Operational Amplifiers

Introduction

Operational Amplifiers, or op-amps as they are commonly called, are incredibly versatile components and are much easier to use than individual transistors for any but the most basic circuits. This set of exercises will give you a chance to experiment with some basic op-amp circuits including inverting and non-inverting amplifiers, adders, and difference amplifiers.

For all of these experiments, use LF411 op-amps unless otherwise specified. The datasheet for this general-purpose FET-input op-amp is on the course website.

Procedure

1. Build an inverting amplifier with a theoretical gain of $-20$. Measure its frequency response (Bode plot) and compare with the expected value. What is the corner frequency?

   The TL061 op-amp is pin-equivalent to the LF411. Replace the LF411 with a TL061 and repeat the above measurements. (Guess which op-amp costs more!)

2. Build a non-inverting amplifier with a theoretical gain of $+20$. Repeat the measurements in part 1 for this circuit.

3. Build an adder circuit for which the output is

   \[ V_{out} = -\left( V_1 + \frac{1}{2} V_2 \right) \]

   Verify that it works, using two different DC voltages as $V_1$ and $V_2$. Also try adding two different AC signals: make $V_1 = 2V_{pp}$, $f_1 = 1$kHz; and $V_2 = 1V_{pp}$, $f_2 = 5$kHz.

4. Build the difference amplifier shown in figure 10.11 of your text. Verify that it behaves as you would expect.

Clean up

There are some sure-fire ways of damaging op-amp chips. Connecting the power supply backwards, for example; or exceeding the maximum input voltage. If you suspect that you have destroyed an op-amp chip, do not put it back in the drawer — just dispose of it. The cost of op-amps is not
negligible, but it’s lower than the time cost of debugging circuitry when the real problem is a blown chip.

Put the rest of your components and tools away; and make sure your area is clean, neat, and ready for the next lab.