1 Lab Introduction

In this lab you will build and characterize several output stages. The learning goals are listed below:

- Implement class A, B and AB amplifiers, which requires considering their biasing.
- Observe differences in distortion, power output and efficiency between the amplifiers.

IMPORTANT NOTE: The class AB circuit you build here is the output stage of your operational amplifier. Please keep it on your breadboard for use in future labs.

Some guidelines apply to all circuits we're going to build today:

- All amplifier measurements (except output impedance) should be carried out with an 8Ω load resistor attached. This resistance is a common impedance for speakers, so we're simulating driving out audio power. (Feel free to put a speaker on your amps and listen to the waveforms as long as you don't annoy others in the lab!)
- Be mindful of the frequency you use to test the amplifiers. You don't need AC coupling in this lab, which changes our consideration of what frequencies to use. Beware of stray capacitance at high frequencies.
- Be careful not to hook test equipment, particularly signal generators, to DC offsets or large AC outputs. Think about the DC voltage of any node that you DC couple to.
- Be careful of the power ratings of your resistors (usually 0.1W) and transistors (about 0.3W w/o heat sink)

2 Class A

The class A amplifier should be an emitter follower which is biased with a 10mA current mirror attached to the emitter. It should operate on a ±6V supply.

1. Drive the amplifier with a sinusoid and determine the amplitude at which it starts clipping. Compare the Voltage at which this amplifier clips to theory. Record waveforms when it is behaving linearly and when it is substantially clipping.
2. Record a transfer characteristic.
3. Measure r_{in}, r_{out} and a_v for a small input signal. Compare to theory.
4. For the maximum sized input wave that does not clip, find the power from the supply P_S, the power delivered to the load P_L, and the efficiency η. Do you reach the theoretical maximum efficiency?

3 Class B

The class B push-pull amplifier should be a push-pull operating off of a ±6V supply.

1. Drive the amplifier with a maximum sized sinusoid. Compare the output to theory. Record a waveform.
2. Record a transfer characteristic.
3. How big is the deadzone? Does this match in all your measurements?
4. We are not measuring r_{in}, r_{out} and a_v for this amplifier. Explain why.
5. We are not measuring efficiency for this amplifier to simplify the lab.

4 Class AB

The class AB push-pull amplifier should be built to the design in Figure 1.

1. Drive the amplifier with a maximum iszed sinusoid. Compare the output to theory. Record a waveform.
2. Record a transfer characteristic. Keep an eye out for any crossover non-linearity where we cancel the deadzone.
3. Measure r_{in}, r_{out} and a_v for a small input signal. Compare to theory. Note this is non-trivial because current in the BJTs varies over one cycle, we don't have a constant bias current like we're used to.
4. For the maximum sized input wave, find the power from the supply P_S, the power delivered to the load P_L, and the efficiency η. Do you reach the theoretical maximum efficiency?

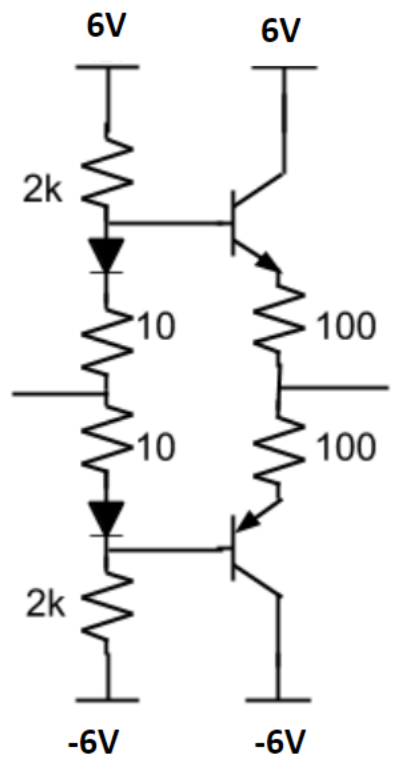

Figure 1: Schematic of a Class AB push-pull amplifier.

Required Data: See table below

	Class A	Class B	Class C
Transfer Characteristic	Yes	Yes	Yes
Waveform at small input amplitude showing linearity.	Yes	No	Yes
Waveform at max input amplitude (compare to theory)	Yes	Yes	Yes
Waveform showing clipping on top/bottom	Yes	No	No
Deadzone size (compare to theory)	No	Yes	Look close
r_{in}, r_{out}, and a_v (compare to theory)	Yes	Why not?	Yes
P_S, P_L, η, and discussion of theoretical max	Yes	No	Yes