ECE 214 – Electrical Circuits Lab
Lecture 6

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Announcements

- Lab re-starts this week!
- Remember you can change up lab partners

Midterm Review

1. Test Equipment

(a) Oscope plot. What does the "1 1.0V" mean?

i. Vpp Signal 1 = Peak to Peak = 8V

ii. Vpp Signal 2 = 4V

iii. Period = 2ms. Frequency = $\frac{1}{T}$ = 500Hz

iv. Phase shift = f*dt*360 or just note is 360/10 blocks = 36 degrees

(b) Lissajous.

$$sin^{-1}(\frac{1.4142}{2})$$

Watch your sig figs, and watch your rounding!

2. RC Circuits

(a) i. high pass filter
ii. 3rd order
iii. $\frac{1}{2\pi RC} = 750.7\text{Hz}$
iv. 60dB/decade

(b) Bode plot. Cutoff at 751Hz, drop 60 dB/decade, high pass.

3. OpAmp

(a) Gain is $-\frac{R_2}{R_1} =$ -2
(b) Plot is twice as big, inverted.

4. Schmitt Trigger

(a) Hysterisis plot. $-V_{sup}$ to V_{sup} and $-\frac{R_1}{R_2}$ to $\frac{R_1}{R_2}$.
Did not want square/triangle wave output.

5. Schmitt Trigger Oscillator

(a) Vout1 $=$ Square
(b) Vout2 $=$ Triangle
(c) $f = \frac{R_2}{4R_1R_3C}$. Solve, $R_3 = 500\Omega$

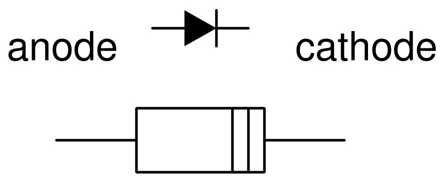
6. Space ship question.

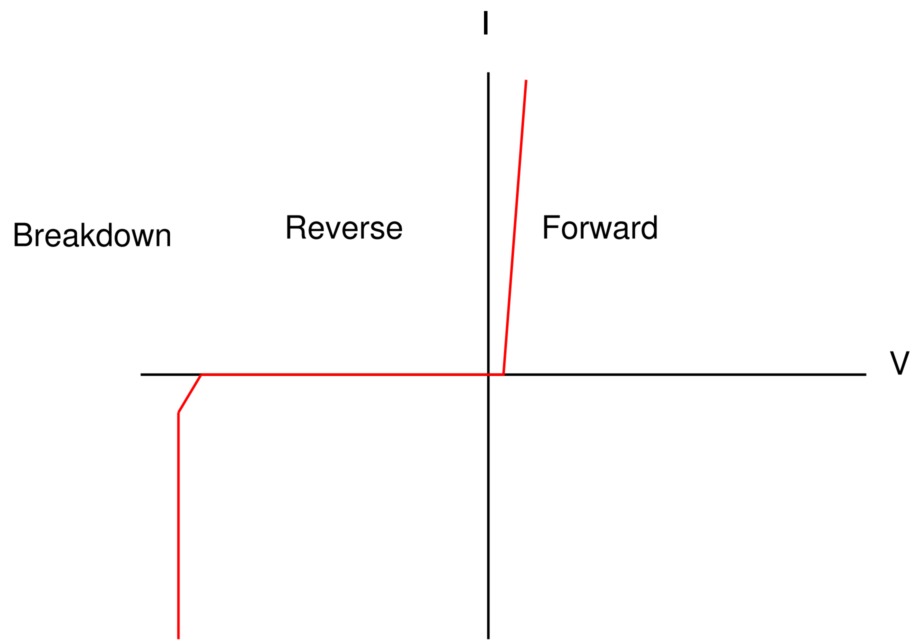
Lab Notebooks

- Overall good
- Follow directions. Plots, semi-log. Label axes.
- Micro-cap. Know it's a pain. For the integrator plots, main issue was getting +/- 5V, not starting at zero. Calculus. Op-amp issues.

Lab #6 – DC – DC Converter

Diodes





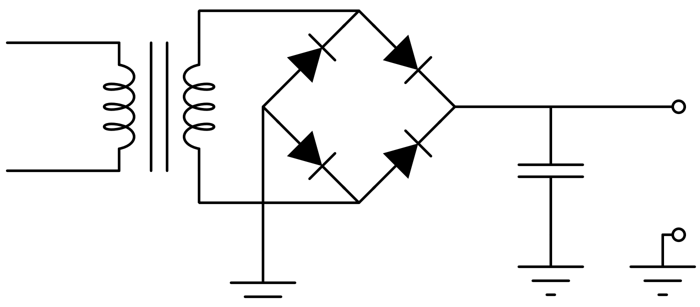
- Many kinds: signal, zener, photo, schottky, (my favorite) LED.

- Block current going one way (ideal).
  Real world more complicated; too much reverse voltage and will eventually breakdown. Also have a forward voltage drop (typically around 0.6V for Si diodes).

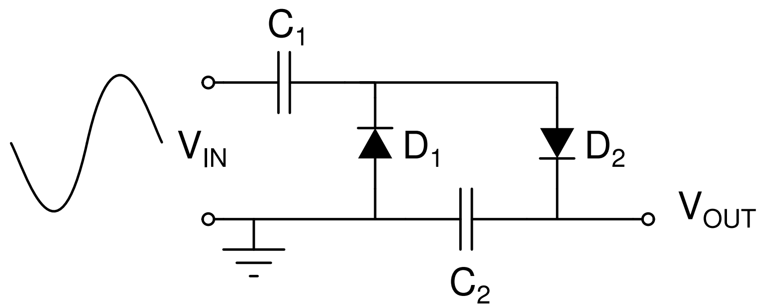
- Zener diodes have breakdown voltage of values like 5V, can be used for simple power supplies.

AC/DC conversion

- Motor feeding into a generator?
- Huge transformer with differing coils
- Bridge rectifier



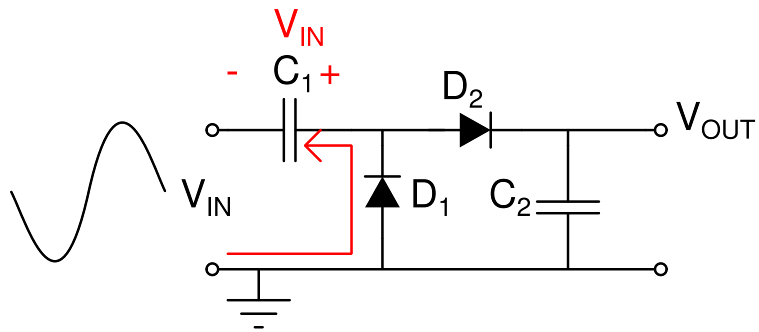
Villard Doubler



- Technically the Villard Circuit only has one diode and one capacitor and doesn't behave well.

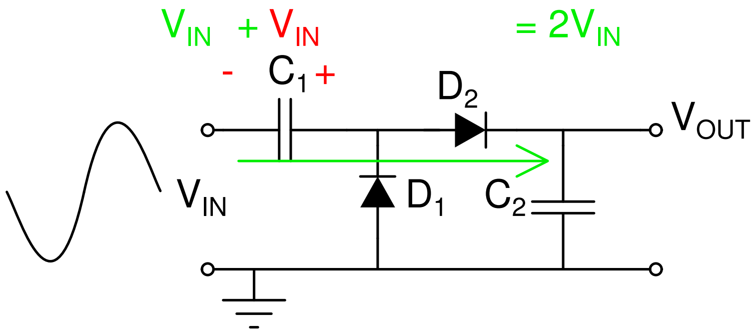
- We'll actually be building a Greinacher circuit.
  Also called a Cockroft-Walton multiplier

Negative Half



- D1 Turns on, Charges C1 to Vin

Positive Half



- D1 Turns off, D2 Turns on, Output is C1 + Vin.
- C2 charges to 2*Vin

Ripple

- Formula: $V_{ripple} = \frac{I_{load}}{(2fC)} * n * (n + 1)$
- I = current load, f = frequency, C = capacitance, n = number of stages (1 in our case)

Drop

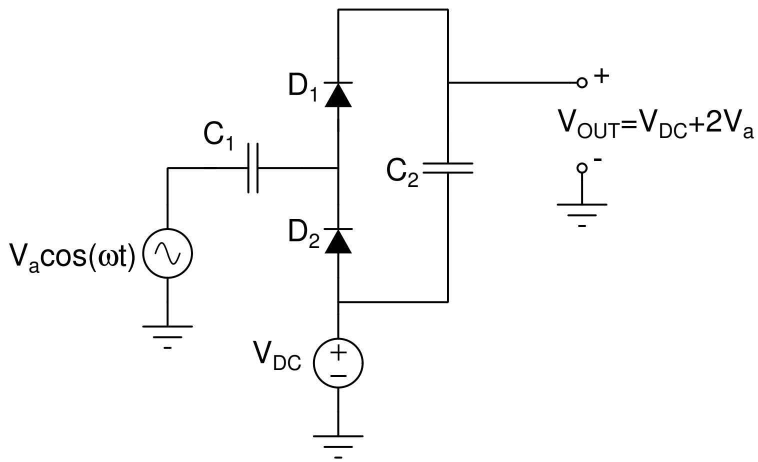
- Formula: $V_{drop} = \frac{I_{load}}{(6fC)} * (4n^3 + 3n^2 - n)$
- I = current load, f = frequency, C = capacitance, n = number of stages (1 in our case)
- Also worry about voltage drop in diodes (0.6V?)

Multiple Stages

- Can multiply out an arbitrary number
- Ripple will increase. can be mitigated somewhat by increasing capacitor values.
- What tolerances for cap/diode?
- USB destroyer in the news

  http://hackaday.com/2015/03/11/killer-usb-drive-is-designed-to-fry-laptops/

Circuit to Build



- Want to input 10V DC, get more than 15V DC out.
- Can you double DC alone?
  No, you need some sort of AC component.

PreLab

- Design it.
- Run it through micro-cap.
- Use 1N4001 in microcap. Also pick a cap value from 10nF to 100nF.
- Remember to include oscilloscope output resistance, etc.

Lab

- Build it.
- The diodes available in lab are 1N4004. See data sheet for difference (hint, breakdown voltage)

Postlab

- Compare.
- Write-up