Linear Power Supplies

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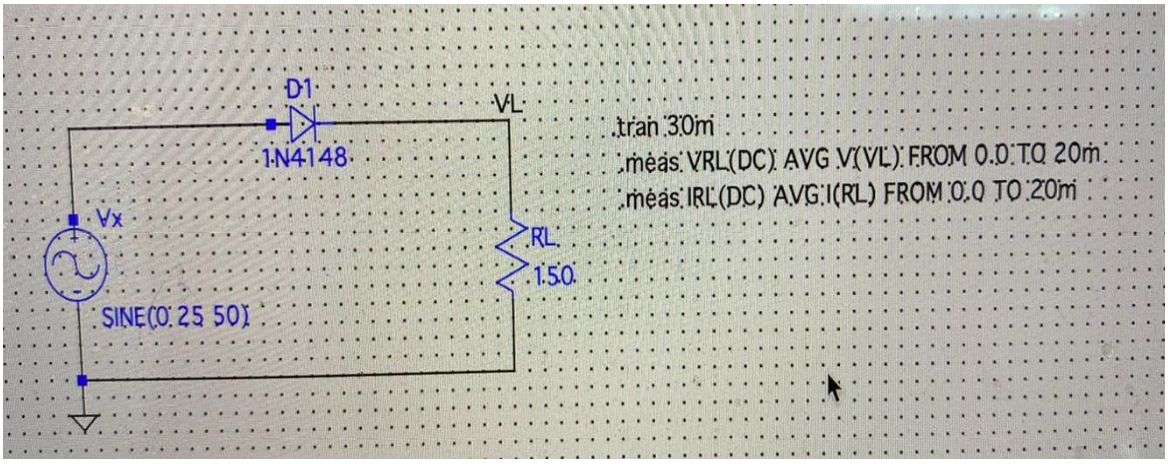
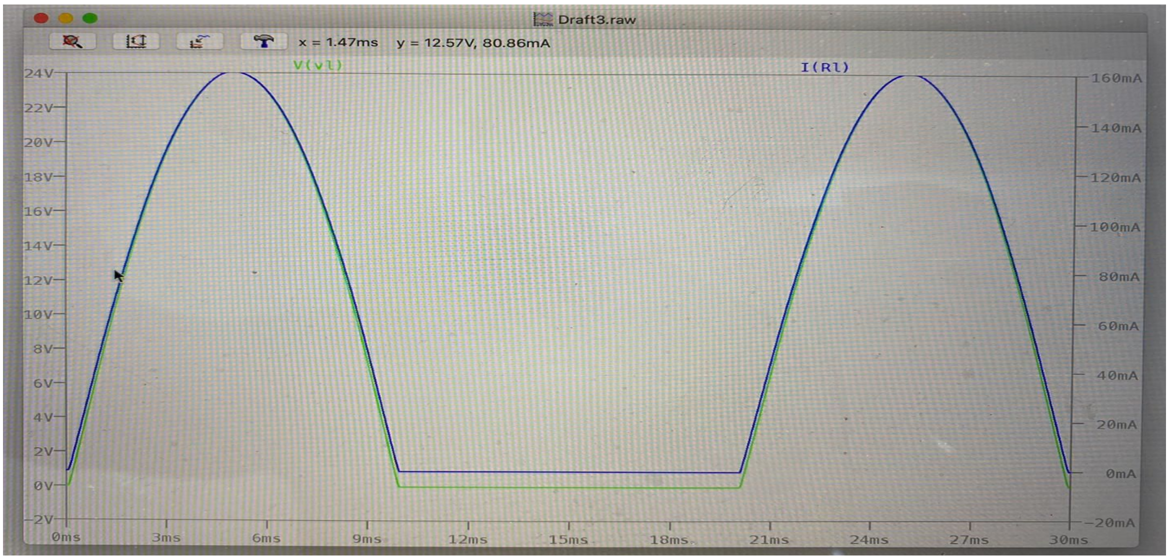
12/11/2020

Part 1) Half-wave rectifier
This circuit allows us to turn the positive half cycles of the sine waves into dc voltage. It is done by forward biasing the diode on a positive cycle of the wave. In the negative cycle, diode is worked in a reverse biased and no current passes.

Circuit and the graph for Voltage and current can be seen below.

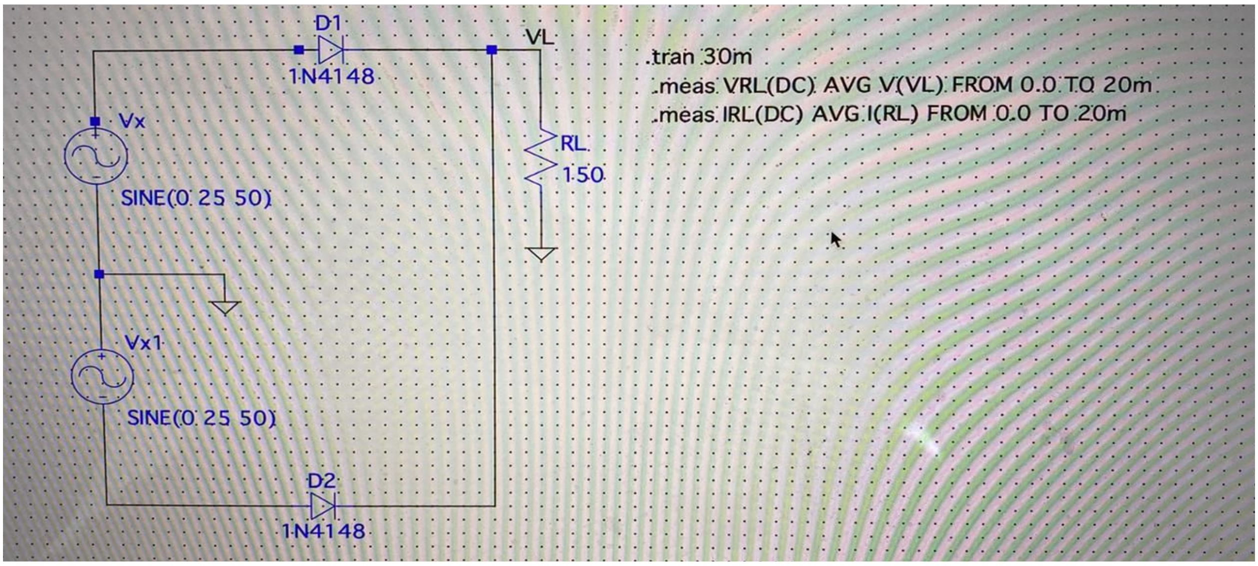


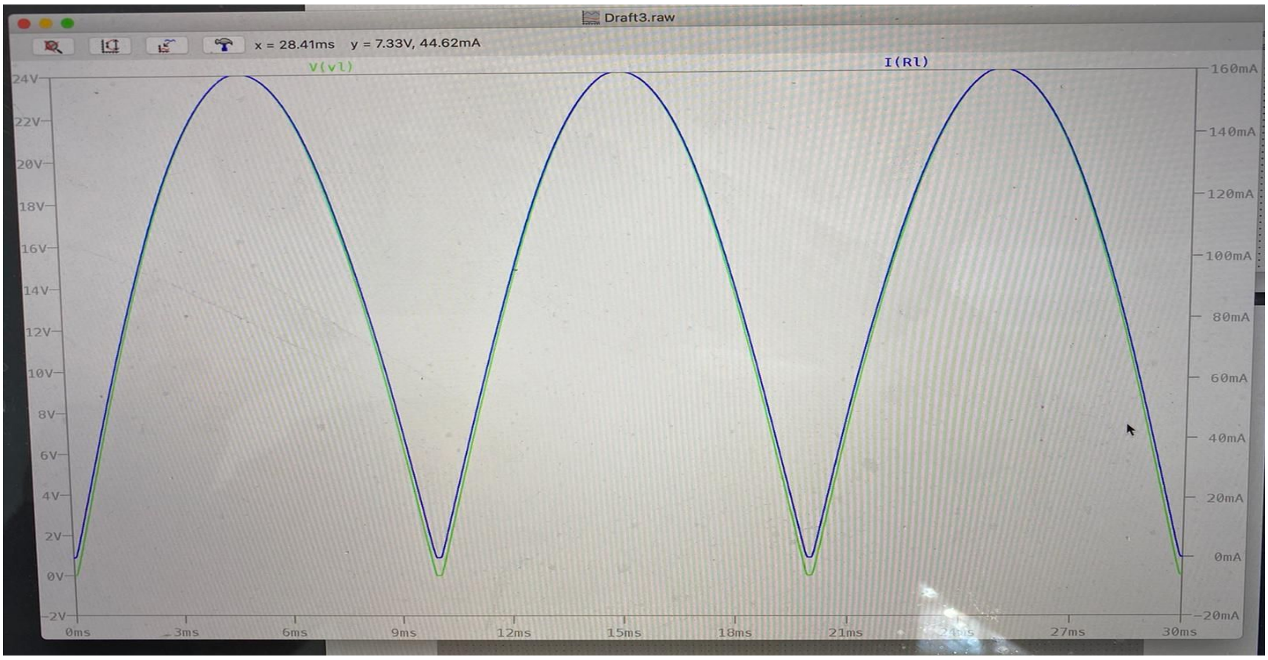


From the LTSpice log, the average value of V(VL) is given as 7,54177. Using the formula and the peak voltage we find from the graphs, ve find V(VL) as 7,84444.
Peak voltage = 24.644, Average V(VL) = peak/pi
This is caused by the voltage loss in the diode when it is not an ideal case in real time.

Part 2) Full-wave rectifier
This circuit initially has the same purpose as the half-wave rectifier with twice frequency. This is done by putting two diodes instead of one which causes the current to also flow on the negative cycle of the sine waves. On the positive cycle, the upper diode; on the positive cycle, the lower diode lets current flow through.

Circuit and the graph for Voltage and current can be seen below.

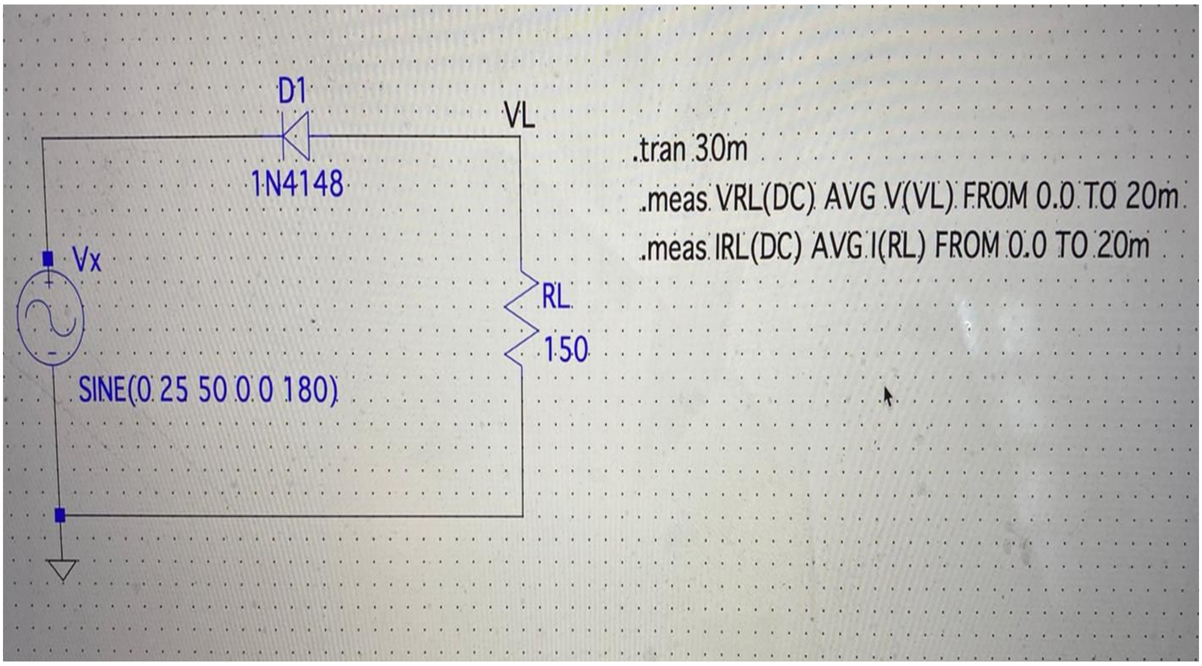


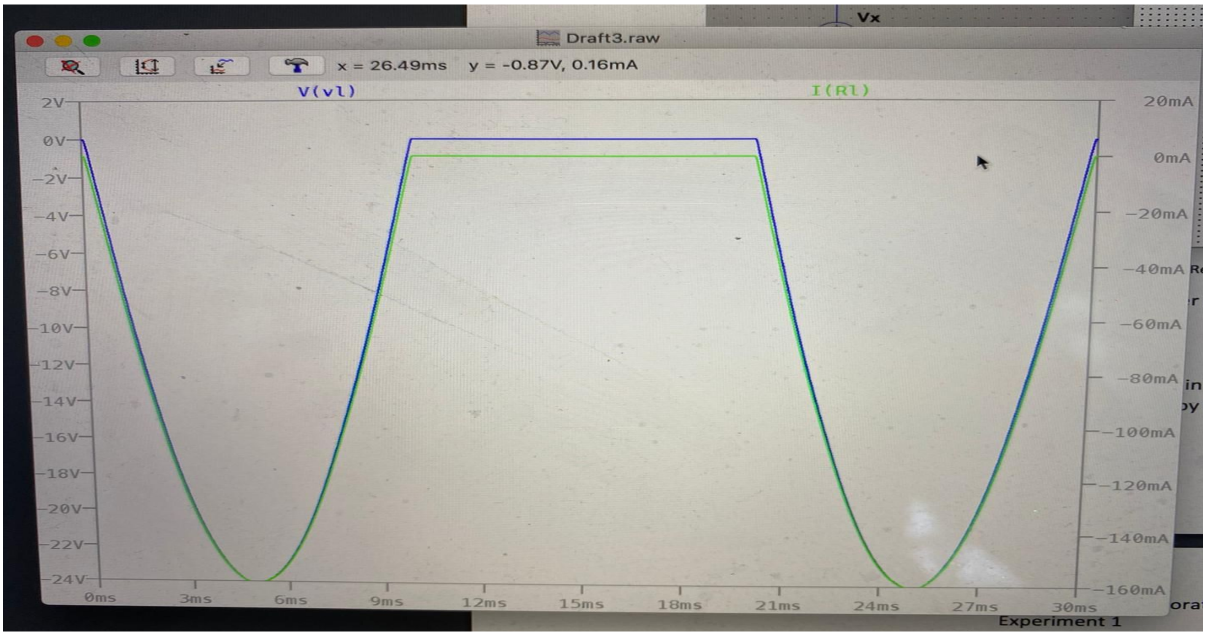


From the LTSpice log, the average value of V(VL) is given as 15.0836. Using the formula and the peak voltage we find from the graphs, ve find V(VL) as 15,31624.
Peak voltage = 24,0587, Average V(VL) = peak/pi
This is caused by the similar ideas we talked about in the first part.

Part 3) Negative Half-wave rectifier
This circuit exactly works as the same as a Half-wave rectifier but since the diode is reversed this time, the output on the diode is reversed (meaning it is negative). So the graphs are seen as symmetrical to the one in the first part.

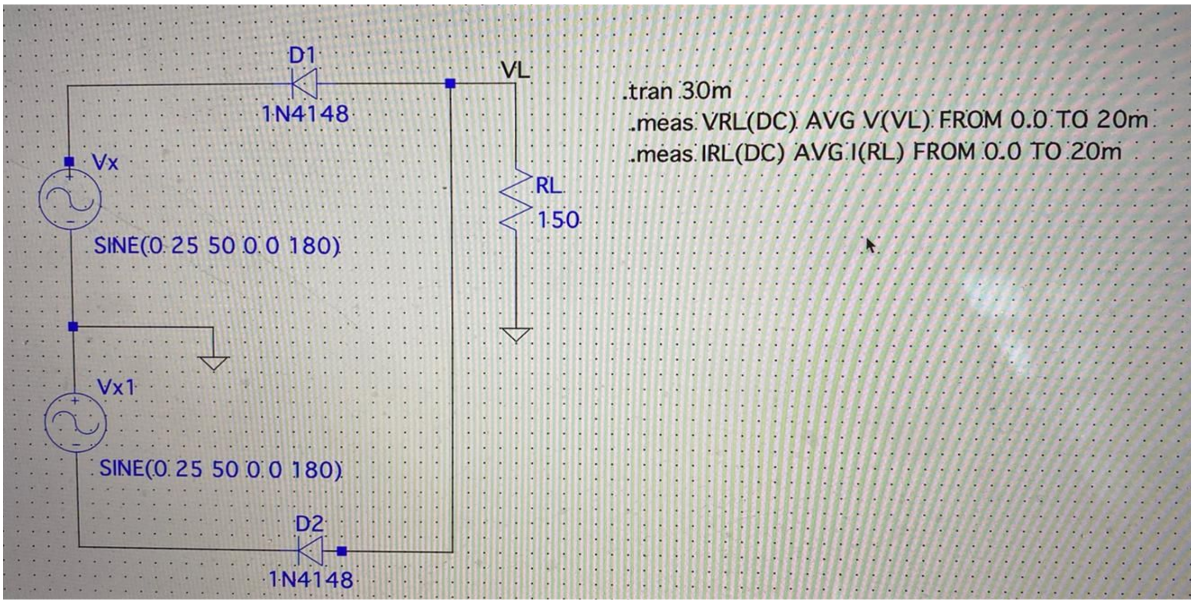
Circuit and the graph for Voltage and current can be seen below.

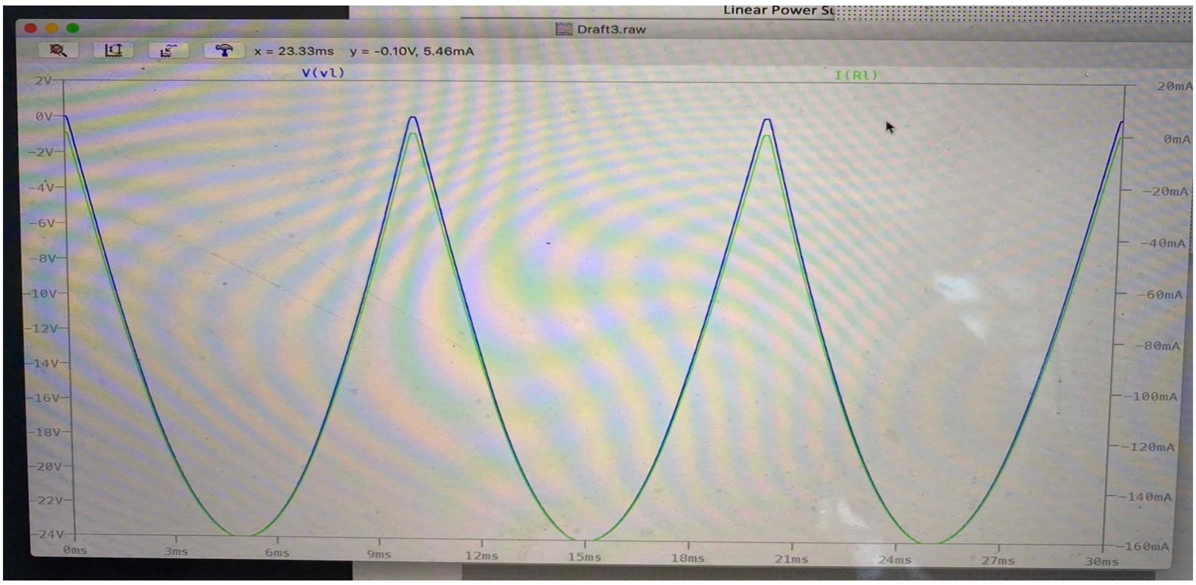




Part 4) Negative Full-wave rectifier
This circuit, just like the previous one, works exactly as the same as a Full-wave rectifier but since both the diodes are reversed, the output on the diode is reversed (meaning it is negative). So the graphs are seen as symmetrical to the one in the second part.

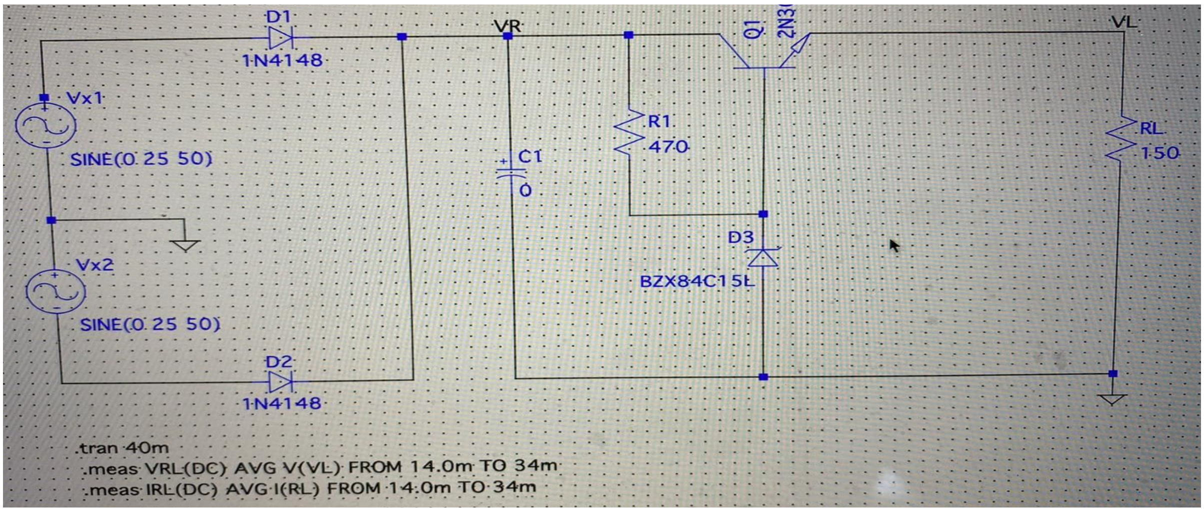
Circuit and the graph for Voltage and current can be seen below.

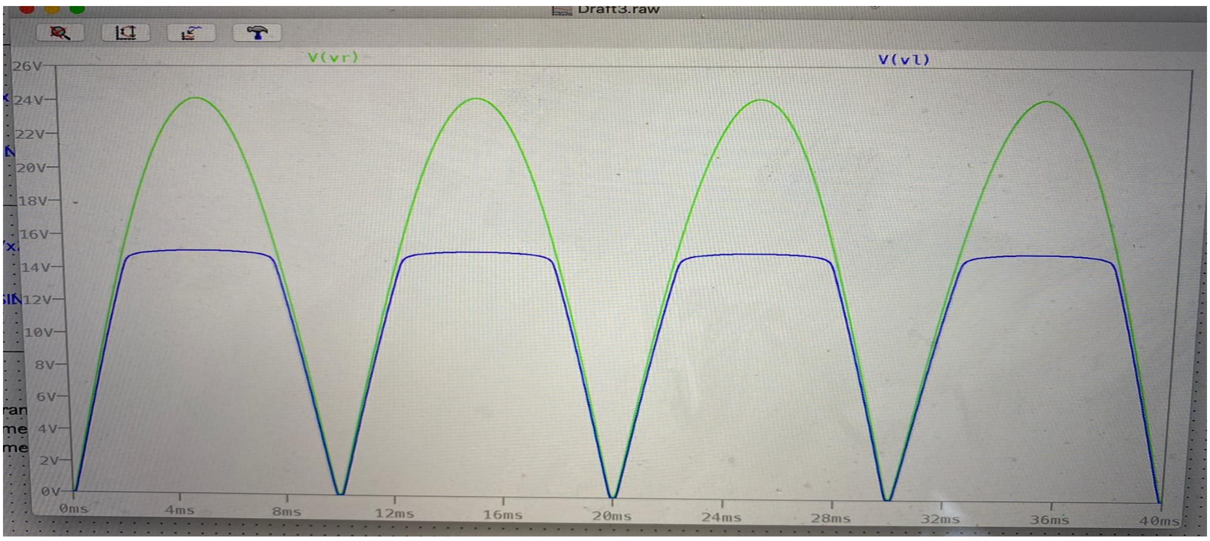




Part 5) Regulator Circuit
This circuit is used to have a steady voltage outputs for a desired value instead of a varying one. This is done by turning sine waves into dc voltages. Using a bjt, we can supply a constant voltage to it by using a zener diode. This with help of a capacitor, turns the sine waves into steady voltage outputs. Capacitor is used to store the load on it. The higher the capacitor value, the time needed to turn into a steady voltage output.

Part 5.a)
Circuit for C = 0 and its graph can be seen below.

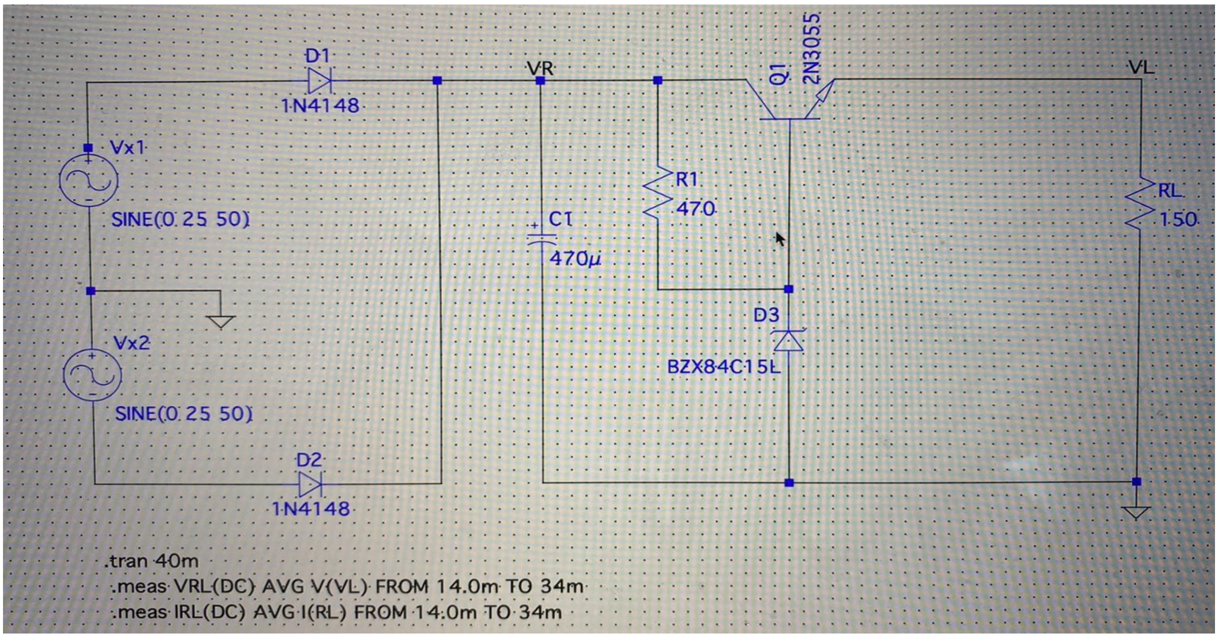


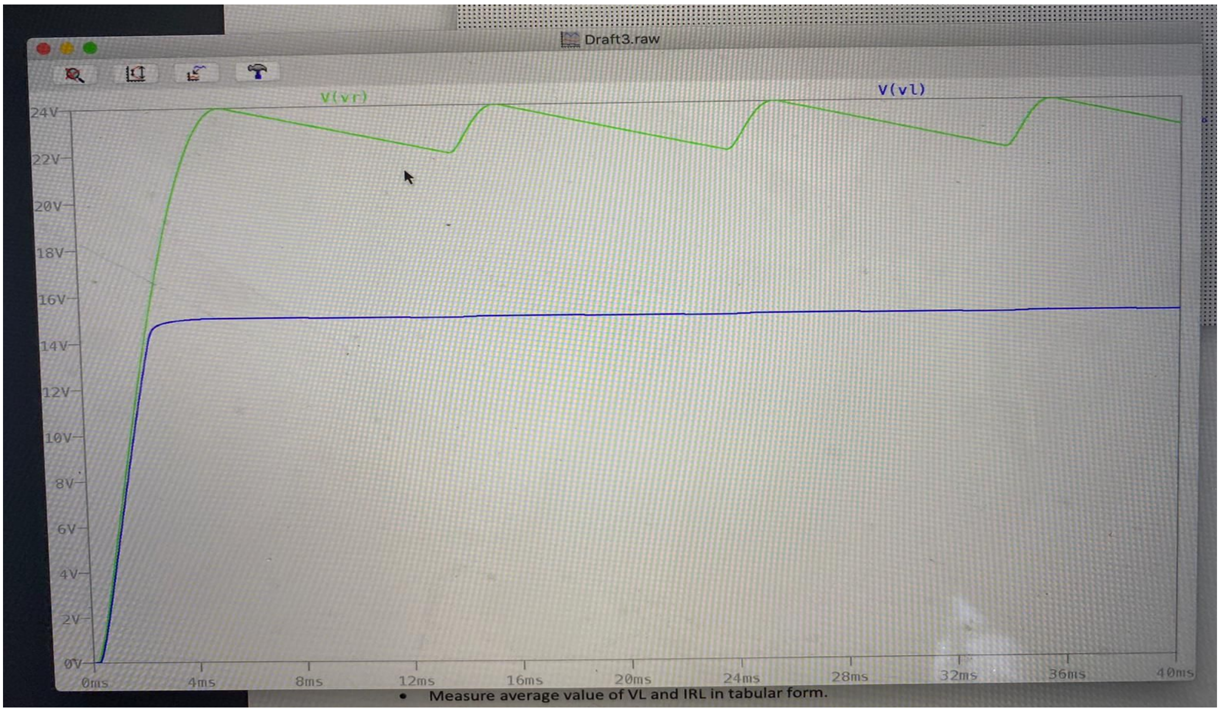


Without a capacitor, as it can be seen, we still have sine waves as the output voltage since with C = 0, capacitor acts as a wire and the zener diode is not in use. This makes the circuit not work as intended.

Part 5.b)

Circuit for C = 470µ and its graph can be seen below.

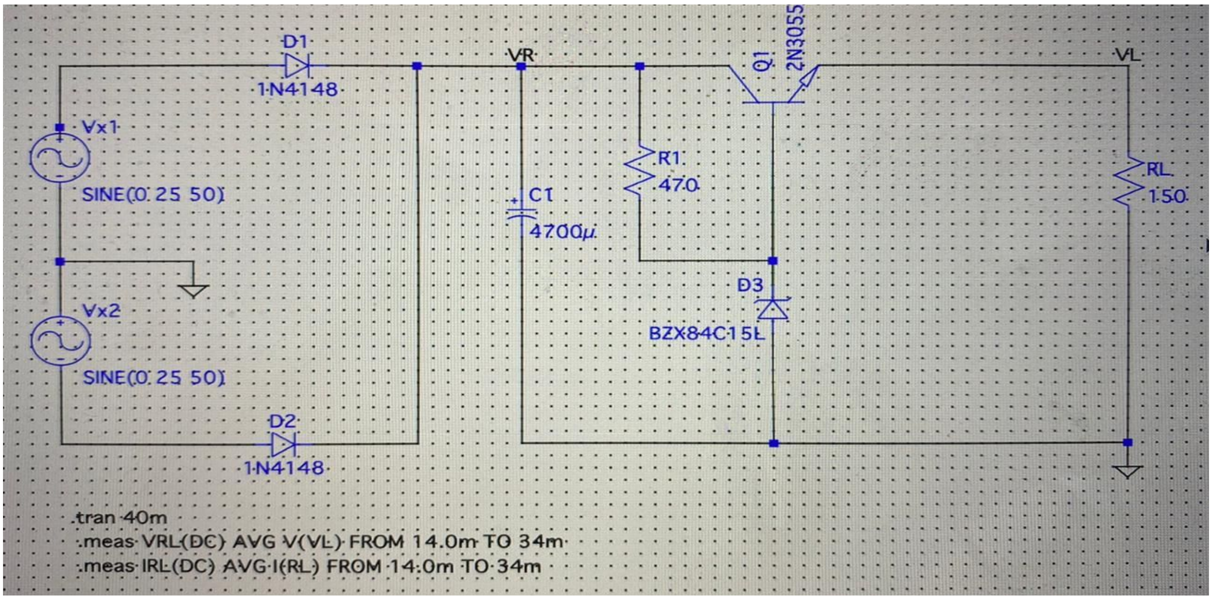


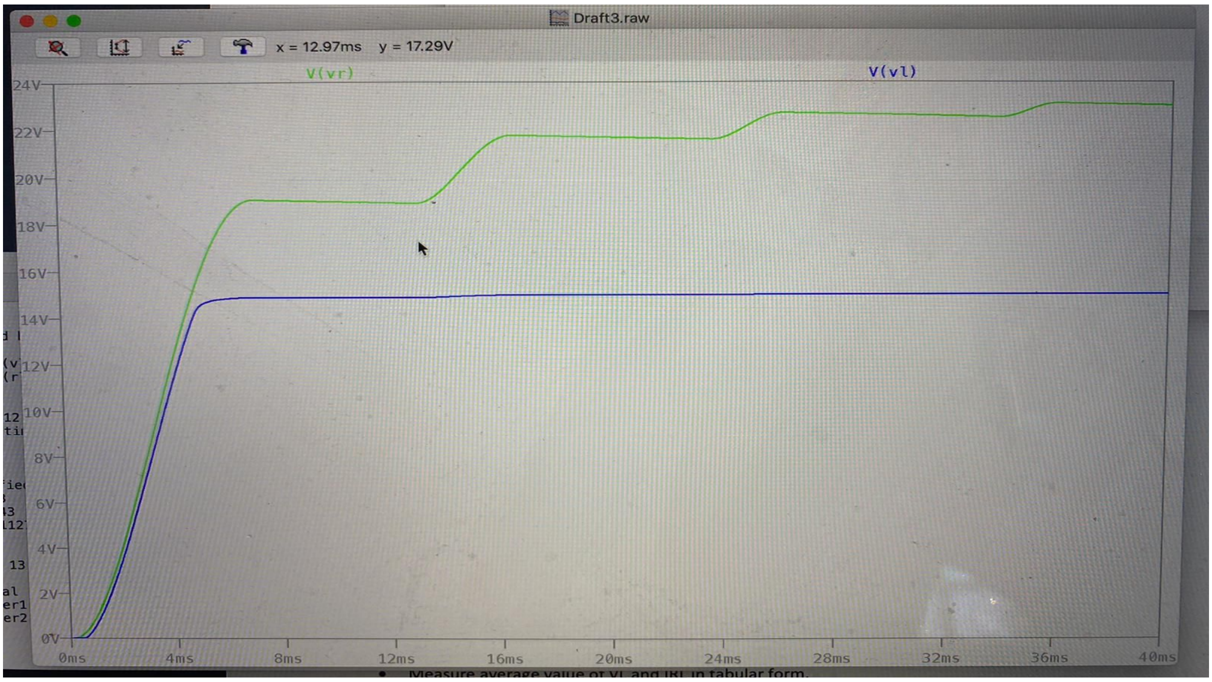


We can see that now with the help of an actual capacitor, the circuit output voltage (VL) becomes a steady value after some time. This is the main idea of what a regulator circuit should do. In the next part, we will compare this result with a bigger capacitor that has a bigger capacitance value.

Part 5.c)

Circuit for C = 4700μ and its graph can be seen below.





With a bigger capacitance than the one in part 5.b, this circuit takes a little more time than the other one to have a steady output voltage. This is caused by the increase in capacitance making it so it takes more time for it to load. It still achieves the same goal though, having the output be a steady voltage supply.