

ECE137A 2025, Lab project 1

Basic Audio Amplifier.

You must purchase lead-free solder from the electronics shop. Do not purchase solder elsewhere, as it will likely be tin/lead solder, which is toxic. "Solder-sucker" desoldering tools are not permitted in the lab, as they disperse a dust of solder granules into the air and onto surrounding surfaces. If you are also foolishly using tin/lead solder, you will then poison yourself. Again, use lead-free solder from the shop, and use desoldering wick to remove solder. Projects assembled using lead-containing solder will receive a grade of zero..

You will build a small single-stage audio amplifier which could ultimately interface between the headphone output of a dataphone or portable music player. You might want to do preliminary prototyping on a proto-board, but the design to be checked off must be soldered together on a circuit board.

A typical speaker is ~ 8 Ohms resistance with some series inductance.

Amplifier Specifications

Supply voltage:

5 V plus/minus 5%.

Voltage Gain:

2, plus/minus 15%, at 1kHz

Small signal input impedance:

At least 10 Ohms at 1kHz

Frequency range:

Gain at 400Hz and at 4kHz must be within 3dB of that at 1kHz.

Output:

You are designing for at least 1.0 V peak-peak maximum output.

Specifically: at 1 kHz, gain must not vary more than 15% between 0.1 V peak-peak and 1.0 V peak-peak output:

Hints:

Common-emitter amplifier, with emitter degeneration, using a 2N5191 or 2N5194. AC (capacitive) coupling on input and output. Expect that you will need some large (expensive) electrolytic capacitors. You will need to mount the transistor FIRMLY to a

heat sink. Power supply bypass capacitors are necessary. Check power, voltage and current ratings of all parts.

If you use the 8 Ohm speaker as your collector load resistor (i.e. let DC current pass through it), you will ease the design constraints.

If you understand the class material really well, you might attempt a 2-stage design with a common-emitter input stage and an emitter follower output stage. This requires more advanced understanding of the class material, but will also much more easily meet the design specifications.

Testing:

Have a switch in your circuit so that you can switch between a speaker and an 8 Ohm dummy load for testing to the above specifications. Otherwise, the noise in the lab will be distracting. Further, the impedance of a real speaker, only nominally 8 Ohms, varies considerably with frequency, and this will cause the circuit gain to vary in unexpected ways.