Experiment #7 Op Amp as Inverting and non-inverting amplifier and voltage follower

Objective

To implement and analyze Inverting, non-Inverting and voltage follower circuits.

Equipment

Function generator with probes
DMM
Dc supply
Oscilloscope
Op Amp LM741
Resistor

Theory

An operational amplifier is DC coupled high gain electronic voltage amplifier with a differential input and usually single ended output. In this amplifier, differential inputs consist of a non-inverting and inverting input. Ideally the op Amp amplifies only the difference in voltage between two which is called differential input voltage. The output voltage is given as in (7.1).

$$V_{out} = A_{OL(}V_+ - V_-) \qquad (7.1)$$

7.1 Inverting operational Amplifier

It is called Inverting because op Amp changes the phase angle of the output signal exactly 180 out of phase with respect to input signal. We use two resistors to create feedback circuit and make a closed loop circuit across the amplifier. The non-Inverting input is ground.

Circuit Diagram

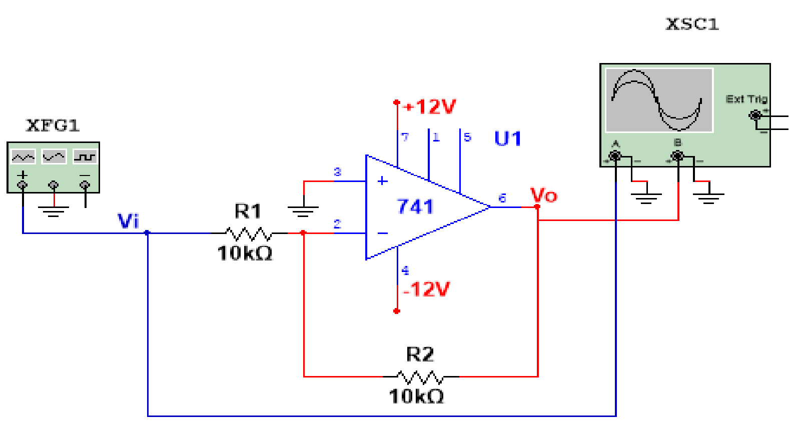


Figure 7.1: Inverting Operational Amplifier

Procedure

1. Connect circuit diagram according to given circuit shown in Figure 7.1.
2. Apply sine wave input signal using f=500Hz with amplitude of 1Vp-p.
3. Measure the output signal using oscilloscope and record in table.
4. Also compare to input signal.
5. Measure Vo(peak-peak)
6. Calculate the voltage gain using (7.2).

$$A_V = -\frac{R_f}{R_A} \qquad (7.2)$$

7. Maintain input signal level at 1Vp-p f=500Hzand change values of Rf. Record the results comparing with calculated one.

Observations

Rf(k-ohm)	10	20	47	68
Vo (Theoretical)				
Vo (Practical)				

7.2 Non-Inverting Amplifier

It is called non-Inverting op Amp because there is no phase inversion between input and output signal. We use two resistors to create a feedback circuit and make a closed loop circuit across the amplifier. The Inverting input is grounded in this case and input signal is applied at non-Inverting input.

Circuit Diagram

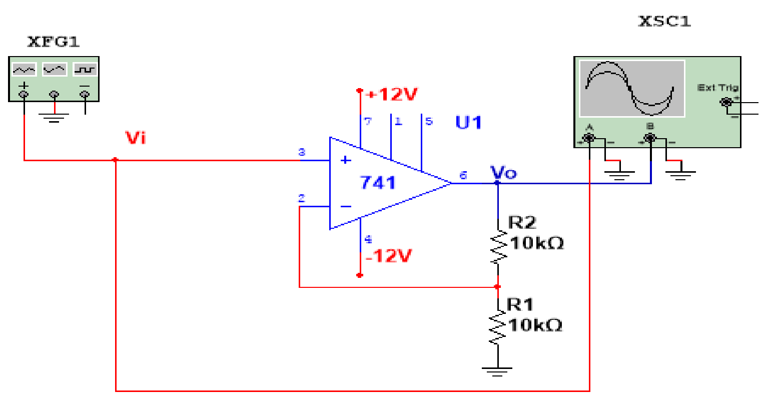


Figure 7.2: Non-Inverting Operational Amplifier

Procedure

1. Connect circuit diagram according to given circuit diagram as shown in Figure 7.2.
2. Apply sine wave input signal using f=1kHz with amplitude of 2Vp-p.
3. Record and compare waveform of input and output signal.
4. Measure Vo(peak-peak).
5. Calculate the voltage gain using (7.3).

$$A_V = -\frac{R_f}{R_A} \quad (7.3)$$

Observations

Rf(k-ohm)	10	20	47	68
Vo (theoretical)				
Vo (practical)				

7.3 Non-Inverting voltage follower amplifier

The non-Inverting voltage follower configuration is a special case of the op Amp where all of the output voltages are feedback to Inverting input by a straight connection. The straight feedback connection has a voltage gain of 1.

As the input signal is connected directly non-Inverting input of amplifier, the output signal is not inverted resulting in the output voltages being equal to input voltages Because of this feature, this amplifier act as unity gain buffer circuit because of its isolation properties. It is also used for impedance matching.

Circuit Diagram

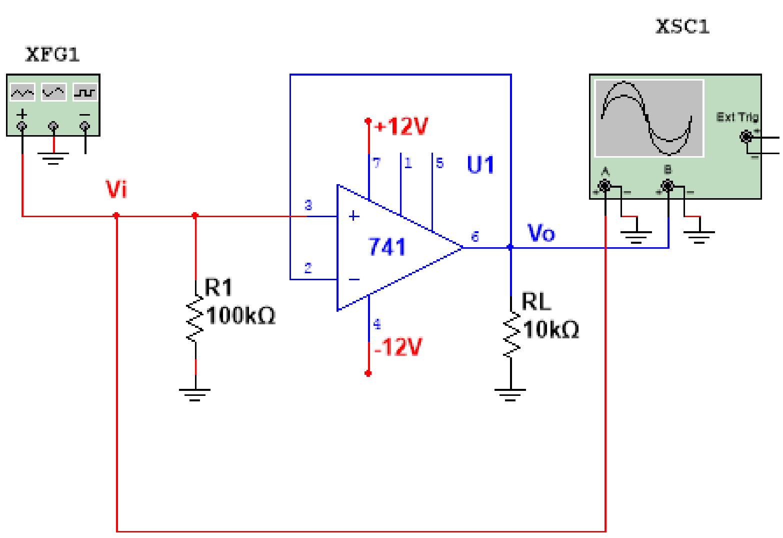


Figure 7.3: Non-Inverting voltage follower Amplifier

Procedure

1. Connect circuit diagram according to given circuit shown in Figure 7.3.
2. Apply sine wave input signal using f=1kHz with amplitude of 2Vp-p.
3. Record and compare waveform of input and output signal.
4. Measure the output signal using oscilloscope.
5. Calculate voltage gain using (7.4).

$$A_V = \frac{V_O}{V_{in}} \qquad (7.4)$$

Observations

Parameters	Av	Vo
Theocratical Values		
Practical value		

7.4 Inverting voltage follower amplifier

It is called Inverting voltage follower amplifier because op Amp changes the phase angle of the output signal exactly 180 out of phase with respect to input signal. In this type of amplifier, we use two resistors to make a feedback circuit but in voltage follower amplifier we keep value of these two resistances same. This gives us voltage gain of unity as (7.3) becomes,

$$A_v = \frac{-R_f}{R_A} \qquad R_f = R_A \qquad A_V = -1$$

Circuit Diagram

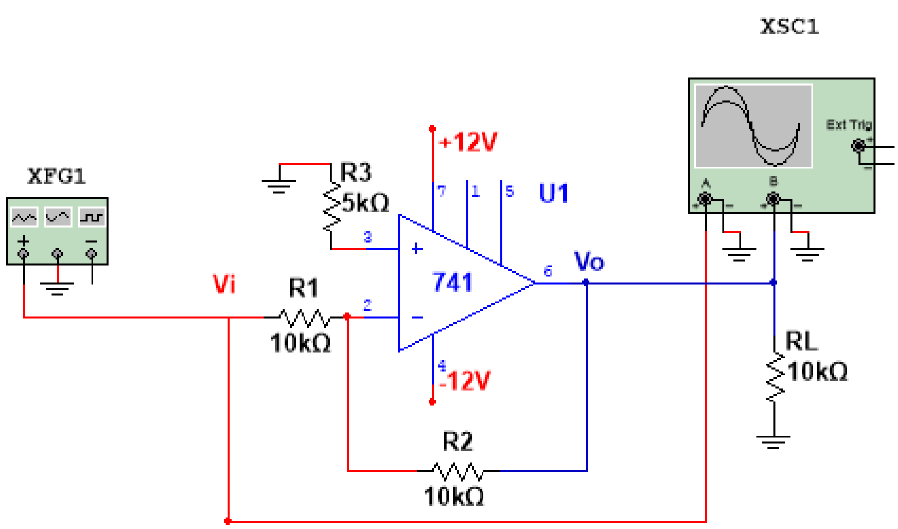


Figure 7.4: Inverting voltage follower Amplifier

Procedure

1. Connect circuit diagram according to given circuit shown in Figure 7.4.
2. Apply sine wave input signal using f=1kHz with amplitude of 2Vp-p.
3. Record and compare waveform of input and output signal.
4. Measure the output signal using oscilloscope.
5. Calculate voltage gain using (7.5).

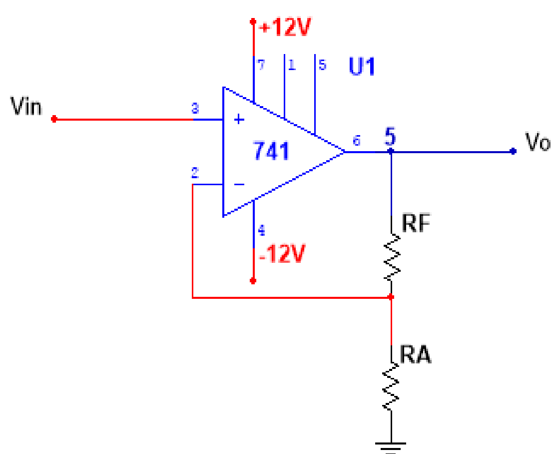
$$A_V = \frac{V_O}{V_{in}} \qquad (7.5)$$

Observations

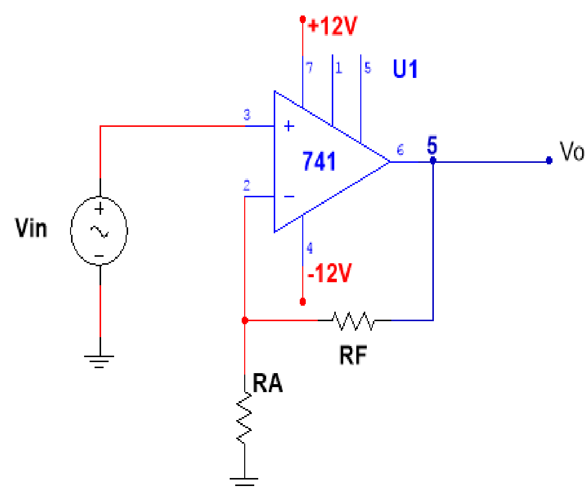
Parameter	Av	Vo
Theoretical Value		
Practical Value		

Lab Tasks

1. From the Figure 7.5(a), put the values of R_f =90k-ohm and R_A=10k-ohm. In the inverting amp circuit, and find the practical and theoretical values of Vo if Vin = 2V.



(a)



(b)

Figure 7.5(a): Non-Inverting Operational Amplifier

(b): Non-Inverting Operational Amplifier

2. From Figure 7.5(b), find practical and theoretical values of Av and Vo when Rf=110k-ohm and Vin=1Vp-p?

Conclusion