

EEO352 Lab 3  
DC Power Supplies

Pete Mills

October 2, 2023

**Copy of Original Assignment**

### EEO 352 Fall 2023 - Assignment 3 – DC Power Supplies - ABET

Please document each step with snapshots of the built circuit, plots, pictures and your observations.  
Please include this page.

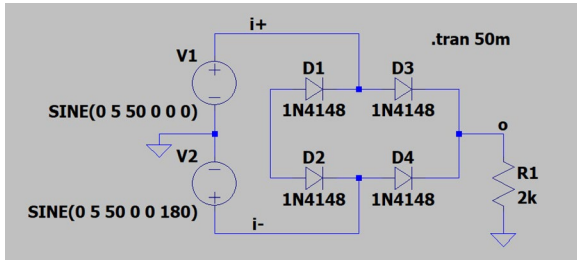


Fig.1a

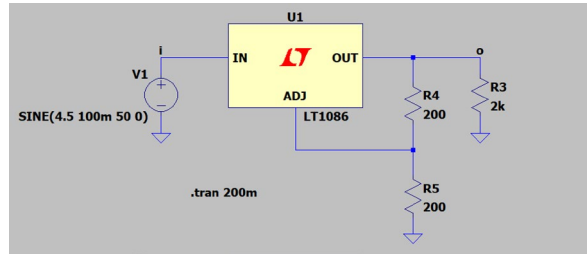


Fig.1c

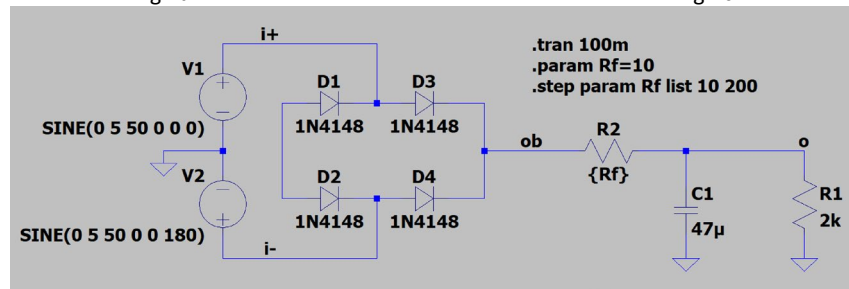


Fig.1b

1) Design and simulate the three circuits in Figures 1a, 1b and 1c (60pts):

- For Fig.1a plot the inputs and output and make your observations
- For Fig.1b plot the outputs from the parametric simulation and make your observations
- For Fig.1c plot the input and output in separate panes and note the peak-peak ripple values, report the DC output voltage and compare with the expected from the datasheet

Note1: Fig.1b is a parametric simulation vs Rf

Note2: You must explain in your own words how each of the three circuits operates

2) Build and measure the three circuits at (1) (140 pts) (ABET PI-62,PI-63,PI-64)

- For Fig.1a plot the positive input and the output, compare with the simulation and make your observations
- For Fig.1b plot the positive input and the output for the  $R_f=10\Omega$  case applying the required offset to clearly show the ripple; report the ripple value; compare with the simulation and make your observations
- For Fig.1c measure and plot the input and output and note the peak-peak ripples, report the DC output voltage and compare with the expected DC value from the datasheet

Note1: You can use the 1N4001 in place of the 1N4148, use the LM317 in place of the LT1086

Note2: For (a) and (b) generate the two input signals using the two synchronized waveform generators

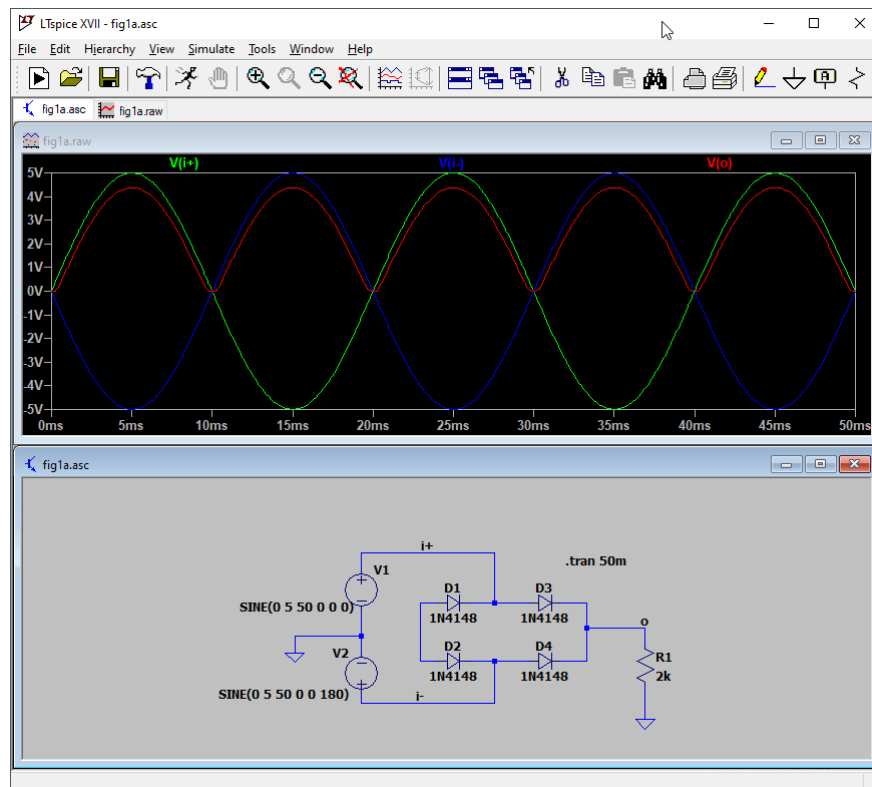
Note3: For the plots in (c) subtract the offsets and use appropriate scales for input and output

# 1 Design and Simulate Three Circuits

a)

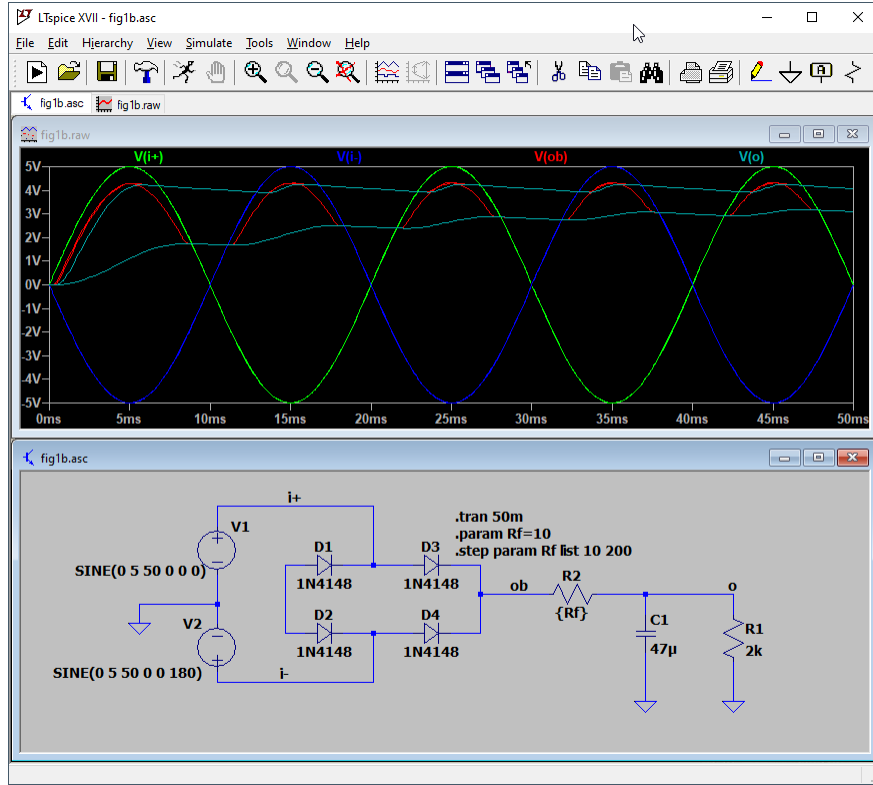
In this circuit D3 passes current during the positive portion of the sine wave from V1. D4 passes current during the positive portion of the sine wave from V2. D1 and D2 block reverse current, but they could simply be deleted from the circuit. R1 converts the current to a voltage so that it can be measured.

This circuit does not seem to make a very useful power supply. The output simply follows the input voltages minus diode forward voltage drop. It can also be seen that there is no negative voltage at the output.



b)

This circuit is the same as in section a, but has a low pass filter. This filter smooths the output and increases the effective DC voltage of the output. The output ripple is about 330 mV peak-peak.



c)

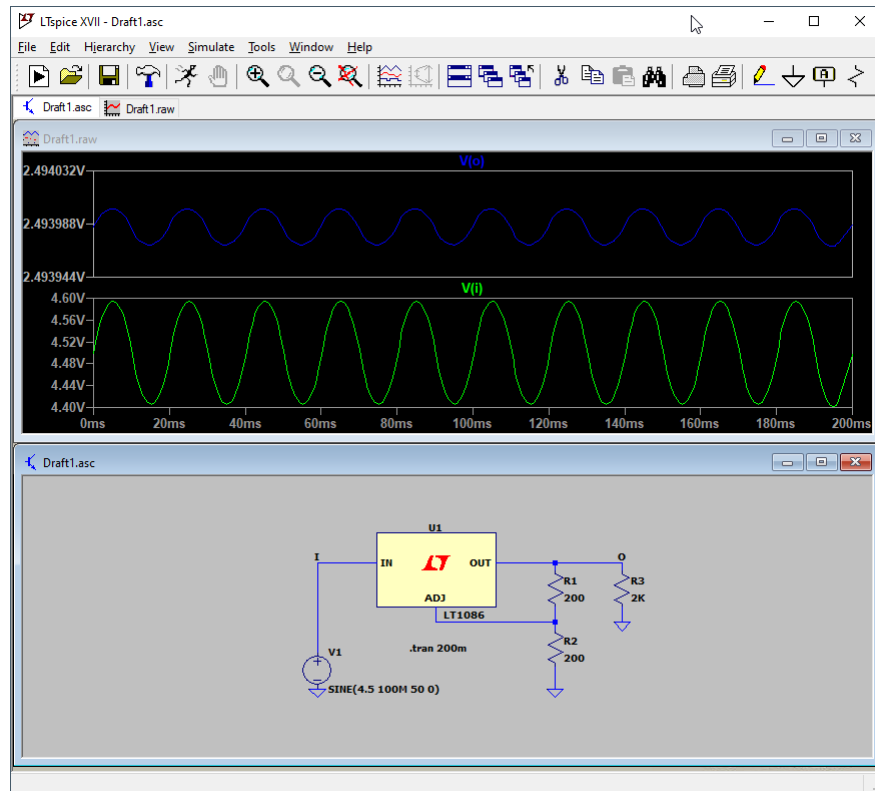
This circuit uses a linear voltage regulator IC to create a DC output voltage up to 1.5 A. The input voltage has 100 mV peak ripple. The output voltage has approximately 30  $\mu$ V peak-peak. The output voltage of this circuit is very stable even with 100 mV input ripple.

With the use of 200  $\Omega$  resistors for R1 & R2, the expected output voltage given by

$$V_{out} = 1.25 \text{ V} (1 + 200 \Omega / 200 \Omega) = 1.25 \text{ V} (1 + 1) = 1.25 \text{ V} * 2 = 2.5 \text{ V}$$

The simulation shows DC output voltage is approx 2.494V. This is within 0.2% of the theoretical value.

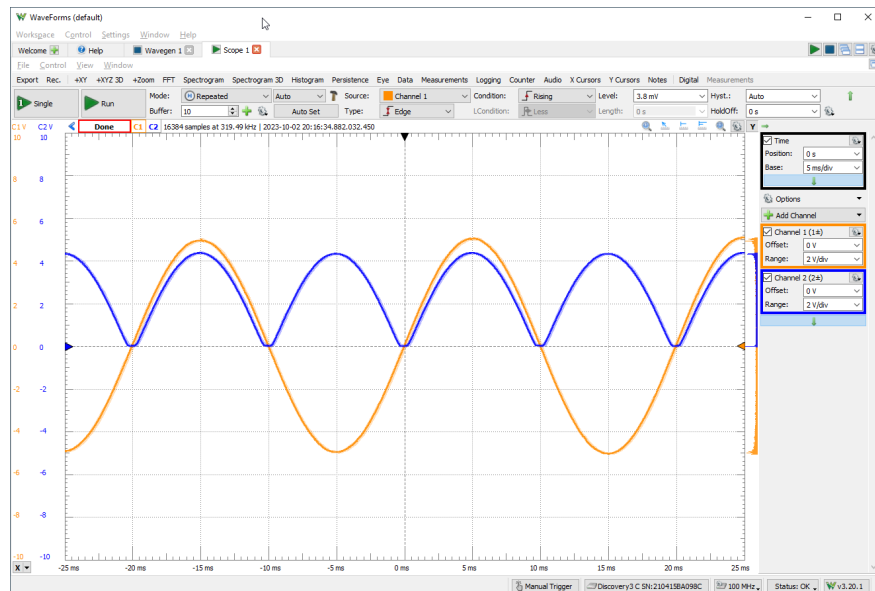
The datasheet indicates a max line regulation of 0.2%, or 5 mV and a max load regulation of 0.3%, or 7.5 mV, both at  $V_{out} = 2.5 \text{ V}$ . Without the addition of 150  $\mu$ F aluminum electrolytic or a 22  $\mu$ F solid tantalum on the output, stability may be affected, however it can be seen that the simulation is well within the expected range for this part.

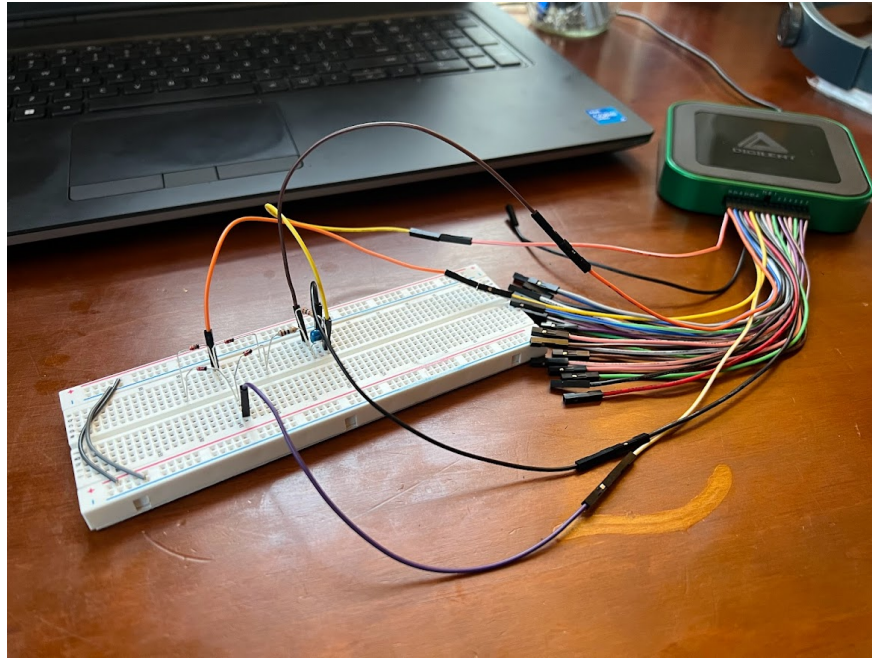


## 2 Build and Measure Three Circuits

a)

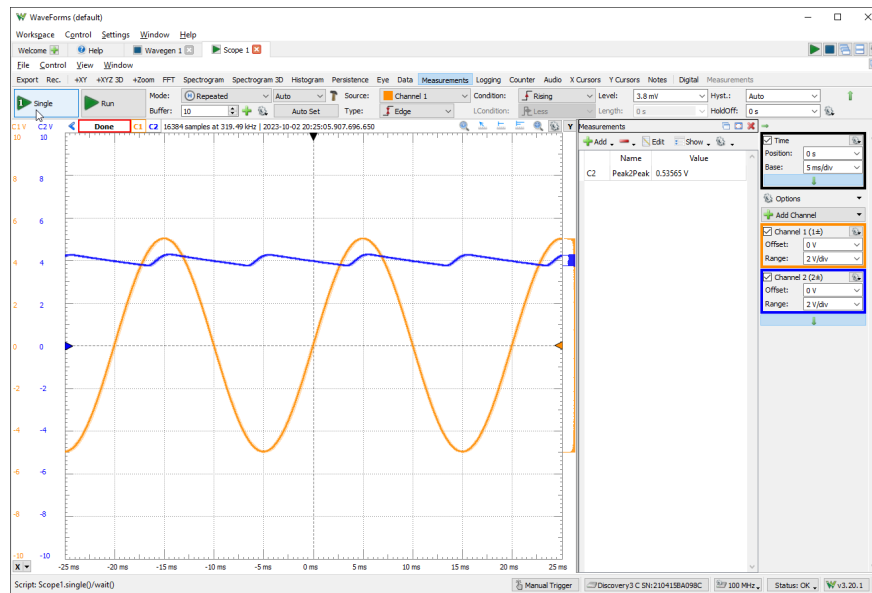
This circuit behaved very similar to that in the simulation. We see a peak voltage equal to the input wave minus diode drop. We also see a brief period of 0 volts before the second input wave creates another positive going pulse.





b)

This circuit also behaved very similar to the simulation, but the measured values differed slightly. In the simulation there is 330 mV peak-peak vs the circuit measurement of 530 mV peak-peak. Both the simulation and circuit have an output voltage centered about 4 V.



c)

This circuit behaved very similar to the simulation, although the output ripple was somewhat higher. The circuit output 2.52 V with 4.9 mV peak-peak ripple. This is within 26 mV of the DC simulation, but significantly higher than the 30  $\mu$ V peak-peak from the spice model. The output voltage is within 20 mV of the calculated value .0049 and ripple is 0.2 % which is below the tolerance per the data sheet.

