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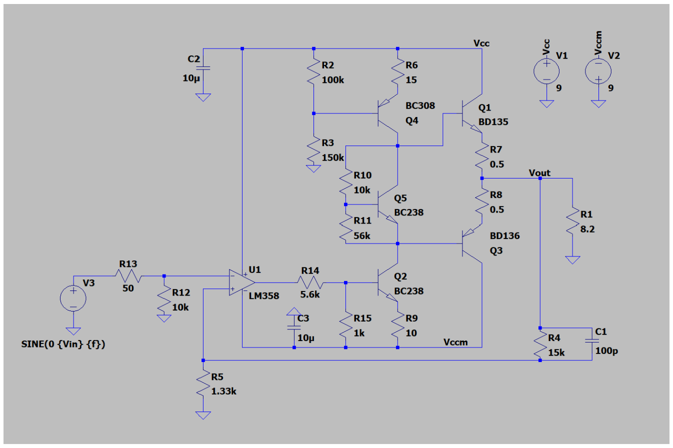
EEE313-2

Lab 3 Preliminary Report

Objectives: Design a complementary push-pull Class-B power amplifier capable of delivering at least 2.25W to an 8.2Ω resistive load. The supply voltage is at most ±9V. It should operate with sinusoidal voltages between 10Hz and 20KHz with a gain you choose between 15 dB and 25 dB. The SRS DS345 signal generator provides the input without an offset

- **Specifications**
  - The amplifier should deliver at least a 2.19W power to an 8.2Ω resistance (12Vpp to an 8.2Ω power resistor) starting from 10Hz to 40KHz at the chosen gain value.
  - The harmonics (the highest is possibly the third harmonic) at the 2.25W output power level should be at least 40 dB lower than the fundamental signal at 1 KHz.
  - The power consumption at quiescent conditions should be less than 500mW
  - The amplifier's overall efficiency (output power/total supply power) should be at least 45% at max power output at 1KHz.

I chose my gain to be 20dB. With this gain and the suggested circuit, here is the schematic of the circuit:



After completing the necessary calculations for the resistor values through the given lab hints, I have run various experiments to test for the specifications.

1. **Varying frequencies**

   To test whether the circuit held stable output average power through a wide range of frequencies, I first set the frequency to 10Hz, then 20KHz, then 40KHz. Then, using "Ctrl + L" to look at the output log provided by LTSpice software, I could see the average power calculated by the ".meas Pout avg V(vout)*I(R1)" opcode.

   Here are the outputs of the 10Hz, 20KHz, and 40KHz accordingly:

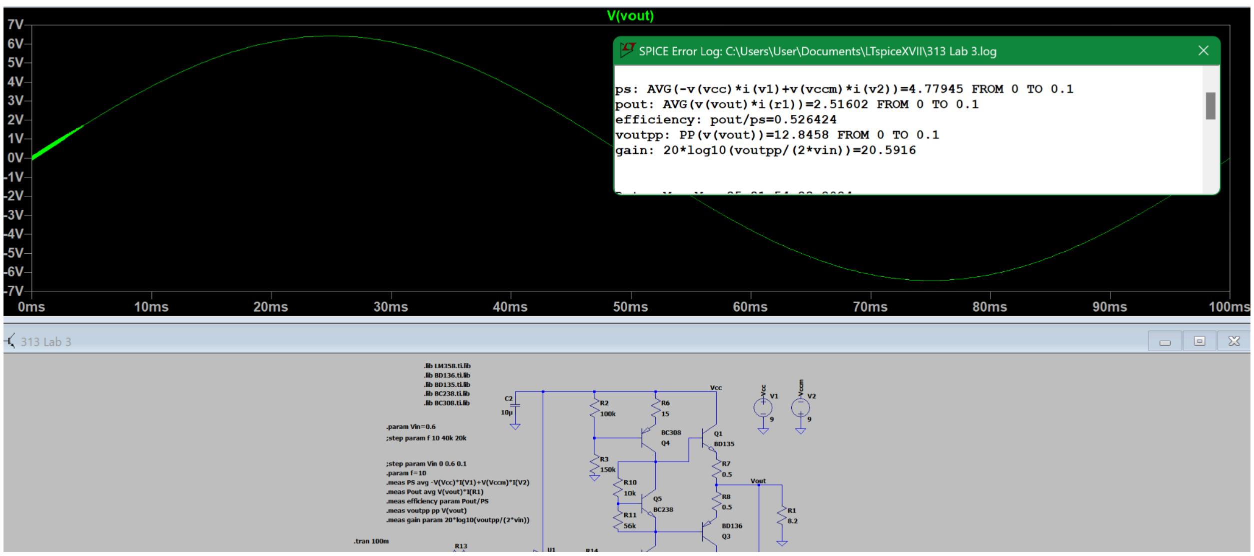


Figure 1.1: Average output power calculated at f=10Hz.

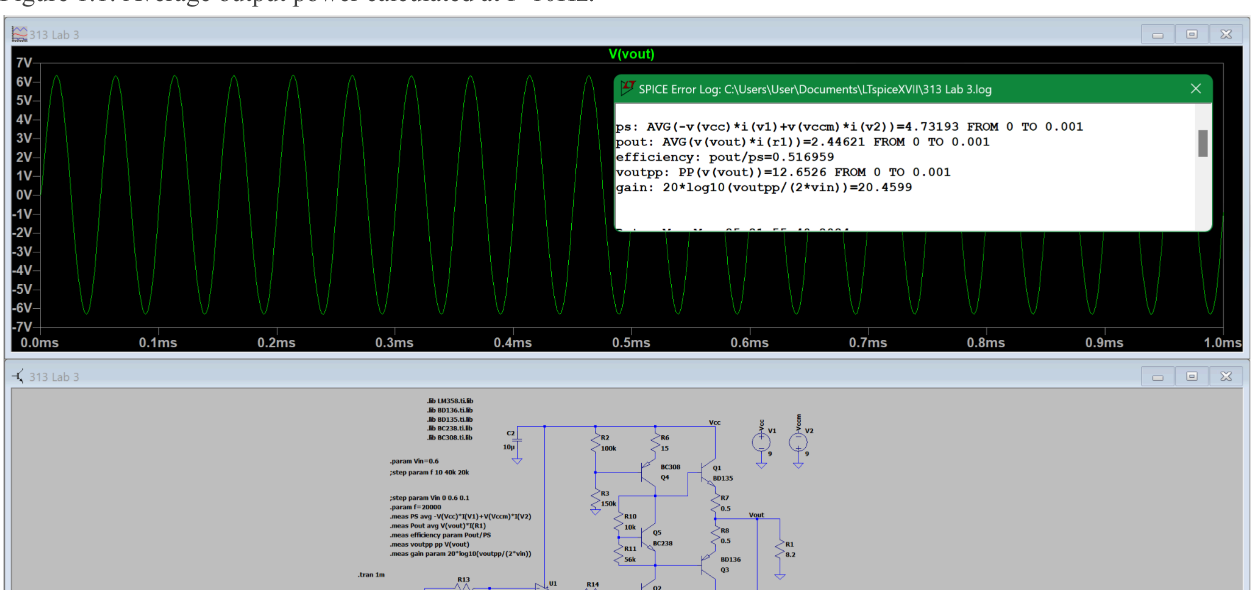


Figure 1.2: Average output power calculated at f=20000Hz.

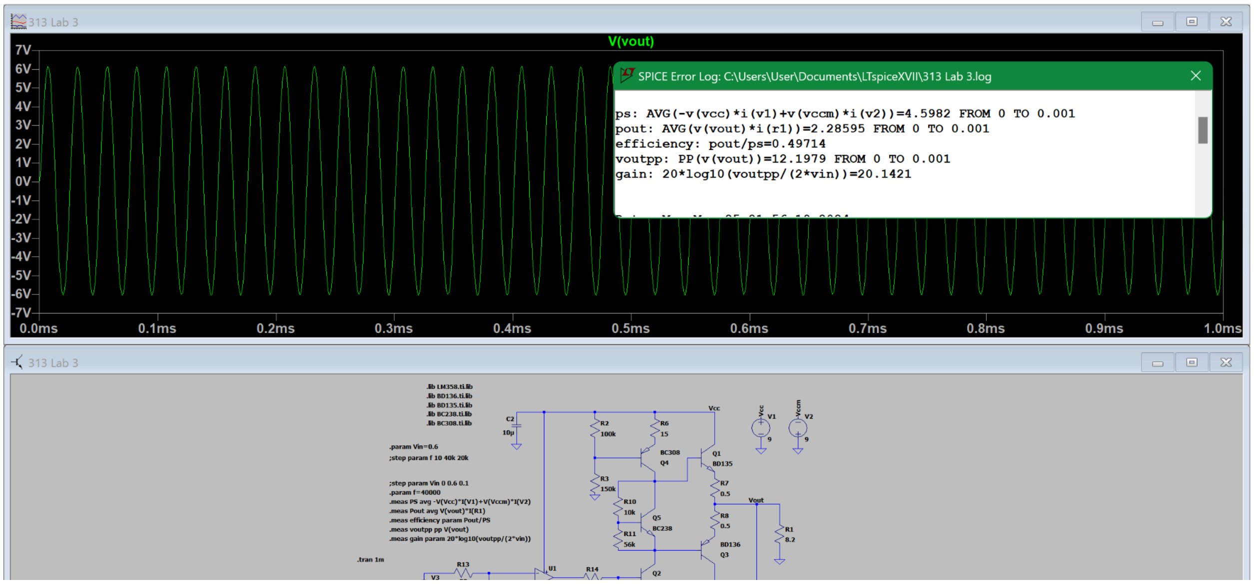


Figure 1.3: Average output calculated at f=40000Hz.

Because the differences in the frequencies are vast, if I had measured them using the same transient analysis, the stop time would alter the output. Therefore, I measured them one by one. 10Hz would not reach the desired values in “stop time=1m”. The software would start saving data for the 40KHz if I used “stop time= 100m”.

2. FFT Analysis

Using the view panel at the output, one can see the peaks of the outputs at certain frequency values and their harmonics. I have run the input voltage from 0V to 0.6V with step size 0.1V. Then I measured the output normally using transient analysis. Finally, I measured the peaks at 1KHz, 2KHz, and 3KHz.

Here are the outputs I obtained:

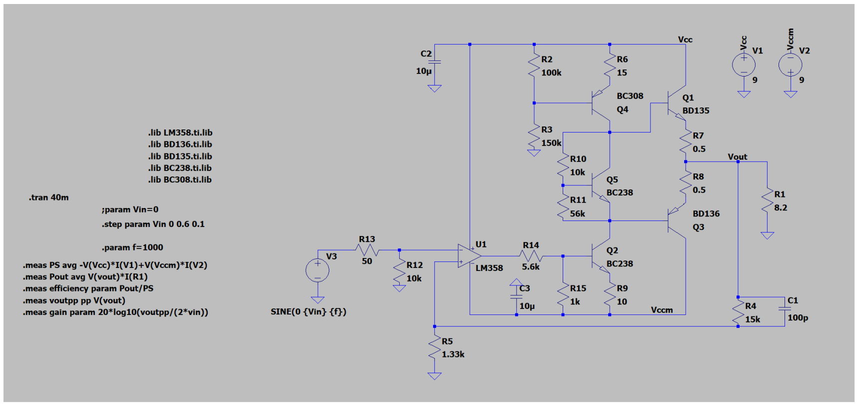


Figure 2.1: Circuit schematic for the FFT Analysis

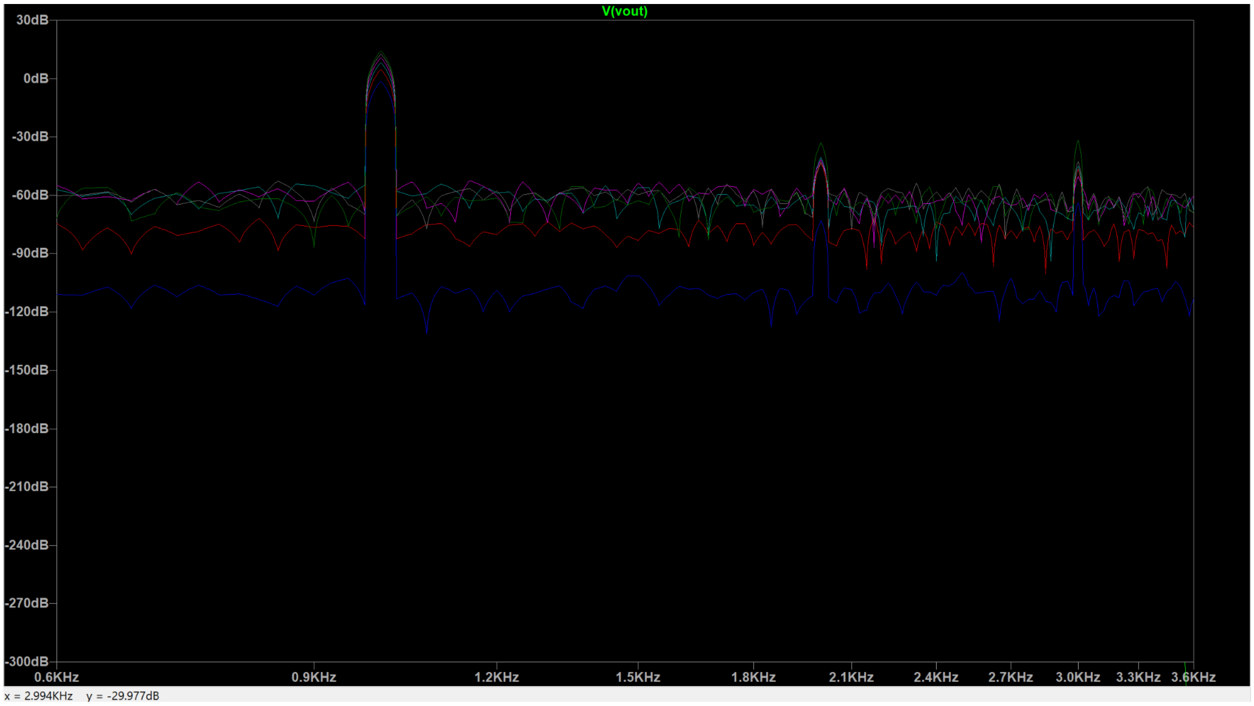


Figure 2.2: FFT Analysis results.

Because of the software I cannot show the exact outputs on the first and third harmonic. But on the bottom left, it can be seen that the third harmonic has at max -29 dB, and the 1KHz had around +10dB, meaning it holds the 40dB requirement.

3. Quiescent Power Consumption

To calculate the quiescent power consumption, I made "$V_{in} = 0V$" as the input. And then plotted "$V_{out} * I(R1)$" which gives the instantaneous power. Here are the results from this experiment:

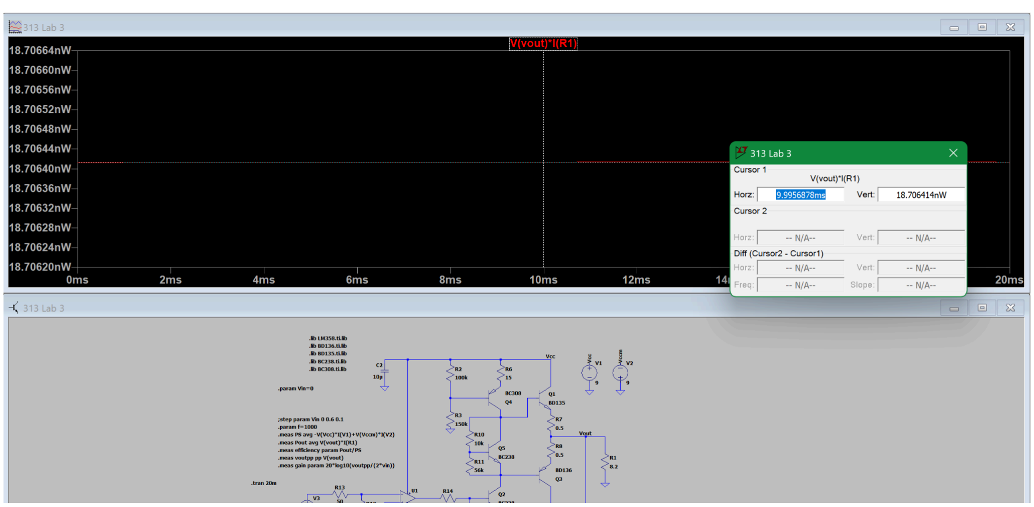


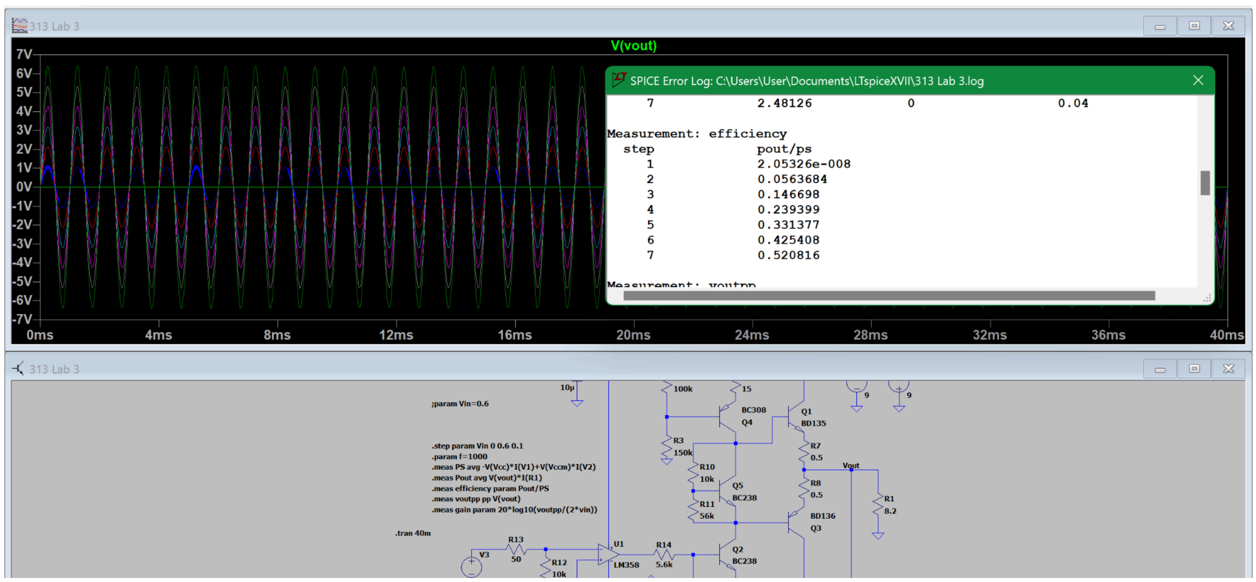
Figure 3.1: Quiescent power consumption graph.

The output graph shows that the power consumed is well below the required 500mW.

4. Overall Efficiency

Using the same technique in the FFT Analysis part, I have set the frequency as 1KHz and stepped the input voltage sinusoidal from 0V to 0.6V with 0.1V step sizes. Then, using the ".meas efficiency Pout/Ps" opcode, I obtained the efficiency of the system first as a list from 0V to 0.6V input, then I measured only the max input 0.6V.

Here are the results:



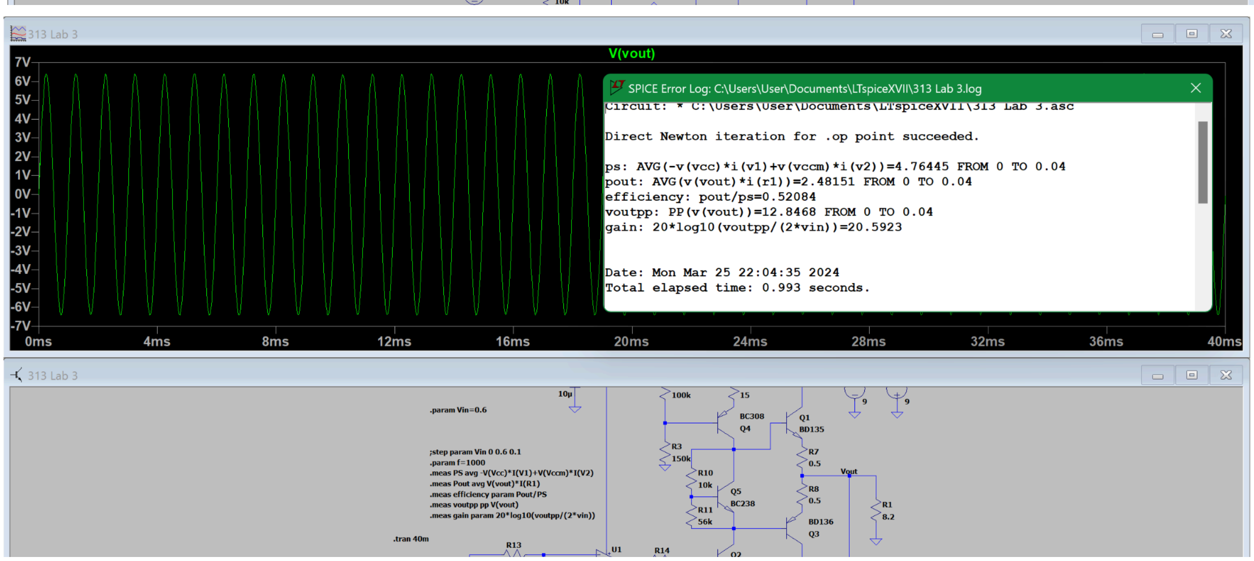


Figure 4.1 and 4.2: Overall output efficiency results vs Max input efficiency result obtained from the code.