Optical Laser Communicator
Module #4 – Power Amplification

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Introduction
In the previous module you constructed a high pass filter that took the positive-centered voltage signal from the photodiode and made it zero-centered. In this module you will construct and test an amplifier that will drive the speaker. Specifically, you will use an LM386 integrated circuit (U1 in Figure 1) that will amplify the input voltage signal by a factor of 10 and drive the speaker SP1. You will also learn to solder by soldering wire to the speaker terminals.

Module #4: Power amplification and soldering

Build the power amplifier (minus the speaker)

The LM386 integrated circuit amplifier has two purposes. First, it provides a voltage amplification of x20. If your input signal, as observed on an oscilloscope, is ±0.2V, after amplification it will be ±4V. Second, it is a power amplifier. Remember power = voltage x current. An amplifier that raises the voltage but that cannot provide much current cannot be used for driving a current-hungry speaker. The LM386 is designed to provide as much current as the 8Ω speakers we use require.

1) Test the previous module. Before you begin to build this module, make sure the output from module 2 works as designed. Do not skip this step or you will end up spending a lot more time debugging; I promise you will regret it! Specifically, power up your circuit and attach an oscilloscope probe to measure the output of module 2. Remember: the oscilloscope ground lead must be connected to a ground wire that is ultimately
connected to the Cadet II ground terminal, and the straight thick black plastic main grabber tip should be
collected to a spare piece of hookup wire that is connected to the output of R2 in Figure 1. Start the NI-
softscope (read the previous lab for more detailed instructions if you need them). You should see a zero signal
that reacts to sudden changes in light from a flashlight, but does not register a strong signal to unchanging
brightness or to unchanging darkness.

2) **Wire up the LM386.** Turn off power to your Cadet II and disconnect your circuit
from it. Turn on the Cadet II and, using your DMM, adjust V- using the knob until it
reads -5V. Turn off the Cadet II power, and place the LM386 on your breadboard
so it straddles the middle of the pin rows as shown to the right. This way no pins
are shorted and you can get easy access to all of the IC pins. Wire up the +5V, the
-5V, and the ground wire first to the LM386, then turn on the power and measure the
voltages at the pins 2, 4, and 6 to ensure they are 0V, -5V, and +5V respectively. Then build the rest of
Module 4 shown in Figure 1 except leave out the speaker. Note that capacitor C2 is polarized. The schematic
shows the positive side C2 goes to U1's pin 5, although the capacitor's negative pin is the one that is typically
marked with a large minus sign that goes to the speaker.

3) **Solder wires to the speaker.**
Soldering is an art, one that teaches young electrical engineers
among other things the smell of burnt human skin. Try to avoid
that. Cut two pieces of hookup wire about 6" long and strip about
¼" form the both ends of each wire. Using pliers, crimp the wire
around the speaker terminals until
the wire holds itself in position -
you need both hands free to solder.
Pick up the soldering iron and clean
its tip by quickly wiping it in a brass
scrubber, a damp sponge, or a pad
of tip cleaner. The tip should not have any black oxides (“crud”) on it. Touch the solder directly to the tip to
wet it. This should leave a smooth, shiny metal film to the tip but not a ball of solder. Then solder the joint
using the technique explained in Figure 2.

4) **Test the system using instruments**
Attach the speaker to your system and power it up. Use the DMM to check that pin 2 of U1 is 0V, that pin 6 is
+5V, and that pin 4 is -5V. If that passes, use the oscilloscope to check that when you alternately cover and
uncover the photodiode from light that you can see a signal at the input to the speaker of roughly 20 times the
voltage you observed entering module 4. Also check that the signal is centered around 0V; it should be positive
about the same amount that it is negative.

5) **Test it with the laser!**
Finally the good part! Get your circuit checked off by the instructor using the actual laser communicator.
Next class you'll have a chance to fix any remaining problems with it and compete to see how far yours works.