

# EE 43/100 FINAL PROJECT: AN AUDIO AMPLIFIER

## Part 2: Audio Amplifier

### Prelab

**1 Amplifier Block Diagram** In this lab we'll be building a simple audio amplification system. This system will be powered by the AC to DC converter you built last week, and so in the end you should have a stand along amplifier that you can take home and use on your own.

The amplifier we'll build is depicted in the block diagram shown in Figure 1.

The tone control stage independently controls the treble and bass content of the signal. The treble and bass can either be boosted (amplified) or attenuated as shown in Figure 2. The two curves on either side of the 640 Hz line represent the twisting the treble and bass knobs to their two extremes. The amp stage can be configured with the volume knob to output anything from 0 (no output signal, not 0 dB) to a 20 dB gain.

Suppose I'm listening to a song that has an annoying singer. This singer sings at around 13 kHz to 15 kHz. I want to cut the singer's voice out of my song so that I don't have to listen to it, but I still want to listen to the rest of the song at a reasonable volume. How much can I attenuate this singer's voice?

Suppose there's also a violin playing at around 10kHz. If we cut out the singer's voice, what will happen to the violin and why?

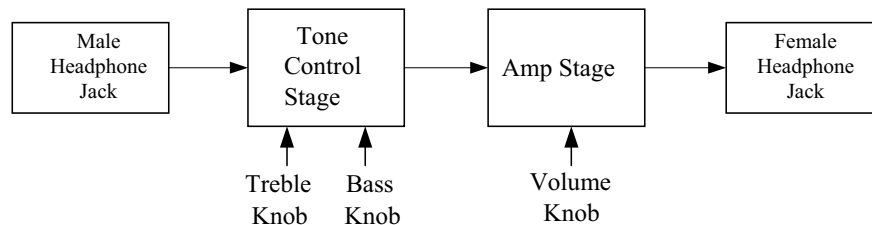


Figure 1: Amplifier block diagram.

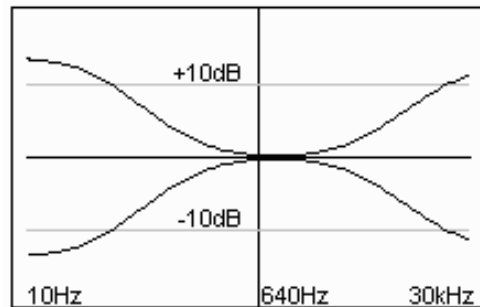


Figure 2: Tone control transfer function. On the left there are two plots representing full bass boost and full bass cut. Twisting the bass knob will yield a transfer function somewhere in the middle. The treble operates similarly.

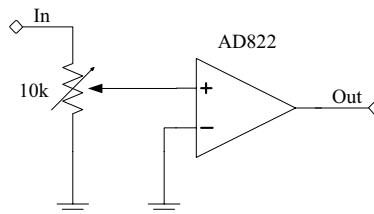


Figure 3: A lower-level look at the amp stage implementation.

Suppose we like bass line in a certain song, and suppose that most of this bass line is centered at about 30Hz. By how much can I amplify that bass line using this circuit?

## 2 A Closer Look at the Amp Stage

The amp stage we'll use in this lab looks something like Figure 3. The AD822 is a high-power op-amp. Good headphones look like an  $8\Omega$  load, and this op-amp is able to drive into an  $8\Omega$  load (how much current is this?) without being damaged. In the lab circuit, the AD822 is configured to provide a fixed 20 dB gain. Figure 3 uses one volume knob to provide anywhere from no output at all to a 20 dB gain. Describe how it does this if the gain of the AD822 is fixed.

Let  $x$  be the percentage that the volume knob is turned. If  $x = 0$  say that the positive input on the AD822 is connected directly to the audio input, and if  $x = 1$  then the positive input on the AD822 is connected directly to ground. Let  $V_{in}$  be the input voltage, i.e. the audio signal, and let  $V_{out}$  be the output voltage. Express  $V_{out}$  as a function of  $V_{in}$  and  $x$ . Note that this requires you to convert the fixed 20 dB gain into a non-logarithmic form.

### 3 Building the Circuit

You will not have enough time to finish the audio amplifier unless you build the circuit outside of lab. Before you show up to the second lab, build the part of the circuit that is listed below. Your pre-lab grade will be based significantly on completion of this section (not to mention, you probably will not finish the project if you do not build your circuit at home). Pay attention to the questions that are asked at the end of each section, as you will have to answer each of them during lab. Don't worry if your POT or AC transformer to breadboard jack does not stay in your breadboard; it may be necessary to solder wires to them.

- **Tone Control:** This section of the circuit controls the amplitude of the high frequency (treble) and low frequency (bass) components of the audio amplifier. Follow the directions in section 5 of the Part II lab guide to build the circuit. Leave the input into this section (male headphone jack) and the output from this section into the audio amplifier section unconnected, since you still need to test the audio amplifier section during lab. Do your best to limit this part of your circuit to the bottom third of your breadboard.

Once you are done, the tone control section of your circuit should look like top half of Figure 7 in the Part II guide.

TA Initials \_\_\_\_\_