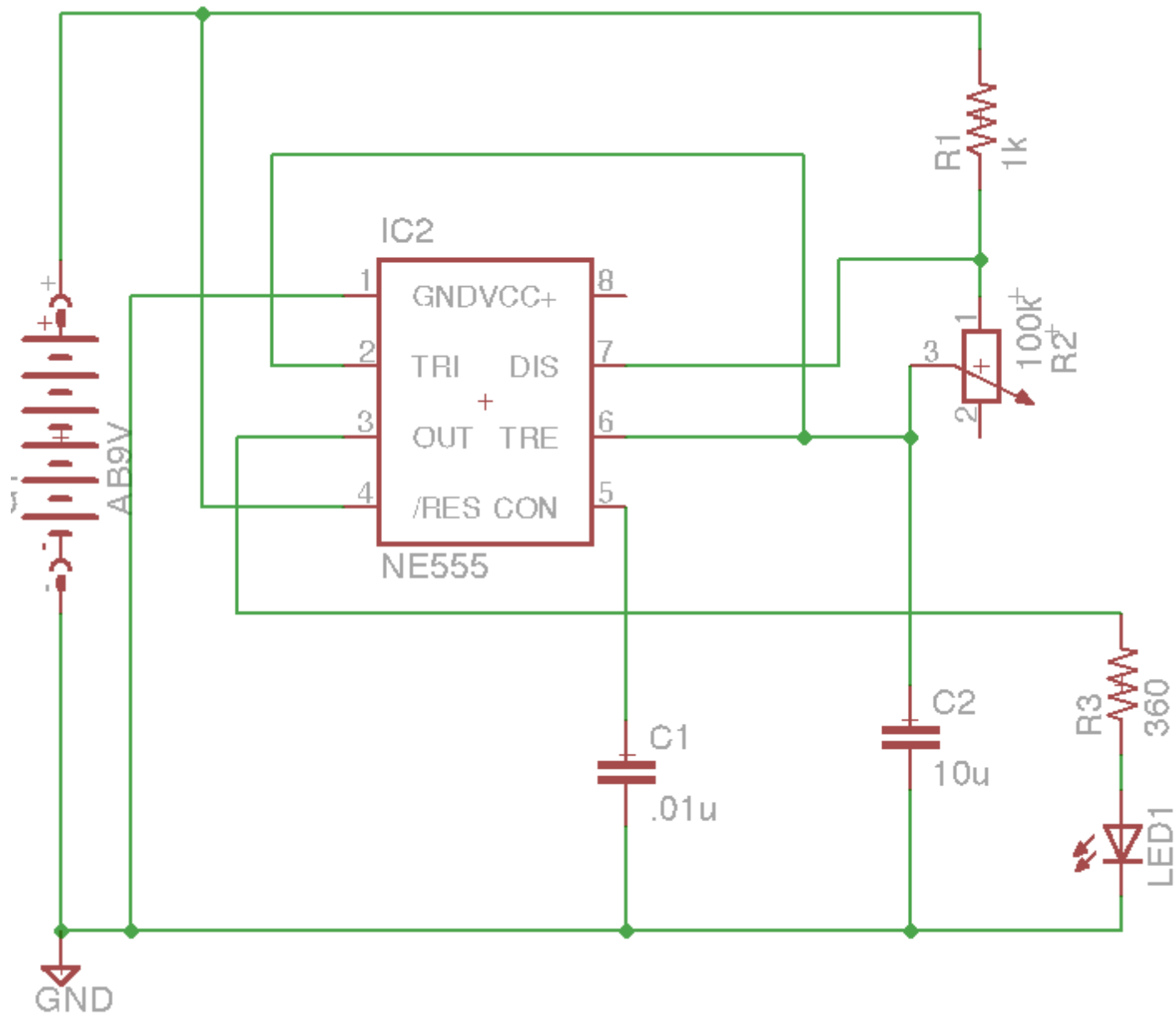
Blinking an LED



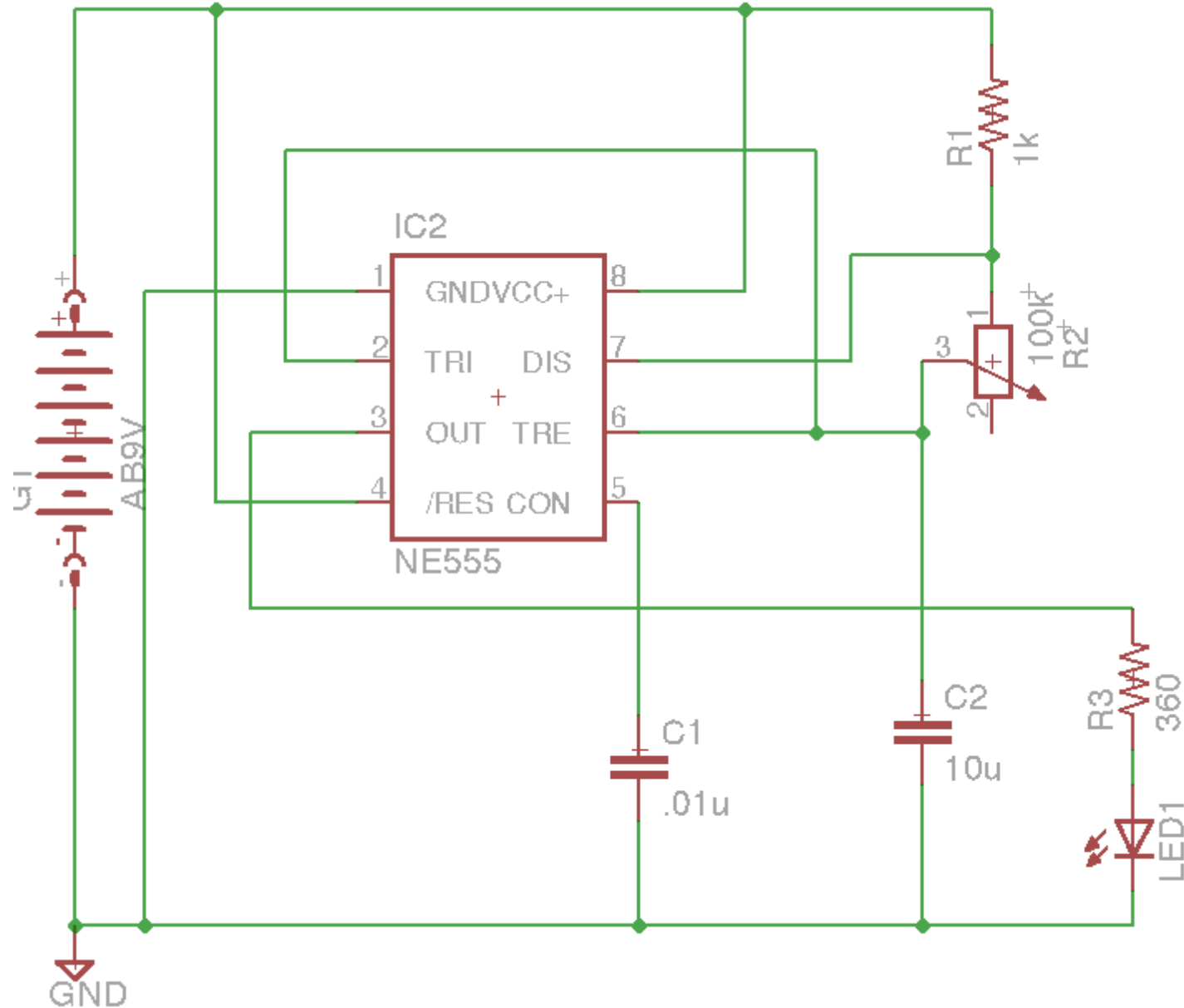
Blinking an LED



Blinking an LED



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