EECS 100/43
Lab 4 – Linear Op-Amp Circuits

1. Objective

In this lab, you will learn about how to build amplifier circuits.

2. Equipment

        a. Breadboard
        b. Wire cutters
        c. Wires
        d. Oscilloscope
        e. Function Generator
        f. Power supply
        g. 1k resistor x 2
        h. 10k resistor
        i. LMC6482 op-amp
        j. Various connectors for power supply, function generator and oscilloscope.

3. Theory

a. Introduction

Thoroughly read chapter 5 from your book (skip sections mentioned the course handout). This theory section is pretty much a repeat of the information in the book. It includes a little more practical op-amp information. You should go through this theory section after reading chapter 5 from your book.

Operational amplifiers (op-amps) were first developed by George Philbrick when he was an employee for the National Defense Research Council in the early 1940s [1]. The op-amp has lived on for over sixty years and is still the mainstay of many circuits. In this lab you will be using the LMC6482 op-amp.

You know from the book that op-amps can be used to build amplifier circuits. In this lab we study such circuits. In the next lab we study an op-amp circuit that can be used to build oscillators.

 The robustness of the op-amp is because the functionality of the op-amp can be extended by the use of feedback. Although a detailed description of feedback is beyond the scope of this guide, we will give you enough information to appreciate the usefulness of feedback. But first, let us learn some practical features of the op-amp

b. Some Practical Op-Amp Information

How do you use an actual op-amp? A real op-amp does not look like the triangle symbol you use in circuits. Rather, it comes in the form of Dual-inline-package Integrated Circuit (DIP IC) as shown below:

Figure 1. Comparing an op-amp IC to a whiteboard marker

As you can see, the actual op-amp is very tiny indeed! In order to use the op-amp above, you refer to the product's datasheet. A datasheet (as the name suggests) has important data describing the many features of your product. The datasheet for the LMC6482 op-amp can be downloaded off the EECS 100 Lab homepage. It contains a lot of information. Feel free to skim through it before the lab and ask the TA questions you may have. The most important information are on the first couple of pages, and understanding these pages should suffice for this lab. They contain the pinout and power supply requirements of your op-amp. The pinout describes how the actual op-amp corresponds to the circuit models you studied in class. Let us take a look at the first page from the LMC6482 datasheet.
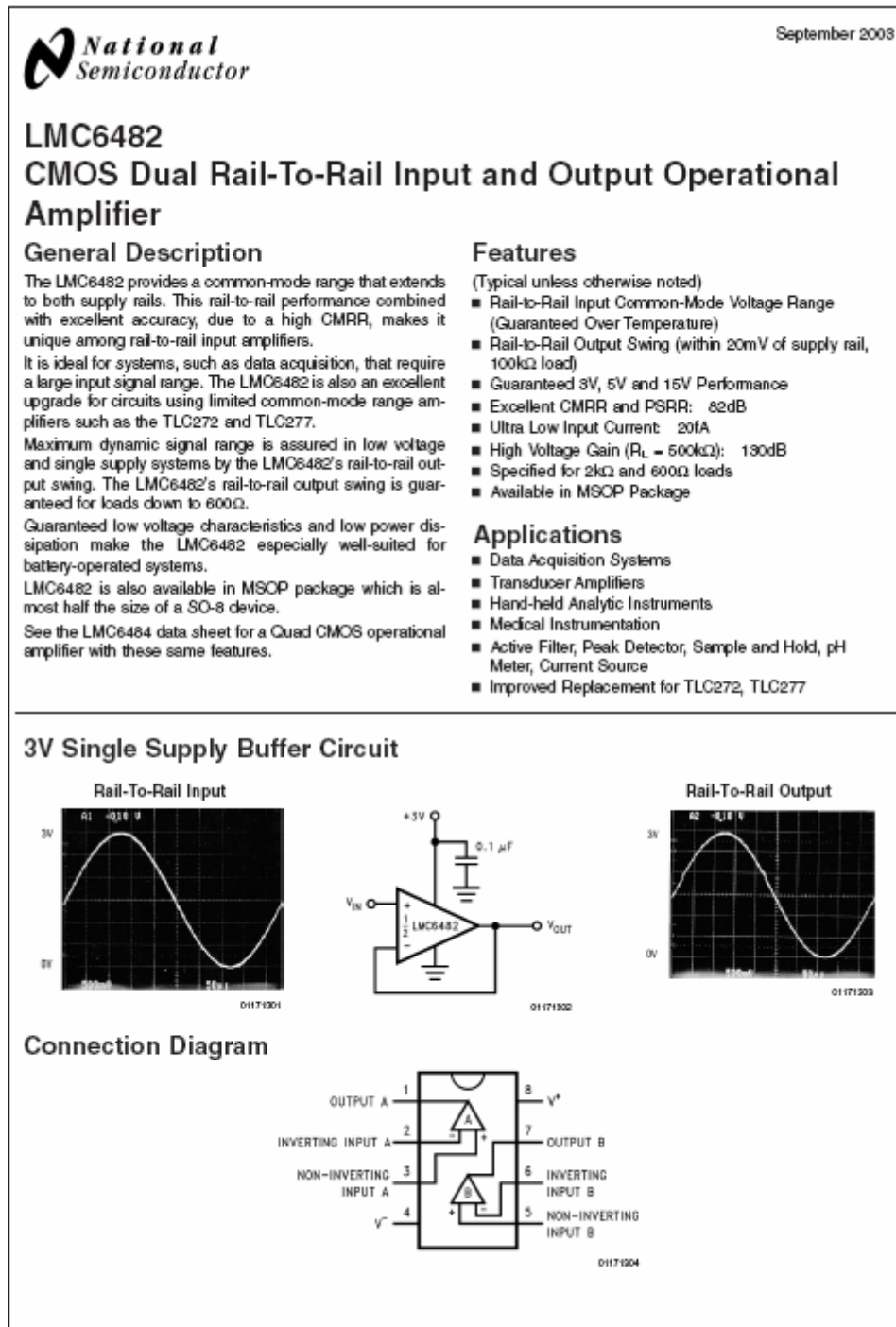
Figure 2. Page 1 from the LMC6482 datasheet

The most important item on page 1 is the pinout of the op-amp. This tells you how to wire the op-amp on a breadboard. Notice that the IC has two op-amps inside. This pinout also shows you how to read the op-amp pin numbering: hold the op-amp with its top-side (the LMC6482 numbering) facing you. You will see a notch (as shown in the

pinout above). The pin to the left of the notch at the top is number 1 and it increases going down. On the right side, the bottom pin is 5 and it increases going up.

As you gain experience with electronics, you will be able to understand more of the datasheet. Specifically, you will deal with the important concept of gain-bandwidth product once you understand frequency response.

4. PRELAB   NAME:_____/SECTION____

Please turn in **INDIVIDUAL COPIES** of the prelab. They are due **10 MINUTES** after
 start of lab, **NO EXCEPTIONS!**

a. TASK 1: Build and simulate the circuit below in MultiSim. Verify the inverting
amplifier functionality of the op-amp circuit.
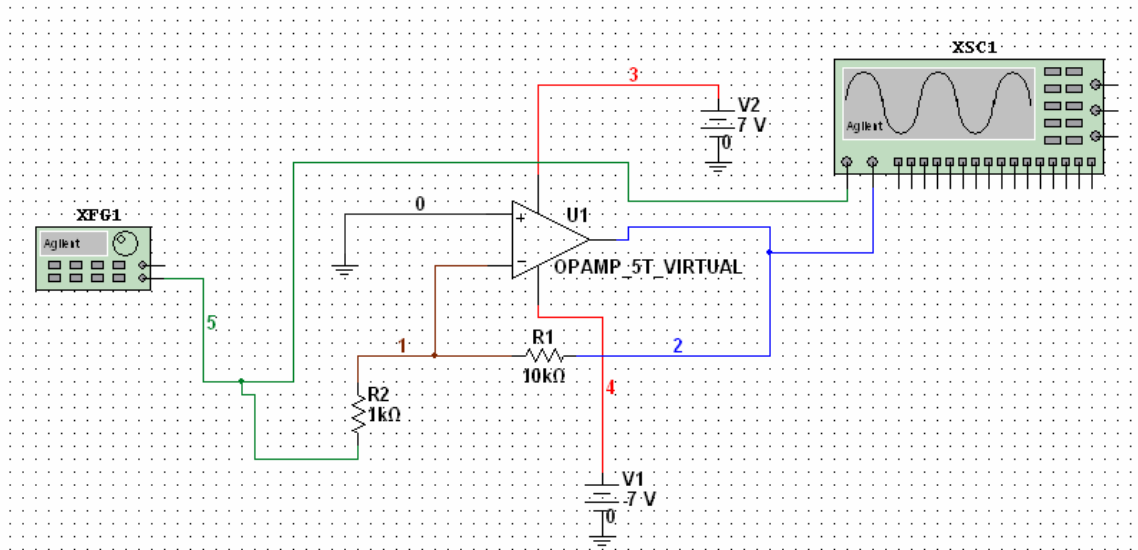
Circuit 1. Inverting Amplifier Circuit

Use 1 kHz frequency for the function generator and a sine wave input. Make sure that in
your oscilloscope you measure the function generator Vpp as 500 mV (remember:
function generator doubles the voltage shown on the display). **Note down your
theoretical gain in table 1.**

b. TASK 2   Build and simulate the following circuit in MultiSim. Verify the non-
inverting functionality of the op-amp circuit.
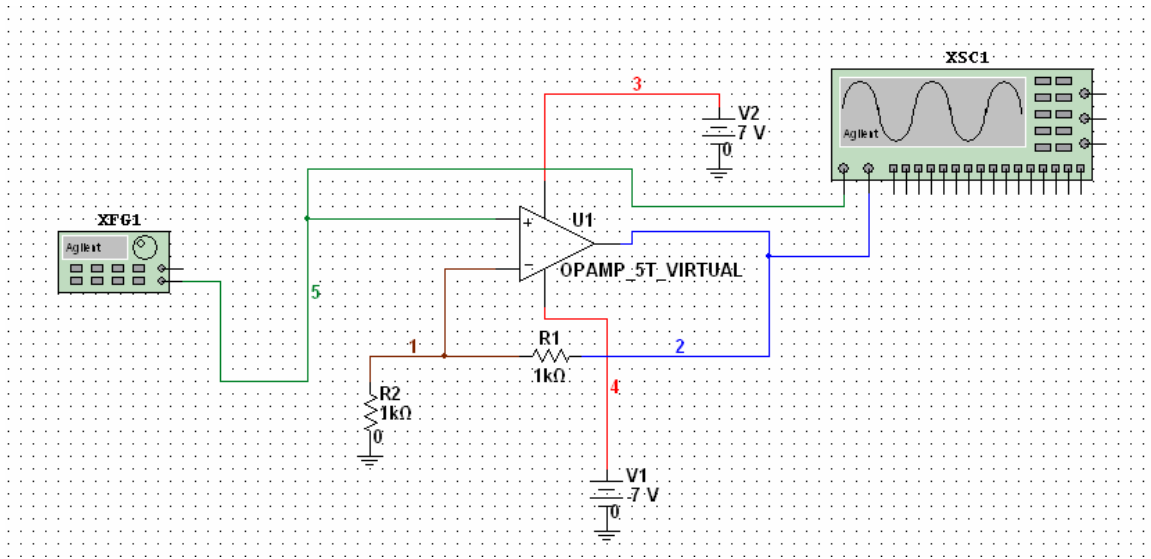
Circuit 2. Noninverting Amplifier Circuit. **NOTICE 1k instead of 10k resistor!**

Use 1 kHz frequency for the function generator and a sine wave input. Make sure that in your oscilloscope you measure the function generator Vpp as 1.00 V (remember: function generator doubles the voltage shown on the display). **Note down your theoretical gain in table 2.**

PRELAB COMPLETE: _____ (TA CHECKOFF)

5. REPORT   NAME(S):_____/SECTION____

a. TASK 1: Build the circuit from prelab task 1 on the breadboard. Use the oscilloscope cursor keys to measure the gain, record it in table 1 and compare to the theoretical calculation.

Parameter	Theory	Experiment	% error
Gain			

Table 1. Gain calculations for the inverting amplifier circuit

b. TASK 2: Build the circuit from prelab task 2 on the breadboard. Use the oscilloscope cursor keys to measure the gain, record it in table 2 and compare to the theoretical calculation.

Parameter	Theory	Experiment	% error
Gain			

Table 2. Gain calculations for the non-inverting amplifier circuit

TURN IN ONE REPORT PER GROUP AT THE END OF YOUR LAB SESSION. THERE IS NO TAKE HOME REPORT.

6. REFERENCES

[1]. Multimedia Tutorial on Operational Amplifiers, Fundamentals and Applications. http://fie.engrng.pitt.edu/fie98/papers/1089.pdf. June 29th 2007.

7. REVISION HISTORY

Date/Author	Revision Comments
Spring 2007/Bharathwaj Muthuswamy	Typed up source documentation, organized lab report, typed up solutions.