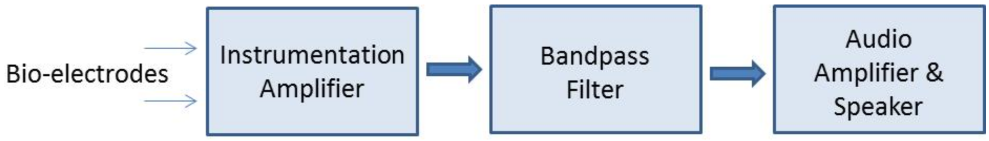
Design of an EMG Amplifier – part 3

Introduction:

You are tasked to design and validate an EMG amplifier that will produce sounds proportional to the intensity of the EMG signal measured with bio-electrodes. The amplifier works with a single 5V dc voltage supply source. The basic layout of the amplifier is shown below. The instrumentation amplifier amplifies the difference between the potentials captured with the 2 bio-electrodes placed on the muscle. The bandpass filter attenuates the frequency signals outside the range of the normal EMG. The audio amplifier produces a replica of the bandpass filter output signal with more power (current) to energize the loudspeaker.



In part 3 of this laboratory, you will experiment with, design, and validate the audio amplifier and speaker circuit. An audio amplifier amplifies low power signals in the audible range of frequencies to drive loudspeakers, which require more power than conventional electronic circuits.

Prelab:

<u>Audio amplifier:</u> Information on audio amplifiers is available in the "Practical Electronics for Inventors" reference book, chapter 16 and you should browse through the chapter.

In the lab, you will have access to several audio amplifiers ICs including the NJM 2113 and the LM 386. The NJM 2113 has a floating load output to the loudspeaker (neither pin of the loudspeaker is connected to ground). The LM 386 has a single ended output to the loudspeaker (the negative terminal of the loudspeaker is connected to ground). You should locate and browse through the data sheets of these devices. You will also have access to several types of loudspeakers including the SP-1511S-2 (a phone speaker) and the CVS-1708. Speakers are characterized electrically by their impedance (8 ohms for the speakers above) and their maximum electrical power.

To prepare for the laboratory, you must implement a Multisim circuit that demonstrates the operation of an audio amplifier built with an LM 386. The LM 386 is not included in the general database of devices within Multisim. You will need to create your own model of LM 386 within Multisim using the instructions available at:
http://ecee.colorado.edu/~mathys/ecen1400/Software/CreateLM386.html

Note that the wiring diagrams on the data sheets show a potentiometer at the input of the amplifier which is used to adjust the amplitude of the signal coupled into the audio amplifier. For our circuit, the EMG signal is riding over a 2.5 V dc level, which should be filtered out by using a large capacitor (~ 10 μF) between the signal generator and the potentiometer.

Turn in your Multisim model as part of your prelab. Verify that the circuit is capable of powering an 8 ohm load resistance and provide substantial current. Explain in your prelab report what you did to test the circuit. Also, use the speaker instrument within Multisim (one of the instruments available on the right hand side with the oscilloscopes – see under the yellow arrow) for a more realistic simulation of the sound generation.

You should also devise a plan to test your audio amplifier in the laboratory. We will discuss your design and your plan at the beginning of the lab.

Expected for the prelab:

- Multisim design of the audio amplifier circuit that can be tested with a resistive load and with the built-in speaker model.
- A plan to test the audio amplifier circuit experimentally.

Report:

Each work group will submit a report due one week after the laboratory experiment which should include the following sections:

1. Tested Multisim design of the audio amplifier circuit that operates with the LM 386 device.

2. Procedure in steps to test the audio amplifier in the laboratory. This should be the plan you settled on after the lab discussion.

3. Measurements demonstrating the operation of the audio-amplifier circuit. These measurements should be based on the plan you discussed in step 2.

4. Your analysis and interpretation of the measurements.

5. A discussion of important issues you would consider when implementing an audio circuit as part of a larger analog design.

6. The data sheets for the components you used in the laboratory, including a discussion of what information you used in the data sheets for your designs.