



Electronics for Artists

Class # 2

**Capacitors, IC's,
oscillators/timers**

Capacitors

- 1) Also called “condensers”
- 2) Made of two conductive plates (called “electrodes”) separated by an insulating layer (called a “dielectric”)
- 3) Stores and releases bits of electric charge
- 4) Charge will stay in a capacitor after power supply is removed (like a little battery)

Capacitance

- 1) Measured in Farads (after the British scientist Michael Faraday)
- 2) Farads are huge. We'll be using microfarads (millionth of a farad: μF) or nanofarads (thousand millionth of a farad: nF)
- 3) Measures the amount of charge stored in a capacitor
- 4) Voltage potential is required to pull charge to one plate while pushing it from the other.

Some types of capacitors:

Ceramic disc

-small in size and in value

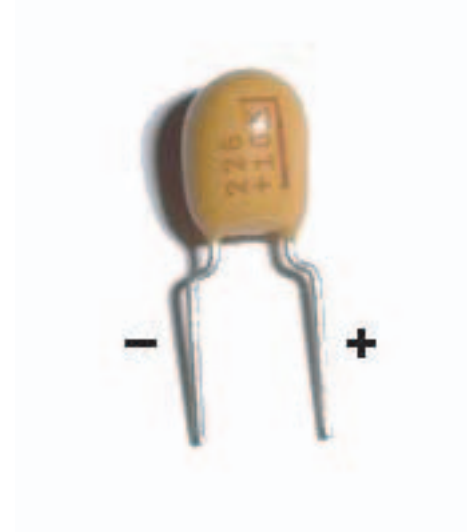
-uses a cryptic code to mark value (plenty of online charts to help you figure out values)



Tantalum

-similar in size to ceramic caps but go up to much higher charges

-typically polarized and clearly labeled



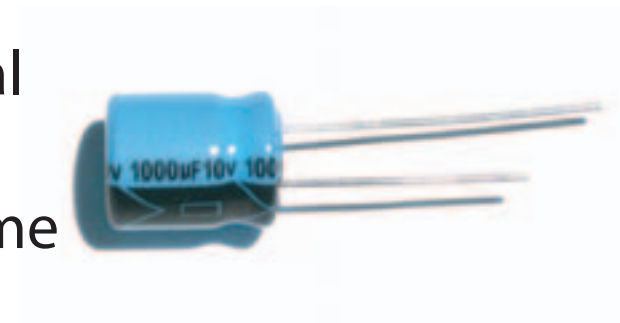
Electrolytic

-cylinder shaped

-can be radial (both legs out of the same end) or axial (one leg out of each end)

-age poorly as the electrolytic changes value over time

-clearly labeled



Capacitors in series

- 1) Just the opposite of resistors.
- 2) When capacitors are in series their total value is less than that of the smallest capacitor present

$$\frac{1}{C_t} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} + \frac{1}{C_n}$$

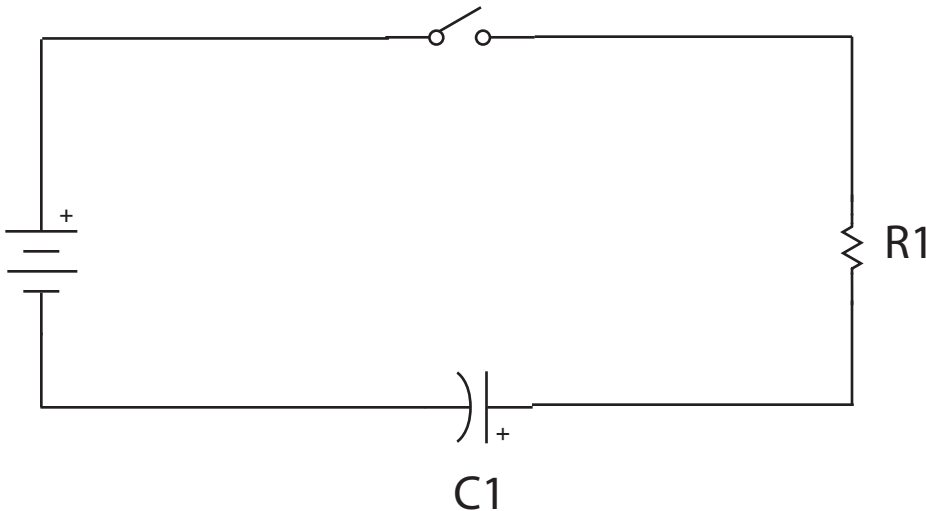
Capacitors in parallel

- 1) Just the opposite of resistors.
- 2) When capacitors are in parallel their total values add together

$$C_t = C_1 + C_2 + C_3 + C_n$$

RC Time

- 1) Capacitors take time to charge and time to discharge depending on the amount of current
- 2) The time to charge and discharge can be controlled with resistors
- 3) Charge time (to 63.2% of supply voltage) and discharge time (to 36.8% of supply voltage) is equal to $R \times C$ in seconds.



If $R1 = 10k$ and $C1 = 1000\mu F$ then the time to charge $C1$ to 63.2% of supply voltage (or about 2/3) and discharge to 36.8% (or about 1/3) is 10 seconds:

$$T = R1 \times C1$$

$$T = 10,000 \times 0.001$$

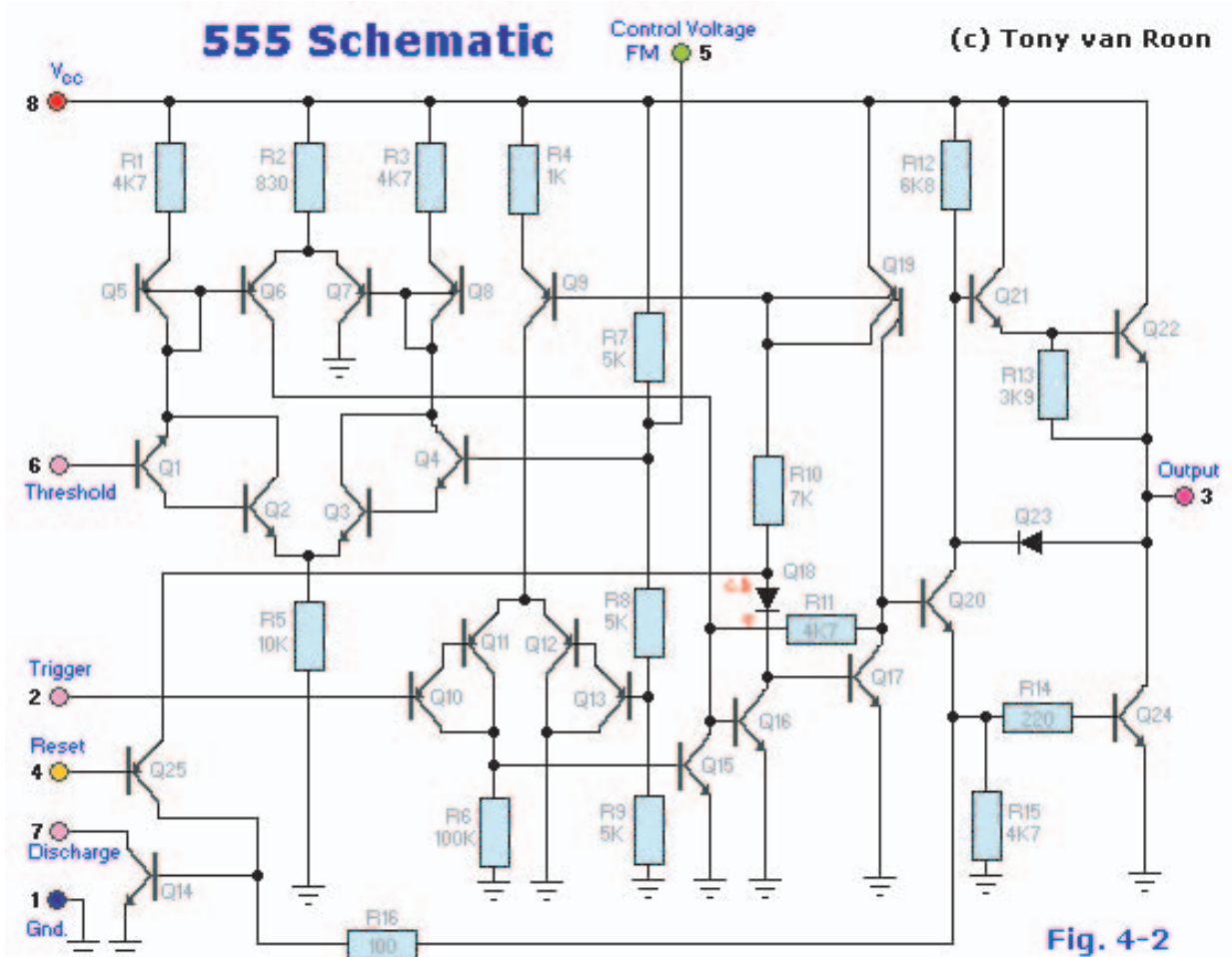
$$T = 10 \text{ seconds}$$

Integrated Circuits (ICs)

- 1) ICs are a bunch of teeny tiny components crammed into a wee package
- 2) A circle or notch on one end always indicated orientation
- 2) today we'll use the 555 timer (named for the three 5k resistors at the heart of it)
- 3) The 555 timer contains 23 transistors, 2 diodes and 16 resistors on a small silicone chip

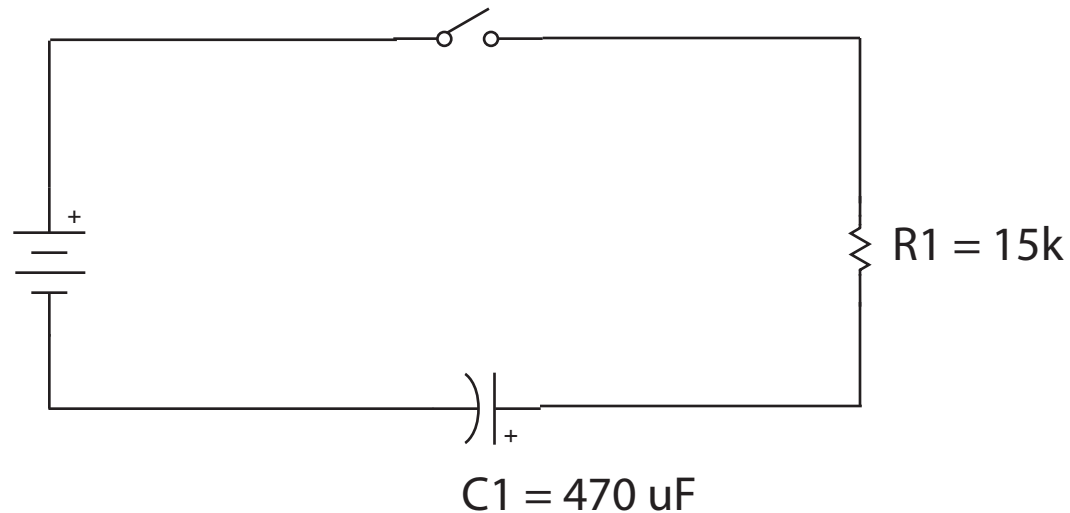


PositiveOffset.com



Lab 1

- 1) Work in pairs or teams
- 2) Someone needs a time keeping device (watch, stopwatch, steady counting, etc.)
- 3) Watch and record voltage across C1 at 5, 10, 15, 20, 25, 30, 40, 50 and 60 seconds turning on and turning off.
- 4) Try it with a 220uF cap instead

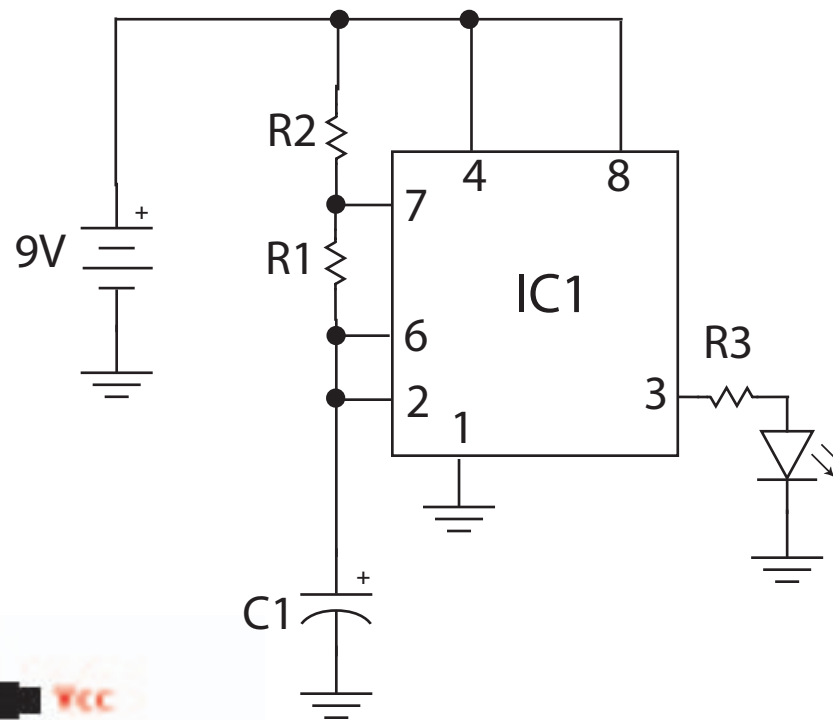


Lab 2

- 1) Astable oscillator
- 2) RC time
- 3) Everyone loves blinky lights

$$\begin{aligned} T1 (\text{high}) &= 0.7 \times (R1+R2) \times C1 \\ &= 0.7 \times (100000 + 100000) \times 0.00001 \\ &= 0.7 \times 200000 \times 0.00001 \\ &= 1.4 \text{ seconds} \end{aligned}$$

$$\begin{aligned} T2 (\text{low}) &= 0.7 \times R1 \times C1 \\ &= 0.7 \times 100000 \times 0.00001 \\ &= 0.7 \text{ seconds} \end{aligned}$$



R1 = 100k
R2 = 100k
R3 = 340
C1 = 10uF
IC1 = 555timer

R1 = 10k
R2 = 4.7k
R3 = 340
C1 = 10uF
IC1 = 555timer

