Pump up the Jam: DIY Audio Amp (CBL Module #4, fall 2022)

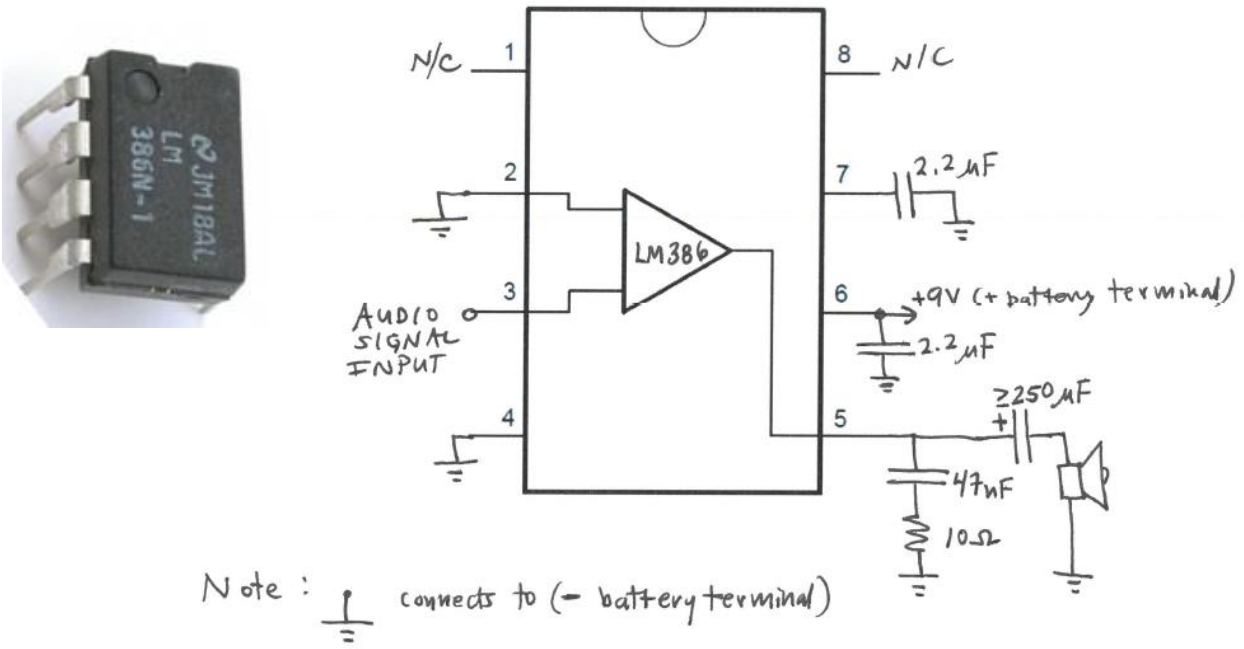

Figure 1. LM386 audio amplifier wiring. Remember to properly orient the op-amp - look for the little dot or half-moon orientation mark on the IC package. You can easily add a slick little volume control using a potentiometer (see figure 3)!

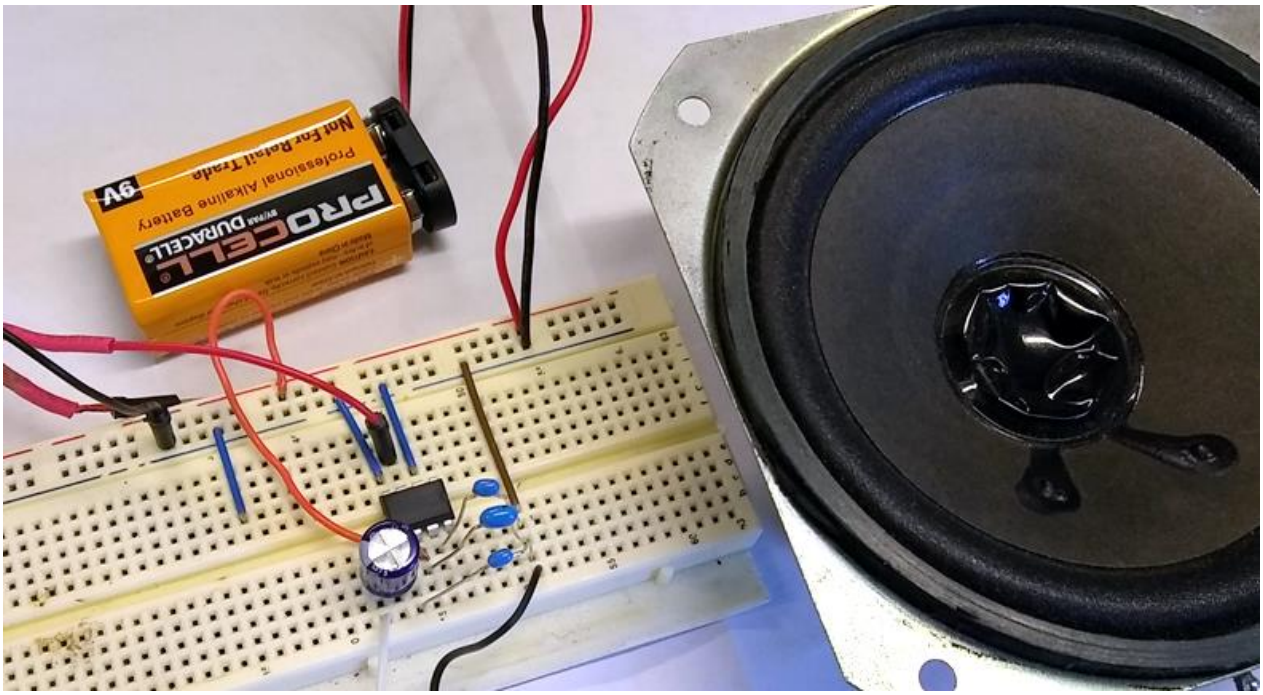

Figure 2. Implementation of the LM386 Audio Amplifier. Note the wiring: nice, tight, simple.

The circuit schematic below shows an optional volume control. It's really easy to implement using a 10k pot (as a voltage divider!!)

9.2.1 LM386 with Gain = 20

Figure 10 shows the minimum part count application that can be implemented using LM386. Its gain is internally set to 20.

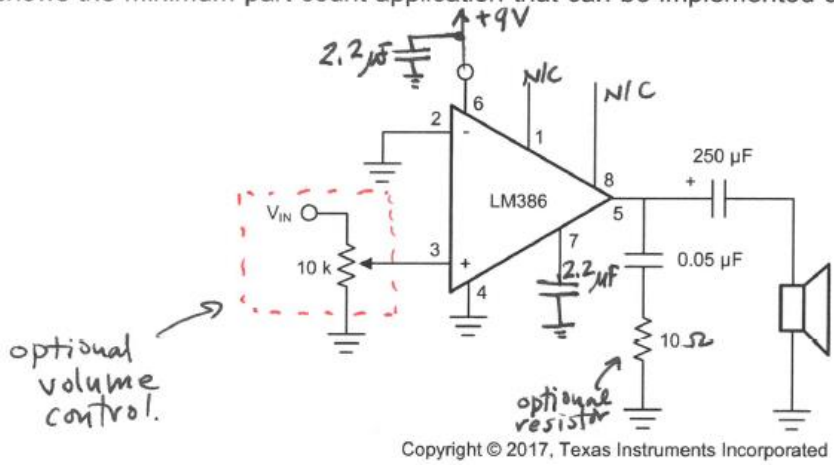

Figure 10. LM386 with Gain = 20

Figure 3. Circuit schematic of LM386 amplifier. Image adapted from TI LM386 datasheet.

An amplifier takes a small signal and makes it bigger! Today's smart phones only output a fraction of a volt, just not enough to drive a speaker. Hence, why we need to amplify the audio signal before playing it through the speaker. Today we'll build a classic audio amp based around the classic TI LM386. By virtue of internal construction, It is set for a gain of 20. This means if you put a 0.1 V amplitude sine wave in, you'll get a 20 x 0.1 V = 2.0 V signal out. The sound quality is quite impressive. So let's build one!

Build notes:

- It should take about <= 20 min to construct the system by a relatively experienced hand.
- The LM386 amplifier is internally constructed to have a **gain = 20**.
- **The giant 250 uF capacitor is electrolytic—it is polarized. Make sure to orient it properly**, else it can blow up. Be sure to connect the positive terminal to the output of the amplifier.
- The entire system is **powered by a 9V battery**. This means the amplifier oscillates around a baseline of 4.5V Volts. Of course, only oscillations matter—we want sound *waves* after all! The giant 250 uF capacitor and the speaker is essentially form a **high pass filter**, cutting out the 4.5V offset, letting just the oscillating waves pass. Those waves are the sound we want to hear!
- The 2.2 uF capacitors are called "**bypass capacitors**". They help maintain a constant 9V supply to the amplifier even when its power demands vary in time. For instance, if a big bass boom comes through, that requires a lot of power. The battery might not be able to deliver enough

current all at once. The capacitors release some of their stored charge to help the battery in a time of need!

- The 47 nF capacitor connected to the output acts like a **short circuit for high frequency noise**, essentially filtering it out. The 10 ohm resistor can be something a little larger, or many a builder has found it can be just short circuited (0 Ohms).

Volume Control:

Add a volume control to your system! All you need is a single potentiometer. As you then the knob the volume increases or decreases accordingly. Add one to your system, as indicated in figure 3

How does this work? The + terminal of the amplifier sees the voltage the voltage across the 'bottom' of the potentiometer. Volume is maximum when the wiper is at the top (connected straight to the audio source; maximal resistance in pot); and minimal when the wiper is at the bottom (shorted ground; minimum resistance in bottom of pot).

One really fun thing to do is view the audio signals in real time using a mobile device oscilloscope app. I like "Sound Oscilloscope" by Bolden in the Google Play store. I imagine there is something similar for iphone and/or laptops.