EE-420, Electronics II Laboratory
Power Amplifiers, Class B and Class AB

Objectives:

1. To perform power calculations for a Class B amplifier.
2. To observe cross-over distortion in a Class B amplifier.
3. To observe the reduction in cross-over distortion when negative feedback is employed.
4. To observe the reduction in cross-over distortion when Class AB biasing is used.

Analysis:

Neglect cross-over distortion for the amplifier in Figure 1 and compute the output power delivered to the 100 Ω load resistor, P_o, the total power delivered by the dc supplies, P_{CC}, the power conversion efficiency, , and the power dissipated in each transistor, $P_{D\ Qn,Qp}$, for each value of sinusoidal peak output voltage, V_{om}, given in Table 1. [Note: If V_{om} (pk value) > 7 V, the power rating for the load resistor (1/4 W) will be exceeded].

V_{om} (pk value)	P_o (mW)	P_{CC} (mW)	(%)	$P_{D\ QnQp}$ (mW)
1.75 V				
3.5 V				
7 V				

Table 1, Power Calculations for Class B Push-Pull Amplifier

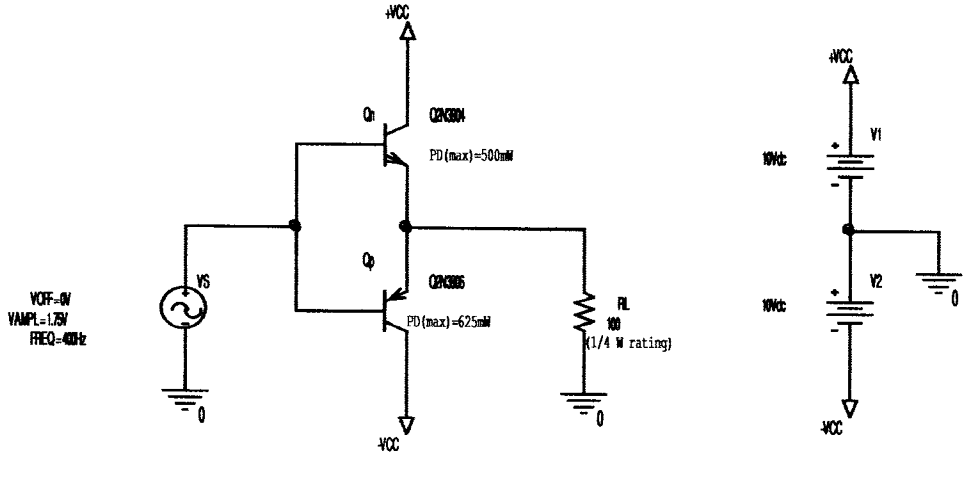

Figure 1, Class B Push-Pull Amplifier

The junction to ambient thermal resistance of the transistors are given as: $_{JA}$(2N3904) = 250 °C/W and $_{JA}$(2N3906) = 200 °C/W. Assuming the ambient temperature is 25 °C, determine the junction temperature of the transistors for V_{om} (pk value) = 7 V and enter in Table 2. (Note: The maximum junction temperature for these devices is specified as T_J (max) = 150 °C). Also, the junction to case thermal resistance of the 2N3906 is given as $_{JC}$(2N3906) = 83.3 °C/W. Determine the case temperature of the 2N3906 and enter in Table 2 in both °C and °F.

V_{om} (pk value)	T_J(2N3904) °C	T_J(2N3906) °C	T_C(2N3906) °C	T_C(2N3906) °F
7 V				

Table 2, Temperature Calculations

Experiment:

(Note: Use short connecting wires and insert 0.1 µF power supply by-pass capacitors between +V_{CC} and ground and between –V_{CC} and ground to help prevent oscillations)

1. Build the Class B Push-Pull amplifier shown in Figure 1. Set the signal generator to produce a 1.75 V peak (3.5 V peak-to-peak), 400 Hz sine wave signal. Display this signal on Ch 1 of the oscilloscope. Observe the amplifier output signal on Ch 2 of the scope. Make a hardcopy of the display noting the cross-over distortion.

2. Repeat your observations of part 1 with input signal peak amplitudes of 3.5 V and 7 V (peak-to-peak amplitudes of 7 V and 14 V). Make hardcopies of the displays and discuss your conclusions regarding cross-over distortion vs. signal amplitude.

3. Build the circuit shown in Figure 2 using an LF353 op amp. Repeat the experiment of part 1 and discuss the reduction in cross-over distortion.

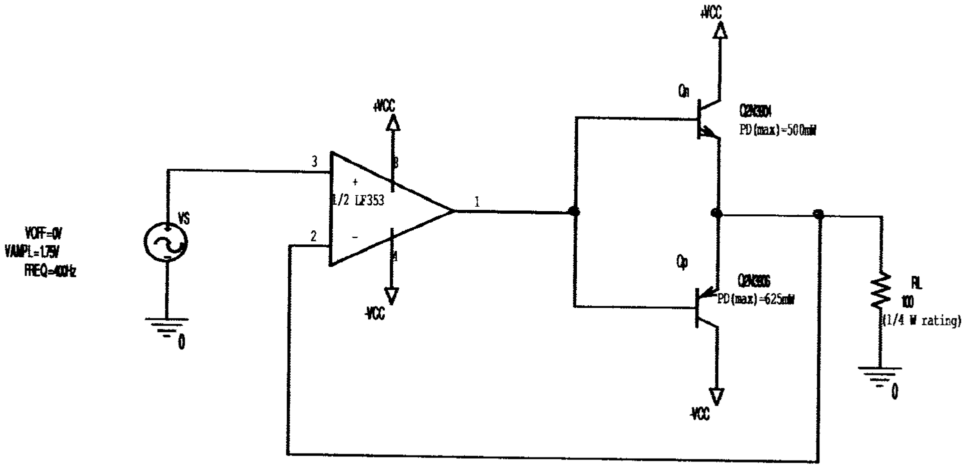

Figure 2, Class B Push-Pull Amplifier with negative feedback

4. Build the Class AB amplifiers shown in Figure 3a and 3b. Repeat the experiment of part 1. Discuss your observations. What trade-offs are made to achieve lower levels of cross-over distortion?

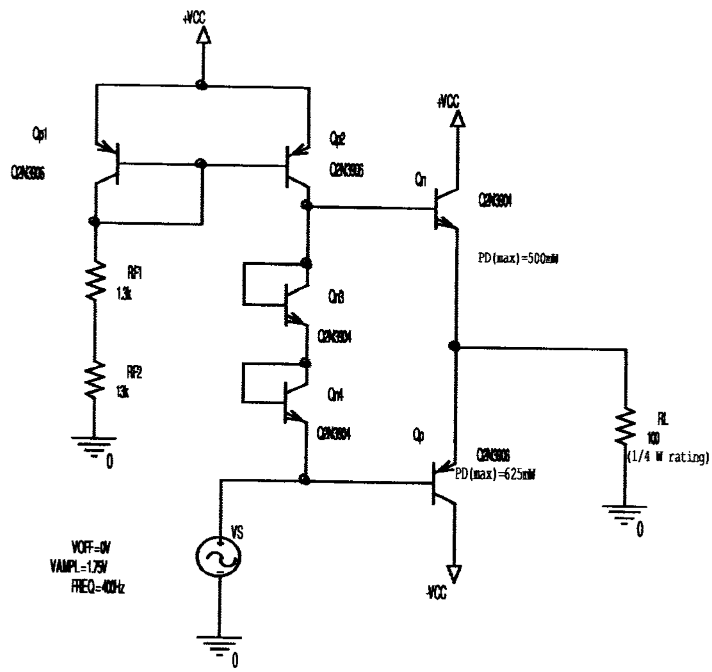

Figure 3a, Class AB Amplifier utilizing diode biasing

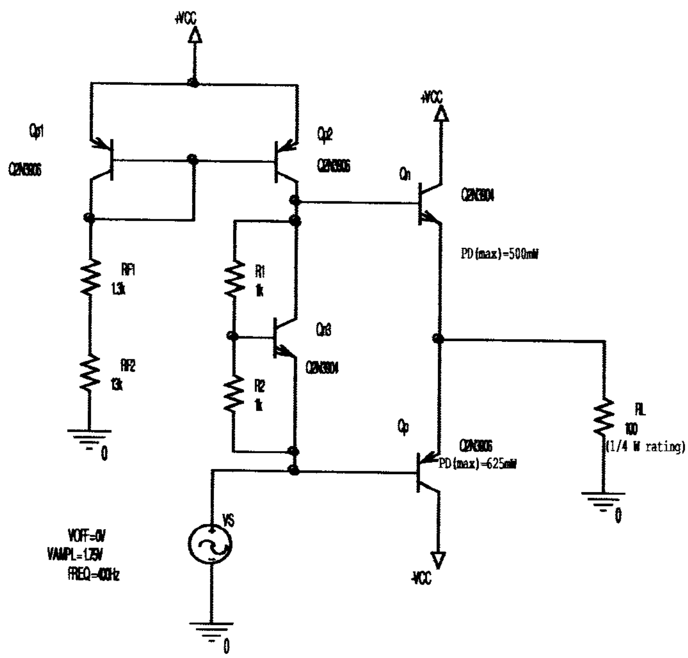

Figure 3b, Class AB Amplifier utilizing V_{BE} multiplier biasing

5 Analysis

5.1 Manual analysis

Perform a DC bias point analysis and AC small signal analysis, and verify that it works as predicted.

5.2 Simulation

Using a simulator, verify the results you calculated and measured. Make all of the same measurements as you did in the lab. Compare the simulation to what you measured.

6 Report

6.1 Executive summary (on cover)

Show a schematic of your op-amp, with its measurements (gain, gain-bandwidth product, clip level, and slew rate).

6.2 More detailed summary.

Write a paragraph on what you learned, and point out any surprises. Does it match the simulation? Explain. Limit this section to one page,

6.3 Journal

Provide a journal of what you did, with enough detail that someone else can reproduce your experiment and verify your work.

6.4 Analysis

Provide your manual analysis of the circuit.

6.5 Simulation

Provide a the results, including commands and netlists, of your simulation. Print it tiny, so you can fit a lot on a page. You should be able to print it "4-up" or smaller. Circle important results.