ECE 214 – Electrical Circuits Lab Lecture 9

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Announcements

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Lab #9 – Astable Multivibrator

- In a power supply you buy, there's not going to be a function generator inside.

Multivibrators

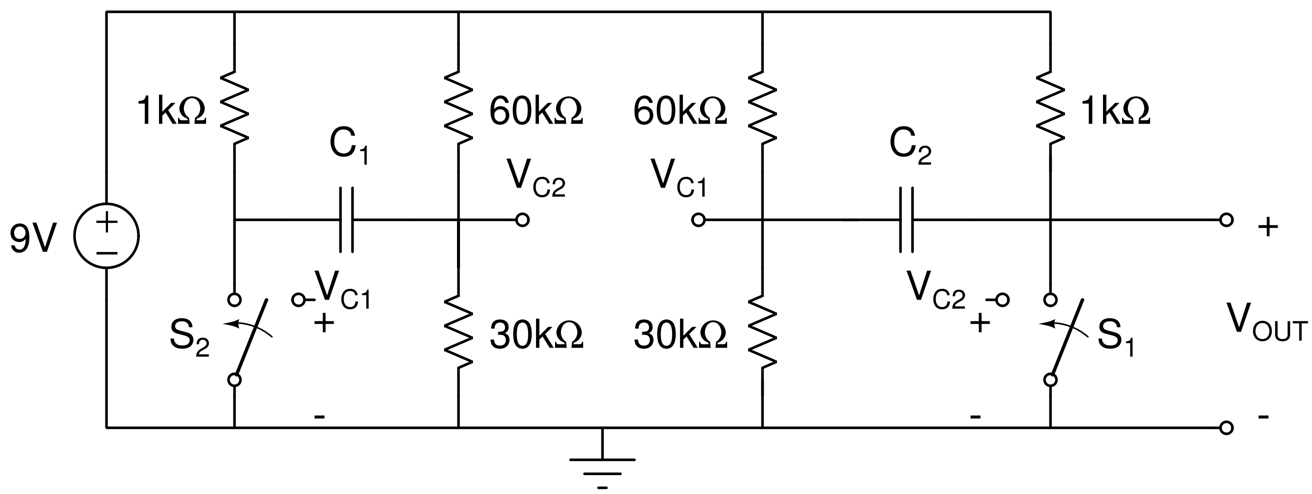
- Multivibrator? Basically means a periodic symbol with a multi-frequency component (i.e. not a sinusoid). Square and Triangle waves qualify.

- Astable? No stable state, oscillates between

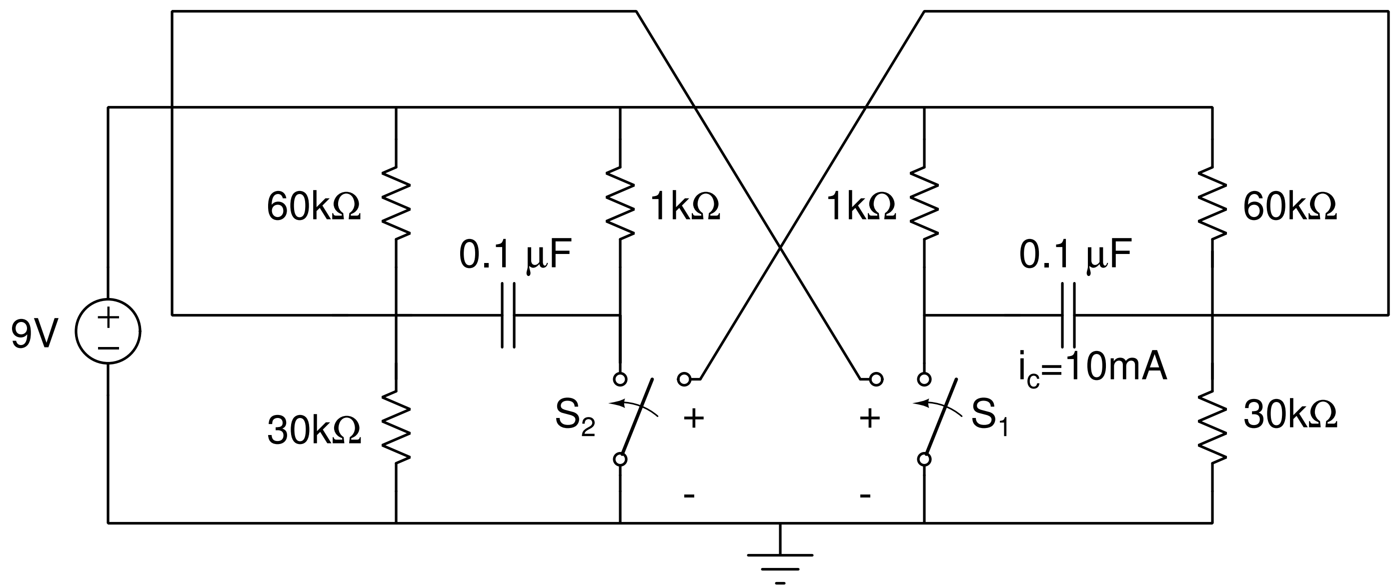
- Monostable? One stable state. Can trigger to unstable but will return to stable.

- Bistable? Two stable states. A flip-flop.

Basic Astable Multivibrator

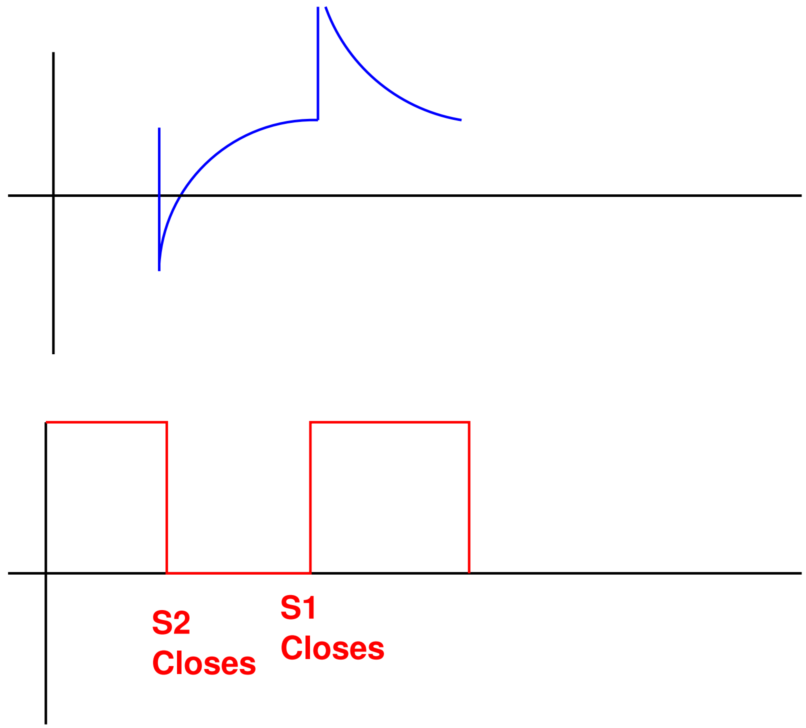


Pre-Lab



The pre-lab is a bit extensive again.

1. Explain how the function works.



With switch open (output 9V), capacitor charges to 9V on one side, 3V on other.
When switch closes (output 0V), capacitor voltage now in reverse, 0 and -6V.

Other side now 2-6=-4V. Discharges until back down to +2V which will flip switchs back.

2. Derive an equation describing the frequency based on function values.
$(V_{switch} - 3) = V_C e^{\frac{-t}{RC}}$
$-1 = -6e^{\frac{-t}{RC}}$
R in this case is the Thévanin equivelent $R2 \parallel R3$ $(30k \parallel 60k) = 20k$
This is just for t_1. Can also solve for t_2, then $T = t_1 + t_2$.

3. If $C_1 = C_2 = 0.1\mu F$, what is the output frequency?

4. Use Micro-Cap to build the circuit.
   Initial conditions: put the value of your cap= `.1u IC=10ma`

5. Does the circuit oscillate as predicted?

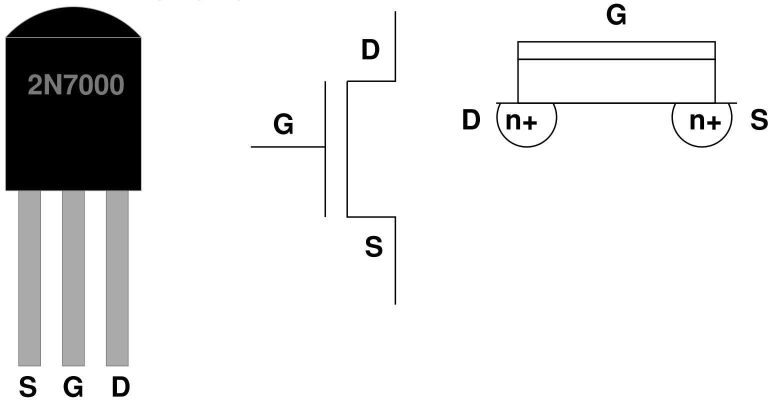
6. Plot the Voltage at each end of the capacitors with respect to ground.

MOSFETs

- Metal-Oxide Semiconductor Field Effect Transitor (some of those no longer true)
- For now, think of it as a voltage-controlled switch. (Why do we not model MOSFETs in Micro-cap directly? Need full version)
- You will see more than you ever wanted to about FETs in electronics.
- High input impedance (basically a capacitor)

Enough charge builds up on plate (gate), opens channel across drain and source.

- 2N7000



MicroCap

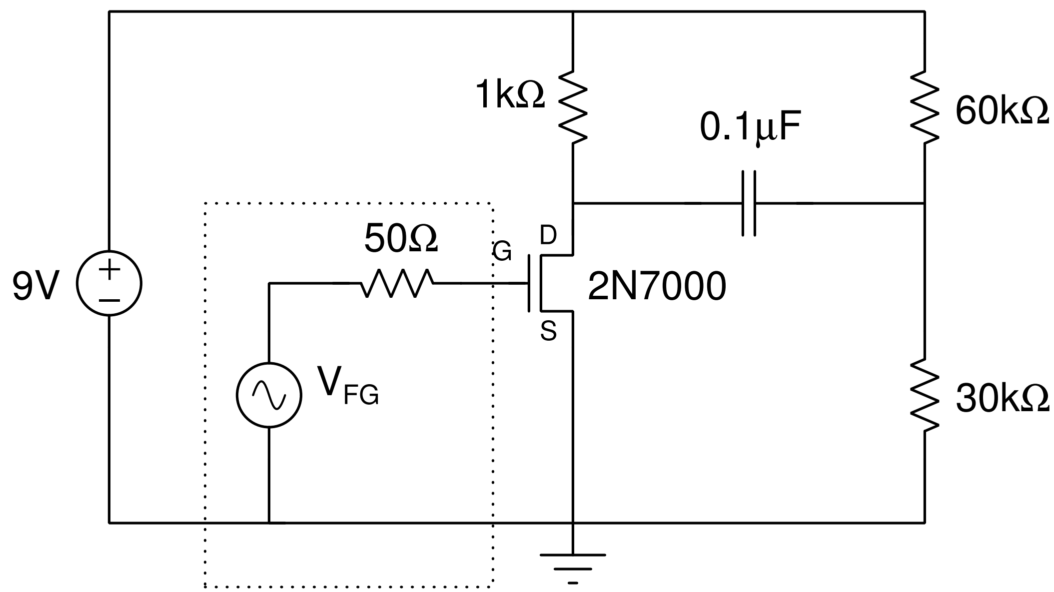
- Why using switches instead of the actual transistors? MicroCap won't simulate transistors.

- Remember, to set initial conditions you can put something like `.1u IC=10ma` in the value for the component

- The lab does ask you to re-calculate values in class so you might want to bring a laptop.

Lab Notes

1. Build the half-circuit.

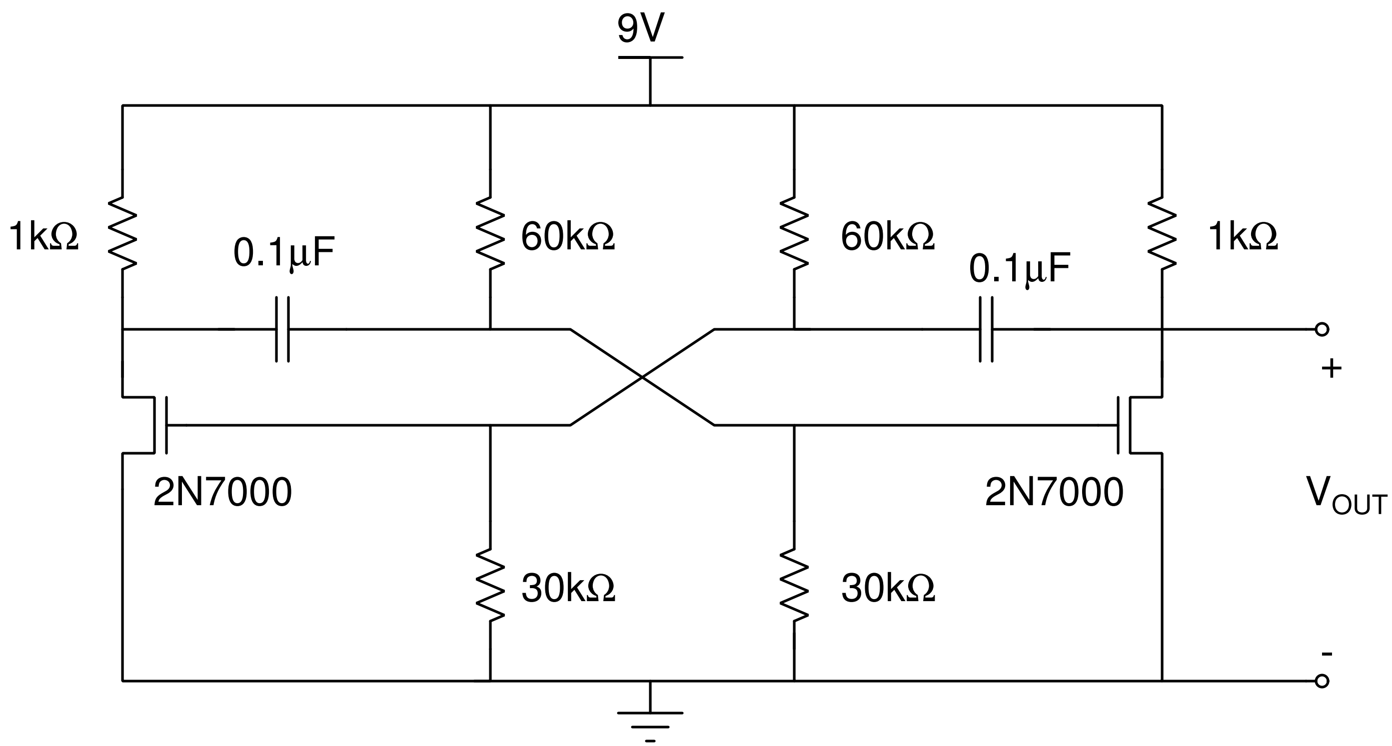


2. Hook up to the function generator with a triangle wave,

determine the MOSFET turn-on values. You've done something similar before, with the Schmitt trigger.

3. Compare voltage across 30k with pre-lab.

4. Build the full multivibrator.



5. Measure the frequency. How does it compare?

6. Update your micro-cap to match the measured transistor

values.

7. Compare micro-cap to actual

8. Modify the values so that you get the time values you need for Lab 8.

   (a) Output frequency matches.
   (b) Duty cycle matches

Post-Lab

- None.
- Do not disassembly this circuit, you will need it for Lab#10.