Lab 4. Operational Amplifiers

Overview of this Session

In this laboratory you will:

- Continue to use an oscilloscope
- Learn how to construct basic op-amp circuits

Introduction

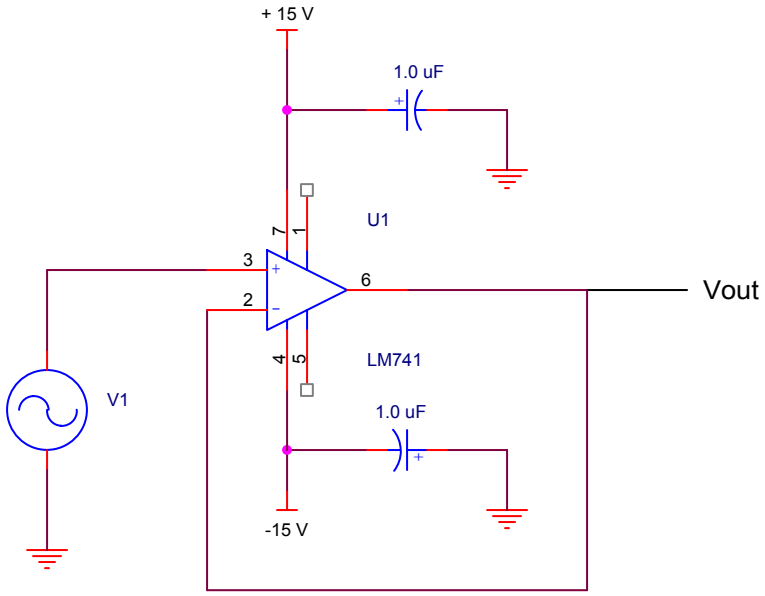
- The TAs will explain the pin outs of the LM741C op-amp.
- The TAs will explain the layout of the powered protoboard.
- The TAs will show how to use an oscilloscope to verify circuit performance.

Oscilloscope Measurements

4.1 Connect the signal from the function generator to the oscilloscope and determine the type of signal present, the frequency, amplitude, and the DC offset.

Buffer Amplifier

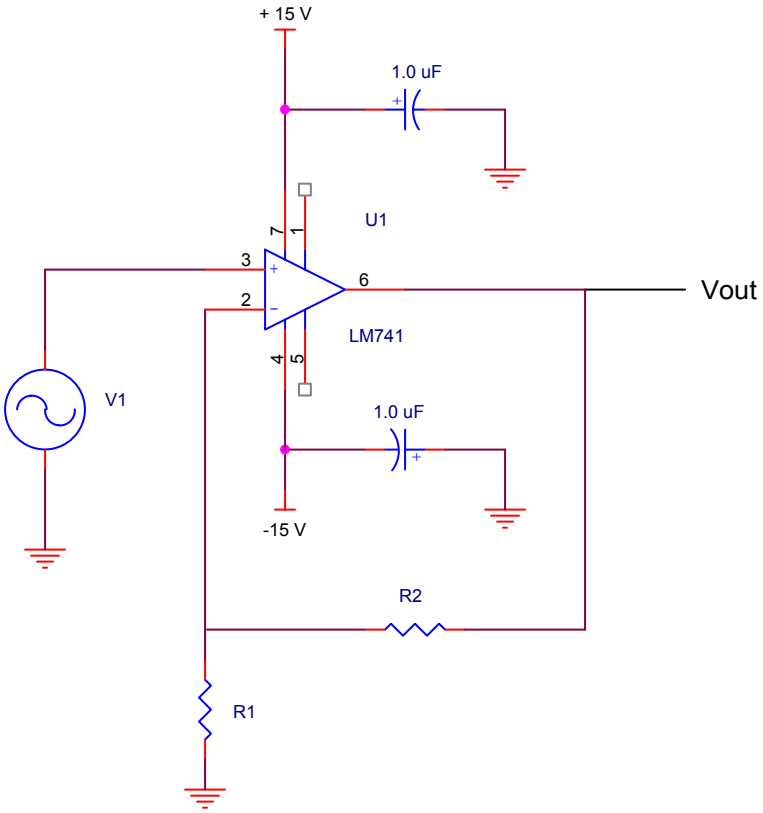
4.2 Construct the buffer amplifier circuit shown below. Connect a 1 KHz, 3 Vp-p sine wave to the input and use the oscilloscope to observe the input and output signals. Compute the voltage gain.



BUFFER AMPLIFIER

Non-Inverting Amplifier

4.3 Construct the Non-Inverting amplifier shown below. Calculate the resistors needed to produce a voltage gain of 11. Connect a 1 K Hz, 0.5 Vp-p sine wave to the input and use the oscilloscope to observe the input and output signals. Compute the voltage gain.

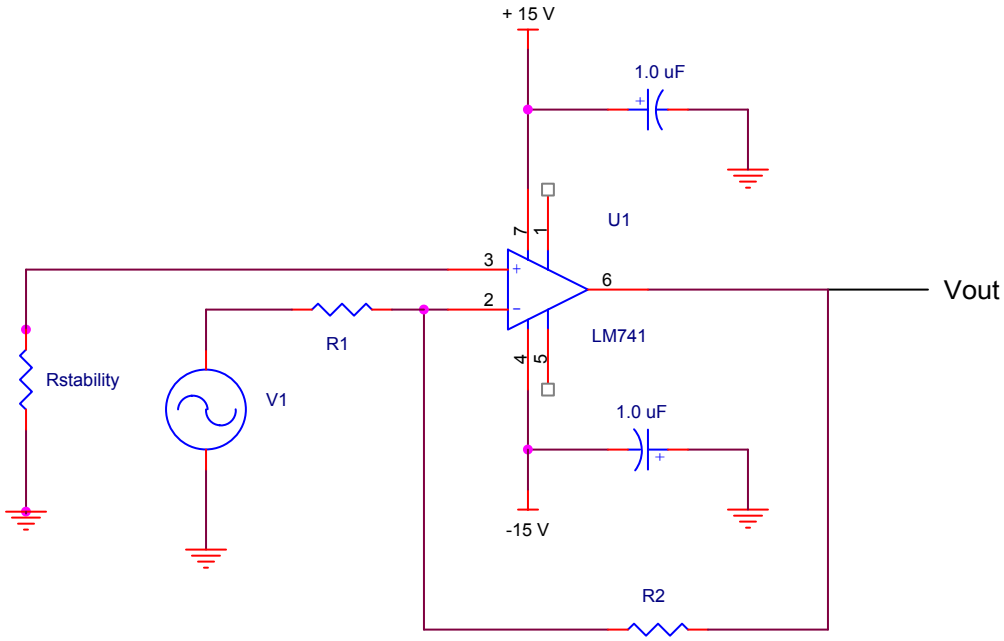


NON-INVERTING AMPLIFIER

$$V_{out} = V_1\left(1 + \frac{R_2}{R_1}\right)$$

Inverting Amplifier

4.4 Construct the Inverting amplifier shown below. Calculate the resistors needed to produce a voltage gain of 15. Connect a 1 K Hz, 0.5 Vp-p sine wave to the input and use the oscilloscope to observe the input and output signals. Compute the voltage gain.

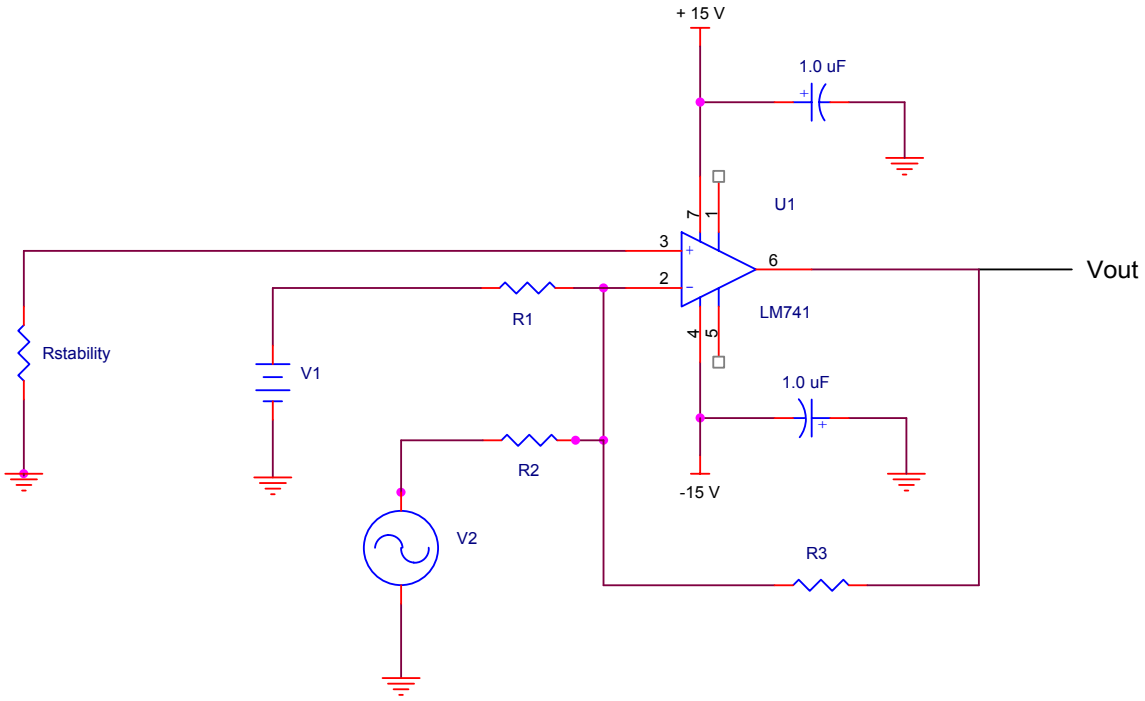


INVERTING AMPLIFIER

$$V_{OUT} = V_1\left(-\frac{R_2}{R_1}\right) \qquad R_{STABILITY} = \frac{R_1 R_2}{R_1 + R_2}$$

Summing Inverting Amplifier

4.5 Construct the Summing Inverting amplifier shown below. Calculate the resistors such that the input V_1 has a gain of 5 and the input V_2 has a gain of 10. V_1 = 1.0 VDC and V_2 = 0.1 Vp-p, sine wave. Use the oscilloscope to observe the input and output signals. Compute the voltage gain.



SUMMING INVERTING AMPLIFIER

$$V_{OUT} = -\left(V_1 \left[\frac{R_3}{R_1} \right] + V_2 \left[\frac{R_3}{R_2} \right] \right)$$

$$R_{STABILITY} = the\ smaller\ of\ \frac{R_1 R_3}{R_1 + R_3}\ or\ \frac{R_2 R_3}{R_2 + R_3}$$

National Semiconductor

August 2000

LM741
Operational Amplifier

General Description

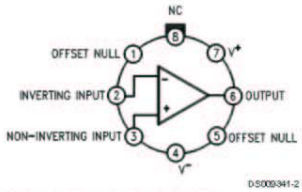
The LM741 series are general purpose operational amplifiers which feature improved performance over industry standards like the LM709. They are direct, plug-in replacements for the 709C, LM201, MC1439 and 748 in most applications.

The amplifiers offer many features which make their application nearly foolproof: overload protection on the input and output, no latch-up when the common mode range is exceeded, as well as freedom from oscillations.

The LM741C is identical to the LM741/LM741A except that the LM741C has their performance guaranteed over a 0°C to +70°C temperature range, instead of −55°C to +125°C.

Connection Diagrams

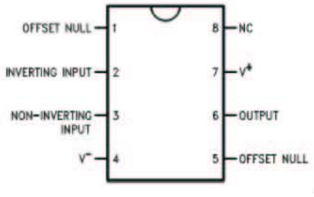
Metal Can Package



Note 1: LM741H is available per JM38510/10101

Order Number LM741H, LM741H/883 (Note 1), **LM741AH/883 or LM741CH**
See NS Package Number H08C

Dual-In-Line or S.O. Package



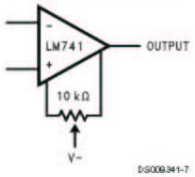
Order Number LM741J, LM741J/883, LM741CN
See NS Package Number J08A, M08A or N08E

Ceramic Flatpak

Order Number LM741W/883
See NS Package Number W10A

Typical Application

Offset Nulling Circuit



Lab 4. Operational Amplifiers Answer Sheet

Name:_____ Section Number:_____
TA init:_____ Date:_____

4.1 Draw the waveform shown on the oscilloscope. What is the name of this waveform? What is the amplitude, frequency, and DC offset? Show all your calculations.

4.2 Draw the input and output waveforms. Compute the voltage gain.

4.3 Draw the input and output waveforms. Show resistor calculations. Compute the voltage gain.

Lab 4. Operational Amplifiers Answer Sheet

Name:_____ Section Number:_____
TA init:_____ Date:_____

4.4 Draw the input and output waveforms. Show resistor calculations. Compute the voltage gain.

4.5 Draw the input and output waveforms. Show resistor calculations. Compute the voltage gain.