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Generating and Measuring Time-Varying Signals, Op Amp Circuits, and an Op Amp Sound System
Experiment 4

Abstract:

We were to build and test several basic op amp circuits. Using our previous knowledge of op amp circuits with the given equipment this was possible. Learning and being able to use a function generator with an oscilloscope was also a goal. By doing both, building these circuits and learn how to use the equipment we can learn the basic properties of a microphone and build a circuit to amplify a microphone signal. Before attending the lab we had to build a circuit consisting of four resistors (two 2kΩ with two 1 kΩ) and two transistor's. This was to be our power amplifier, a piece of one of our circuits to be used in the near future. Following the given circuit diagram we received (featured below), part of our microphone was already done. The amplifier utilized two transistors, one n-channel MOSFET and one p-channel MOSFET. By correctly wiring their gate, source and drain with the before mentioned resistors, an amplifier was achieved. The V_in and V_out are the be the rest of our microphone. For the first part of the experiment we had to set up the oscilloscope and function generator. The function generator was set to a 2kHz sine wave with peak-to-peak 4V value and DC offset of 2V. Then we simply described what we saw as settings were changed, such as using an AC or DC coupling of the oscilloscope. Part two was connecting our speaker directly to the output of the function generator. Setting the output to 800 Hz sine wave with zero DC offset, we varied the the output voltage until the speaker was reasonably audible. 4V was our voltage. Part 3 consisted of connecting the microphone to the oscilloscope using the provided circuit diagram. Then we found the approximate amplitude of the

voltage Vx from the microphone, which for us was 20mV. This determined the gain needed. Part 4 was to check to see if the microphone can properly hear us as at this point everything was connect (microphone, speaker and circuit as a whole). Part 5 was was to build the given circuit diagram which was a summing amplifier. Function generator was set to 30 kHz, amplitude of 2V peak-to-peak for channel one and 2 kHz, amplitude of 2V peak-to-peak for the second channel. The output was displayed below. This experiment could have been improved if the whole thing was done in class, building the amplifier before lab could result in human error.

Introduction:

The work to be done consists of using new equipment and creating new circuits for eventually what will be a microphone. Learning more about op amp circuits and their potential application was done. The new equipment consists of the function generator and the oscilloscope. We were able to get sound to come out of our microphone. We started by building an amplifier before lab. Part 1 was to connect and use the function generator with the oscilloscope, we played with settings and described what was seen. Part two was to check and use the speaker directly with our function generator. Part three was to connect the microphone to the oscilloscope and test it. Part four was to design a system that would enable our microphone to work by selecting which resistors to use. Part five was to build a summing amplifier and report image of what was seen.

Theory:

__Operational Amplifier:__ Electronic circuit with two different inputs (Vin & Vout) and produce a Vout (one output).

__Function generator:__ Equipment used to create functional voltages for our circuits

__Oscilloscope:__ Equipment used to observe the waveforms of our voltages

__Transistor:__ Circuit element that acts like a voltage controlled current source.

Experiment:

Materials:

P-Channel transistor (IRF 4905), N-Channel transistor (IRF 620), digikey multimeters, protoboard, circuit kit providing everything else from speaker and microphone to wires and resistors.

Pre-lab:

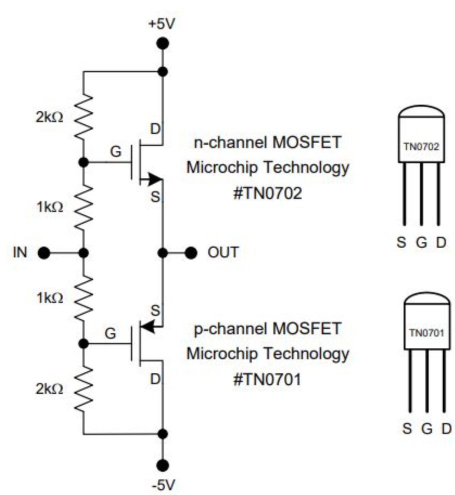


Figure 1, Amplifier Circuit diagram

The featured circuit above was the circuit we needed to build before attending the lab. By using four resistors (two 2kΩ and two 1kΩ), and two transistors (P-channel and n-channel) we were able to do this.

Part 1:

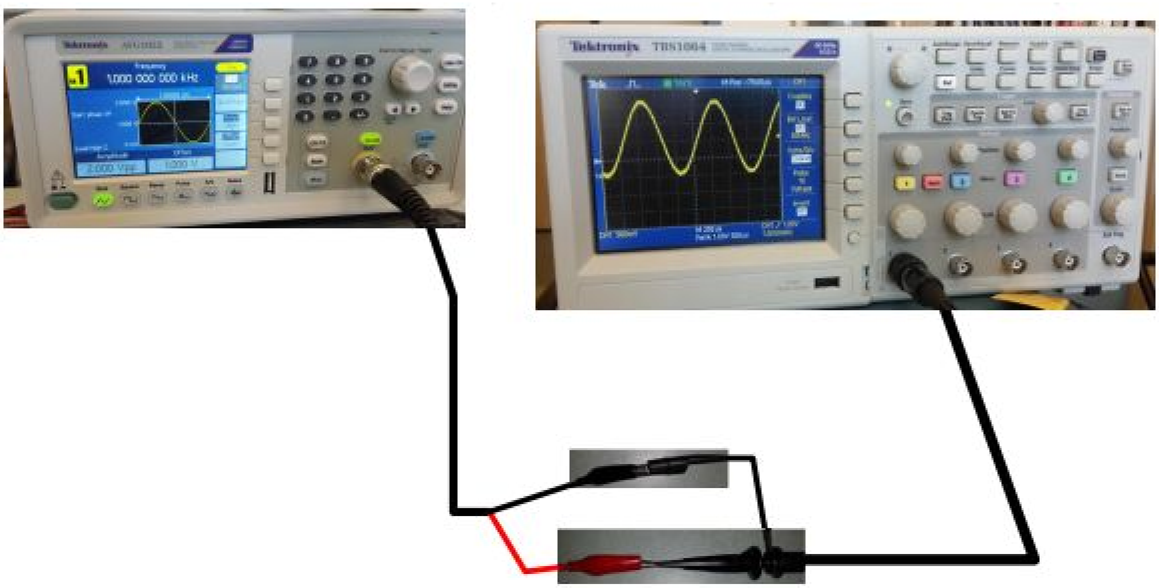


Figure 2, Oscilloscope and Function Generator set-up

The featured picture above was the set up we had to do with our function generator and oscilloscope. As mentioned in the abstract, the function generator was set to 2 kHz sine wave with peak-to-peak value of 4V and DC offset of 2V. Then we simply adjusted the horizontal and vertical scale on our oscilloscope to view the voltage.

Part 2:

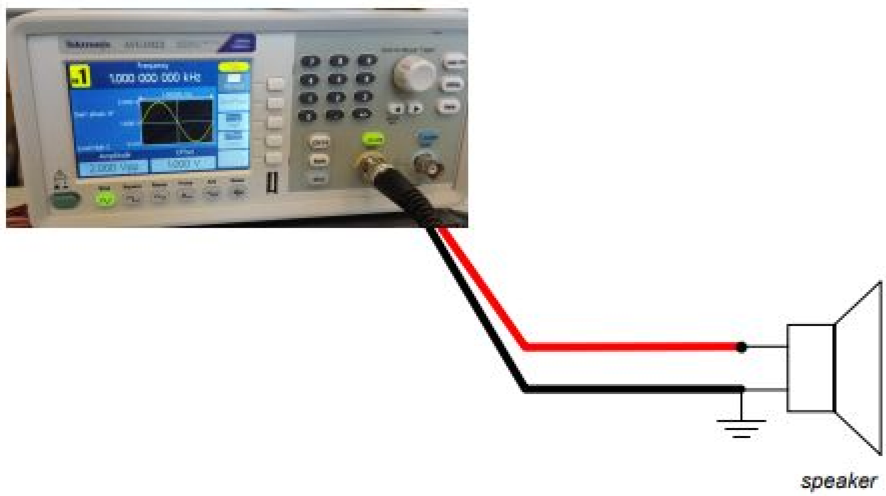


Figure 3, Speaker set-up

The featured pic above shows what we did in part 2. Connecting the speaker to the function generator directly and setting the generator to 800 Hz with zero DC offset, we varied the output voltage until a reasonable sound was generated. Our voltage was approximately 4V.

Part 3:

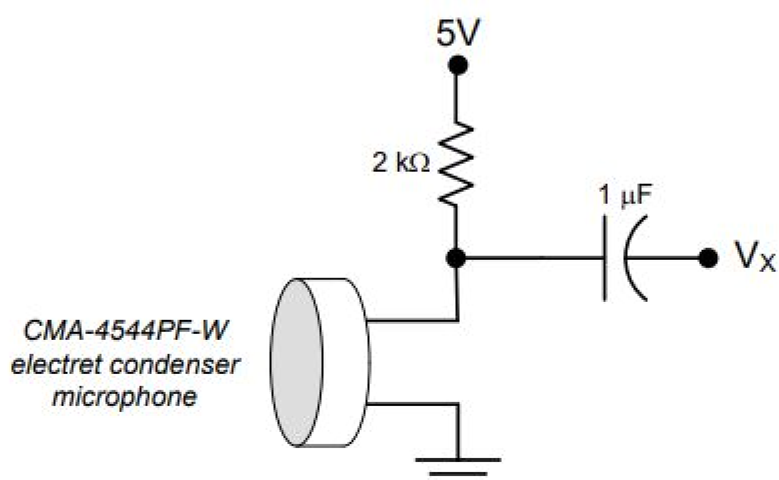


Figure 4, Electric condenser microphone circuit.

We connect the microphone to our oscilloscope using the circuit diagram featured above. By continually speaking into the microphone we were able to approximate the approximate amplitude of Vx (we got 20mV).

Part 4:

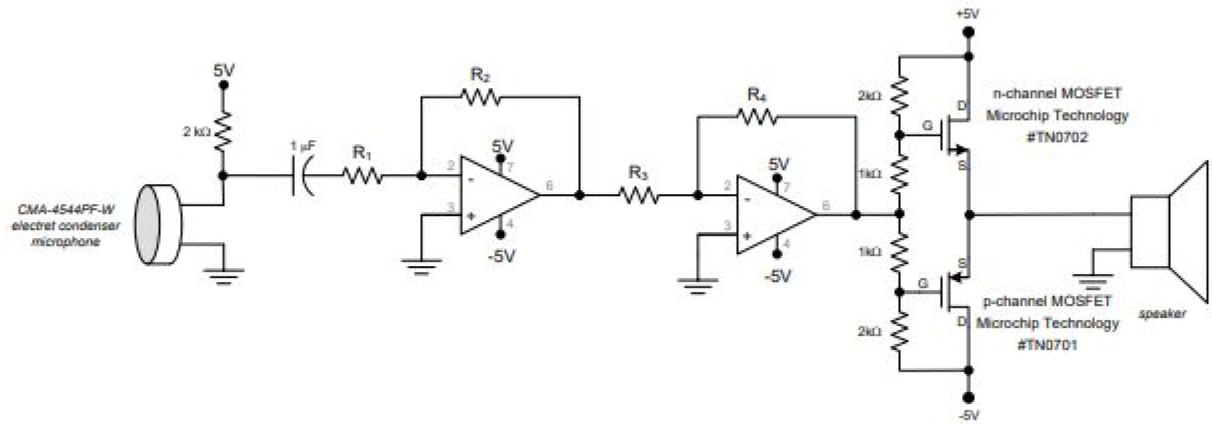


Figure 4, Full mic diagram

The above circuit was constructed and designed to give a nice optimal sound output. By testing different resistors we were able to get the desired effect (four resistors being: 20kΩ, 1kΩ, 50kΩ, and 10kΩ).

Part 5:

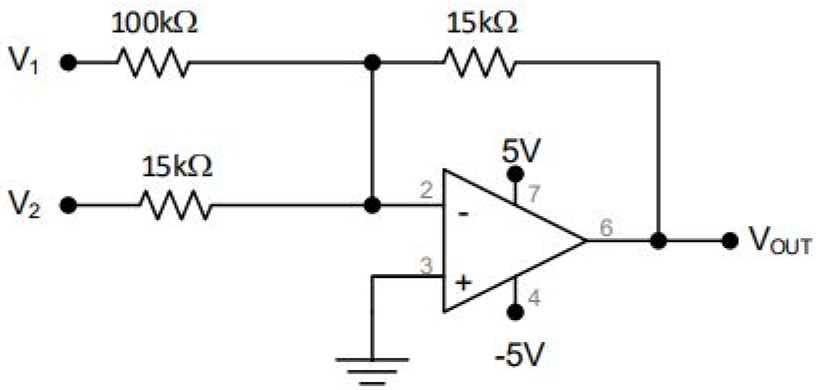


Figure 5 circuit diagram.

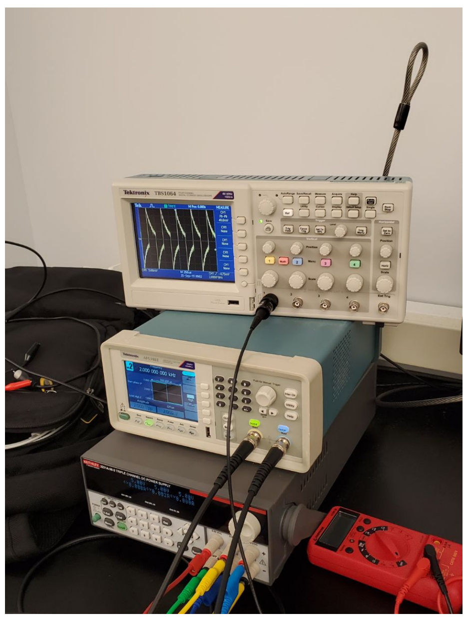
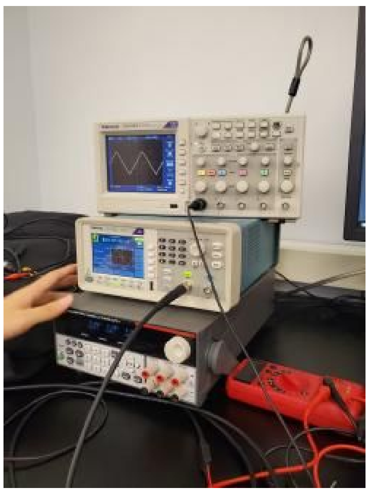


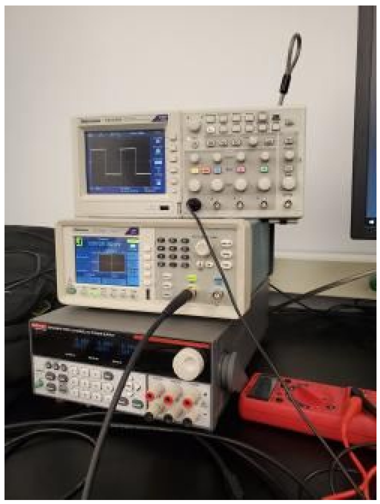
Figure 6

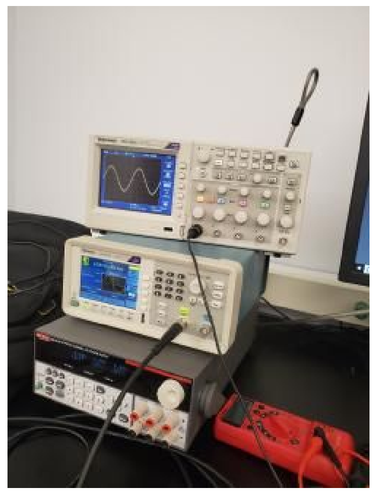
For the last part we constructed a summing amplifier featured above in figure 5. We connected two different voltage inputs, one with a sine wave and the other with a square wave, and recorded the outcome in figure 6.

Results and Discussion:

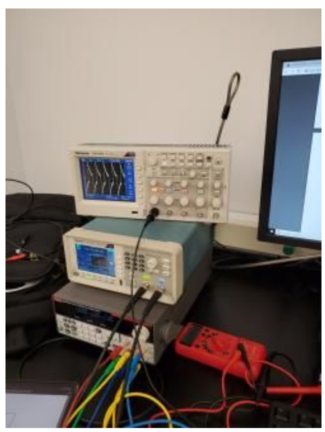
Our results were mostly in viewing the oscilloscope and function generator outputs. Besides getting the four resistors for part 4 (20kΩ, 1kΩ, 50kΩ, and 10kΩ), the 20mV for part 4 and the 4V for part 3, the other data was essentially just pictures:







Triangle Wave **Square Wave** **Sine Wave**



Sine + Square Wave Second Attempt (Correct)

Conclusion:

We were able to get a better understanding of the application of op amps and respective equipment such as an oscilloscope and a function generator. Our methods consisted of setting up the circuits and using the correct output/input channels to do the correct testing. Besides calculating what resistors to use for our design aspect of this experiment (part 4) the data was mostly gathered from changing setting on the respective equipment already mentioned. My only recommendation for the lab is to have the amplifier built in lab and not before.