

Lab 3b – Audio Amplifier Soldering

GOAL

The overall goal of Lab3 is to build a battery powered audio amplifier.

OBJECTIVES

Lab3a: (1) Design an audio amplifier using an op amp and Class AB stage.

(2) Build a prototype on a breadboard.

(3) Test your prototype to validate your design.

Lab3b: (1) Build a soldered version.

(2) Demonstrate a working amplifier.

GENERAL GUIDELINES

You should know the guidelines by now ...

PARTS AND MATERIALS

- Power supply, scope, scope probes, function generator, BNC+alligator clips, banana cables
- Lab kit containing breadboard, wires, wire stripper, and other tools
- Same circuit components as last week
- 16 ohm speaker (one)
- Audio cable (one)
- AA batteries (six)
- AA 3-pack battery holder (two)

INTRODUCTION

The overall goal of Lab3 (two weeks) is to build a battery-powered audio amplifier. You get to keep the soldered version of your amplifier (includes audio cable and speaker)! The overall specifications are the following:

- 1) $\pm V_{CC} = \pm 4.5V$
- 2) Overall voltage gain ≥ 10 from 400 Hz to 4 kHz
- 3) Input impedance $R_{IN} \geq 50 k\Omega$
- 4) Drive a 16Ω speaker with up to 125 mW.

PART 1: BREADBOARD PROTOTYPE

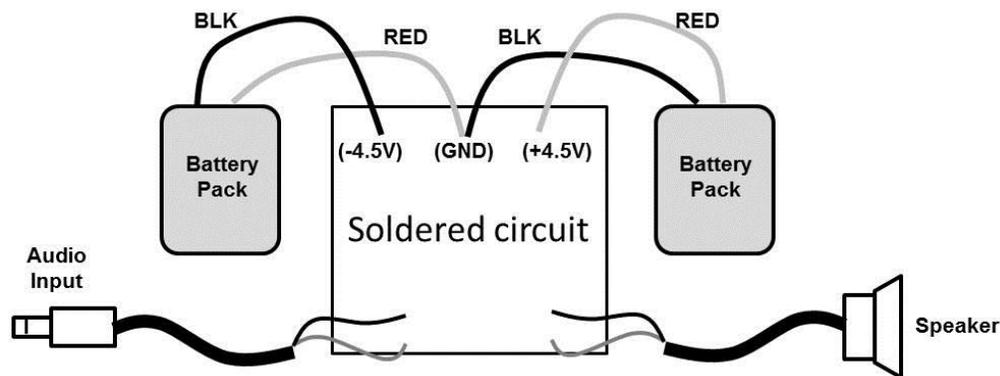
It is a good idea to confirm your breadboarded amplifier still works!

- Clean up the wiring – this produces an easier-to-follow “blueprint” for your soldering.
- Hook up $\pm V_{CC} = \pm 4.5V$
- Configure the Agilent function generator:
 - High Z output
 - Sine wave at 1 kHz
 - Set the sine wave amplitude to produce an amplifier output of at least $4V_{PP}$.
 - Apply the input signal with coaxial cable and alligator clips
- Use the scope to measure the voltage across the 16 ohm load resistor.
- You do NOT have to demo your completed prototype.

PART 2: SOLDERING

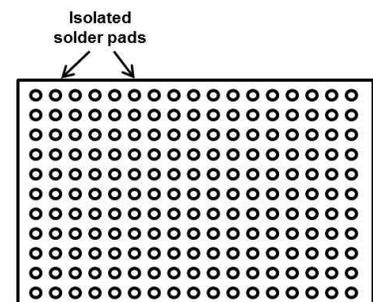
This is perhaps the most rewarding, as well as frustrating, part of the lab. Your finished amplifier should look something like the figure below.

- The circuit is soldered onto a “protoboard” (described below).
- Power is provided by TWO battery packs, one for $+4.5V$ and the other for $-4.5V$.
- A two-foot long audio cable delivers signal from the “headphone” output of a computer, phone, etc.
- The output is a small 16 ohm speaker.



The “protoboard”:

- Each hole on the protoboard is isolated! This is different from the breadboard, where all five holes in a row are connected.
- There are NO bus lines to deliver power or ground.
- The soldering pads are on ONE side of the protoboard.
- You place components on the NON-metallized side of the protoboard.

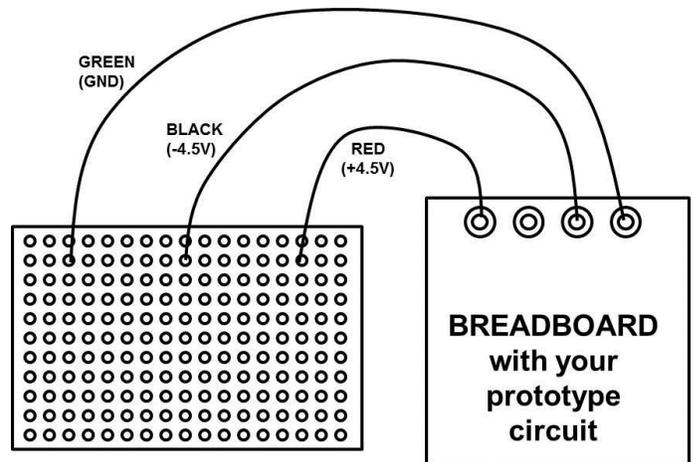


When you first solder your circuit, you should do the following:

- 1) Use the benchtop supply to power your circuit (see below).
- 2) Use the Agilent function generator + alligator clips to provide an input test signal.
- 3) Use the 16 ohm load resistor.
- 4) **Record and demo scope traces of max V_{OUT} (400 Hz, 1 kHz, and 4 kHz sine wave) to Prof. Hedrick (6 out of 10 pts of lab demo grade) with the 16 ohm load resistor.**
- 5) Replace the benchtop supply with the battery packs.
- 6) Replace the alligator clip connection with the audio cable.
- 7) Replace the 16 ohm resistor with the speaker.
- 8) **Demo your working amplifier with an audio signal (e.g. from computer or phone) (4 out of 10 pts of lab demo grade).**

Power supply wires:

- It is a good idea to **FIRST** power your soldered circuit from the benchtop supply. **Only at the very end (after confirming your soldered circuit works) should you attach the batteries.**
- A recommended starting point is to solder a long red, green, and black wire to the proto-board. Each wire should be about 6 inches long. This allows you to connect to the power pins of your breadboard (see figure).



Circuit components:

- For the op amp, use the 8-pin IC socket. You can then plug in the actual op amp into this socket.
- If you want to connect two neighboring holes, just use a “solder bridge”. This simply means you glop on extra solder to cover both pads.
- If you need to connect widely separated holes, just use a wire. This wire can run on either side of the board. It’s up to you!

Extra time:

- There is a good chance you will need extra time. There will be some soldering irons in N100 for the next week. Note: due to exam 1 we may extend the due date for Lab 3.

(End of Lab 3b)