

ES 330: Electronics II

Laboratory Experiment No. 2**Title:** Design and Analysis of Class B and Class AB Amplifiers

Objective: The main objectives of this lab session will be

- 1) Analyze the dc and ac characteristics of class B and class AB amplifier
- 2) Measure the efficiencies of the amplifiers

N. B. This lab experiment will be a part of your **project 1**. SO YOU MUST SAVE YOUR DESIGN.

Introduction:

In a Class AB Amplifier, each transistor operates in the active region for slightly more than 180° of the ac cycle. With a single power supply, the ac output compliance is approximately equal to V_{CC} . Class AB amplifiers are often used as the output stage of audio systems because they are much more efficient at delivering load power than the Class A amplifiers. We know from our studies that the theoretical efficiency of the Class B amplifier is 78.5%. This is much greater than the Class A amplifier at 25%. The difference between the Class B amplifier and the Class AB amplifier is the biasing level. The Class B amplifier is biased into cutoff and this introduces crossover distortion. This distortion occurs during the time that neither transistor is conducting; and is caused by the transition time required for the transistor to come out of cutoff into the active region of operation. The Class AB amplifier is biased at soft cutoff. This is the point at which the transistor is just beginning to conduct. I_{CQ} is slightly above zero with the Class AB, but the transition time is greatly reduced and this virtually eliminates crossover distortion.

In this lab you will build a Class B amplifier with voltage divider bias, and with diode bias. The voltage divider bias unit will show crossover distortion. It is biased into cutoff and is true Class B. The diode bias unit should be much more stable. We know that there is a real danger of thermal runaway in these amplifiers. The compensating diodes are the usual way to bias these amplifiers. The diodes serve two purposes. The first is that they automatically bias the transistors at soft cutoff (Class AB) and this helps to eliminate crossover distortion. Secondly, they help eliminate thermal runaway by counteracting the thermal runaway effect caused by the emitter diode. Note that these diodes must match the current – voltage characteristics of the emitter diodes.

Class B Amplifier

Build the circuit as shown in Figure 1. Initially set the R_1 value at its mid position. Now apply the power and adjust R_1 to provide mid point bias. Set the signal generator frequency to 1 kHz and amplitude to the minimum. Now gradually increase the amplitude of the input signal until you get an output voltage of 6 V (p-p) at the output terminal.

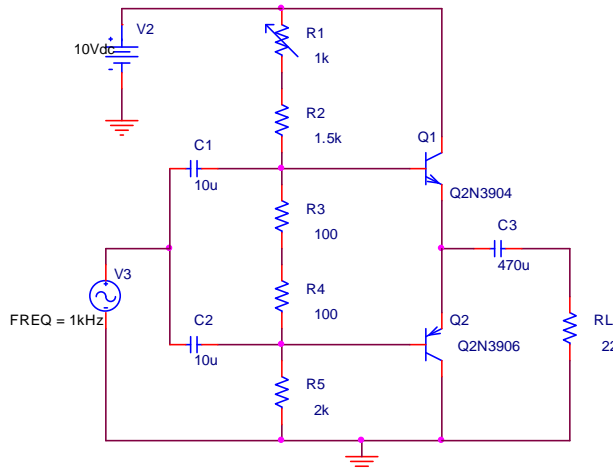


Fig 1: Class B Amplifier

1. Observe the input and output waveform on the oscilloscope. Explain the reasons of any sort of signal distortion in the output signal.
2. Measure the frequency response of the amplifier
3. Measure the voltage gain of the amplifier at the mid band frequency
4. Insert an ammeter to properly measure I_{CC} . Increase the input signal until the amplifier reaches compliance. Measure I_{CC} .
5. With the amplifier at compliance, measure the peak-to-peak output voltage, $V_{out(max)}$.
6. Calculate efficiency $\eta = P_{ac}/P_{avg}$

Class AB Amplifier

Build the circuit as shown in Figure 2. Initially set the R_1 value at its mid position. Now apply the power and adjust R_1 to provide mid point bias. Set the signal generator frequency to 1 kHz and amplitude to the minimum. Now gradually increase the amplitude of the input signal until you get an output voltage of 6 V (p-p) at the output terminal.

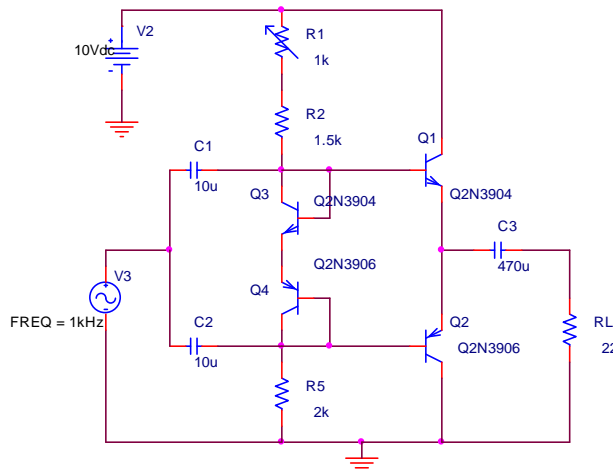


Fig 2: Class AB Amplifier

1. Observe the input and output waveform on the oscilloscope.
2. Measure the frequency response of the amplifier
3. Measure the voltage gain of the amplifier at the mid band frequency
4. Insert an ammeter to properly measure I_{CC} . Increase the input signal until the amplifier reaches compliance. Measure I_{CC} .
5. With the amplifier at compliance, measure the peak-to-peak output voltage, $V_{out(max)}$.
6. Calculate efficiency $\eta = P_{ac}/P_{avg}$

Reference:

http://www.carlmozetic.net/userfiles/Lab_8.pdf