Part 1: Some basic op-amp circuits

Op-amp follower

The simplest op-amp circuit is called a <u>voltage follower</u>. The circuit consists of simply wiring the op amp output to the negative input. The output of the op amp is then taken as equal to the voltage at the positive input. This circuit is useful since the input to the op amp draws no current, the follower can be added between components of a system in order to isolate the components from each other. A simple example is found in the difference between the two circuits shown in figure 1.
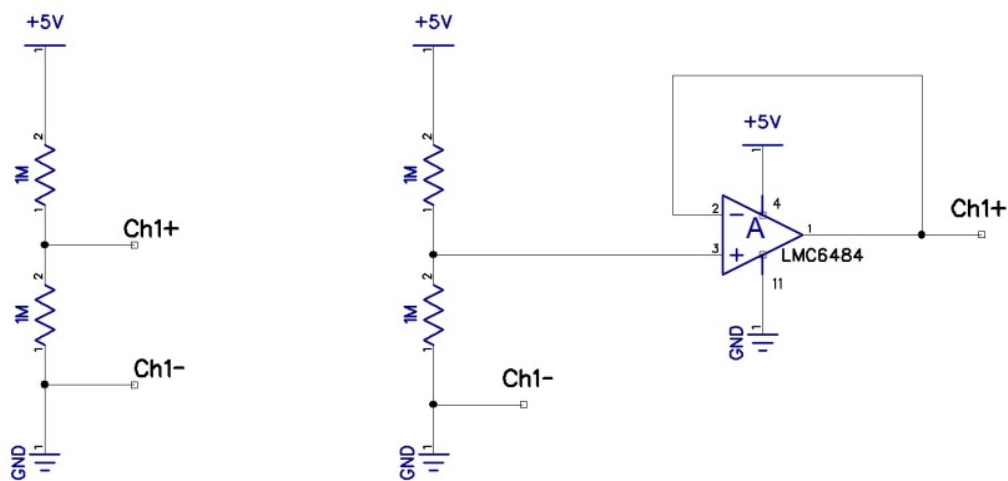

Figure 1: Simple voltage divider with and without an op amp buffer.

Your first experiment is to measure the voltage between two 1 MΩ resistors, as shown on the left of figure 1. We expect the measured voltage to be 2.5 volts. Build the circuit and **report the voltage that you measure**. The reason that the voltage is different than expected is that current flows into the input of the Analog Discovery. Inside the Analog Discovery, there is a relatively large resistance between both the positive and negative inputs (Ch1+ and Ch1-) and ground. This is value is referred to as the device's <u>input impedance</u>. Based on your measurement, **what is the input impedance of the Analog Discovery (Hint, just imagine another resistor sits between ch1+ and ch1- in the figure)?** Repeat the experiment by replacing the two 1M resistors with two, 499K resistors. **What was the expected and measured value of the voltage with a 499K voltage divider, accounting for the devices input impedance?** Now build the circuit on the right with the op amp acting as a buffer. **Report the measured voltage for this circuit. Try to explain why we haven't really noticed the effect of the Analog Discovery's input impedance in our previous labs**. In your lab report you should have a few sentences or a short paragraph describing your results and some simple calculations of the device's input impedance.

Inverting amplifier

Build the circuit shown in figure 2. Test the circuit by using the waveform generator and scope on your Analog Discovery. Put a 100 mV amplitude sinusoidal signal with an offset of 0 volts. With the scope, measure both the input and the output voltage as shown. Adjust the scope time and volts/div scale so that you can see the signal clearly. Now adjust the offset voltage on the input of the waveform generator to 2.5 V. Now adjust your circuit so it looks like Figure 3 – the reference point is changed from ground to 2.5.

In you lab report, provide your measured and theoretical amplifier gain. Explain in a very short paragraph the role of the changing the reference voltage (the positive op-amp input) from ground to 2.5 V.
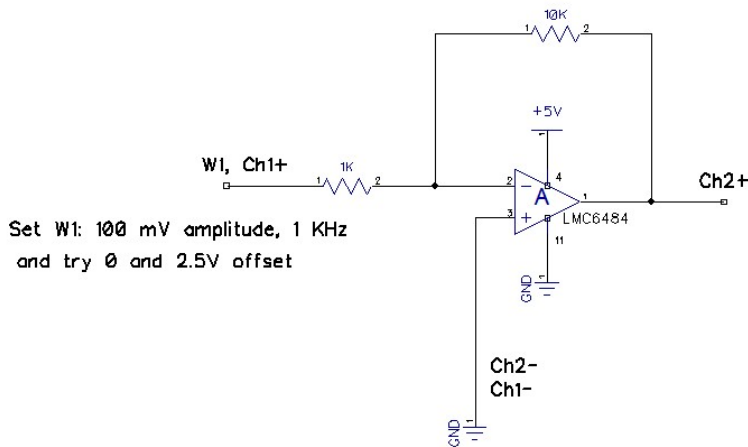
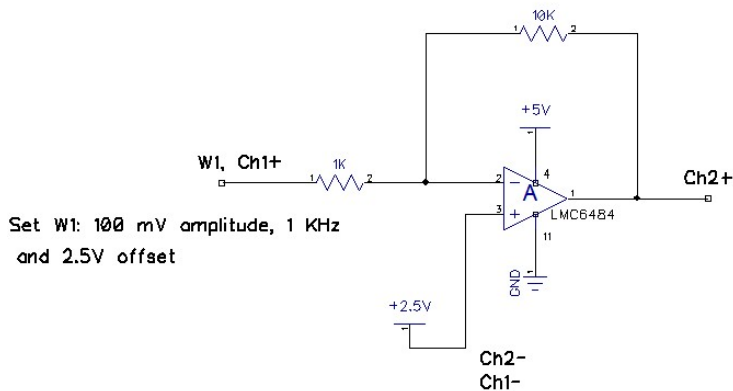**Figure 2: Inverting amplifier - ground referenced.**

Figure 3: Inverting amplifier - 2.5 V referenced.

Non-inverting amplifier.

Build the circuit shown in Figure 4. Test the circuit by using the waveform generator and scope on your Analog Discovery. Put a 100 mV amplitude sinusoidal signal with an offset of 0 volts. With the scope, measure both the input and the output voltage as shown. Adjust the scope time and volts/div scale so that you can see the signal clearly. Now adjust the offset voltage on the input of the waveform generator to 2.5 V. Now adjust your circuit so it looks like Figure 5 – the reference point is changed from ground to 2.5.

In you lab report, provide your measured and theoretical amplifier gain. Explain in a very short paragraph the role of the changing the reference voltage (the positive op-amp input) from ground to 2.5 V.
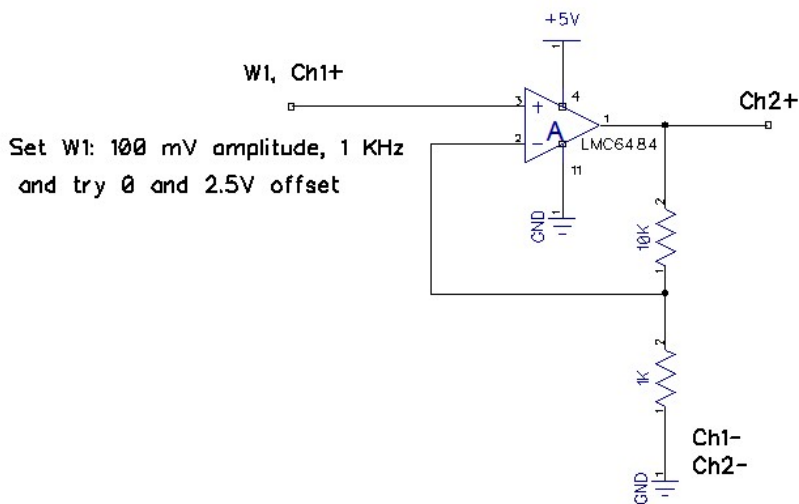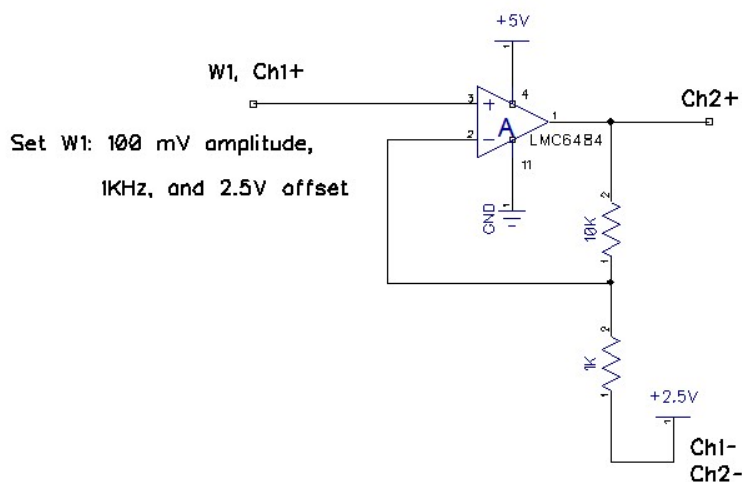

Figure 4; Non-inverting amplifier, ground referenced.

Figure 5: Non-inverting amplifier, 2.5 V referenced.