

Lab 5: Two-Stage Op-Amp Amplifier

U.C. Davis Physics 116A

INTRODUCTION

The purpose of this first lab is to become familiar with the gain and frequency limitations of real components. We will build a high-gain two stage amplifier using standard LM741 op-amps and then explore their performance limits.

1. The Two-Stage Amplifier

Set up the function generator to produce a 1 kHz sine wave with an output amplitude of 100 mV. The build the circuit shown in Fig.1. For this circuit, use LM741 Op-amps as the amplifiers, use the function generator as the input voltage source; use 1 k Ω resistors for R_1 , 10 k Ω resistors for R_2 , and a 1 M Ω resistor for R_3 .

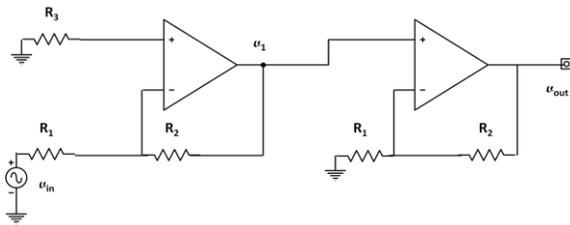


Figure 1: Schematic diagram for a two-stage amplifier.

Calculate and measure the gain at u_1 and at u_{out} . Does the output waveform have the expected gain? What is the phase angle of the output waveform?

2. LOADING

Reconnect the original two-stage amplifier.

We will now explore the ability of this amplifier to drive a load. Test the gain of the output wave form with load resistors of 15, 75, 330, and 1 k Ω . Record the results and discuss the performance of the amplifier under different loading conditions. Of which specification of the LM741 are we testing the limits?

3. Frequency Response

Repeat the experiment of section 2, however this time, instead of varying the load resistance, we will be varying the frequency of the input signal. Try increasing the frequency in steps of an a third of an

order of magnitude from 1 kHz to 1 MHz. Record the results and discuss the performance of the amplifier under different source frequencies. Of which specification of the LM741 are we testing the limits? Make a Bode plot of the output voltage gain. Determine the corner frequency (in Hz) and the high slope of the high frequency fall off (in dB/decade).

4. One-Stage Versus Two-Stage

Could you have achieved the same gain with a one stage amplifier? Design a one stage amplifier and build a one-stage amplifier to achieve the same gain characteristics of the previous two stage circuit. Does the output waveform have the expected gain? Determine the corner frequency for this single stage amplifier.

5. RF Amplification

Consider building a similar circuit using LF357 op-amps. As a homework exercise, use SPICE to test whether a two-stage amplifier using LF357 op-amps would be able to achieve a gain of 10^3 for a input of 1 MHz.