EE 40 Final Lab: 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
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.

to the violin and why?

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 LM386 is a high-power opamp. Good headphones look like a 8Ω load, and this opamp is able to drive into an 8Ω load (how much current is this?)
without being damaged. In the lab circuit, the LM386 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 LM386 is fixed.

Let $x$ be the percentage that the volume knob is turned. If $x = 0$ say that the positive input on the LM386 is connected directly to the audio input, and if $x = 1$ then the positive input on the LM386 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 Circuit Assembly

At home before lab, build all circuitry needed to get Section 4 of the lab working. This means making sure your power supply circuit is built properly and then building the amp circuit. You will not be able to solder the male headphone jack at home, but you should be able to do everything else. This should give you a running start when you get to lab.

Present your built circuit to your GSI at the beginning of lab and have him sign here as proof that it was built at home: