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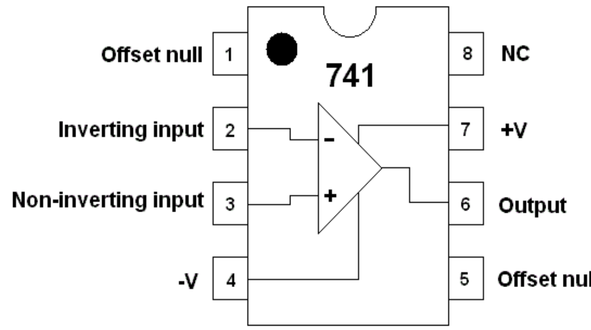
Experiment: 5

OPERATIONAL AMPLIFI



OBJECTIVE : Realization of amplifier circuits with Op-Amp (Operational A

MATERIALS REQUIRED

1. Components
   Op-Amp : One: LM741.
   Resistance : Five: 1 kΩ (1 no), 10 kΩ (1 no), 12 kΩ (2

PRECAUTIONS AND GUIDELINES

1. The op-amp generally works on split power supply (e.g. ±12 V). Both positive and negative power supplies must be present whenever op-amp is powered. The range of power supply is from ±5 V to ±15 V. Do not forget to connect the common terminal of the power supply to the *ground* on the breadboard.

2. **Connecting only one side of power supply or interchanging positive and negative power supplies damages the op-amp**.

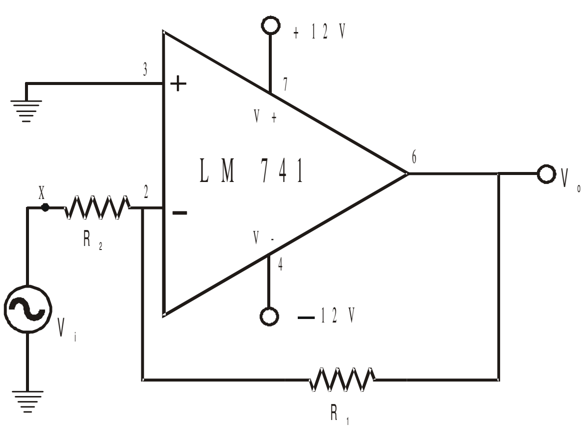
3. For connecting power supply, you have to follow the procedure as given below.
   a. Disconnect the power supply to op-amps.
   b. Switch on the power supply.
   c. Set the output voltage as required (e.g. ±12 V).
   d. Switch off the power supply.
   e. Connect the power supply to op-amps.
   f. Switch on the power supply.

4. For any IC, never exceed the input voltage beyond the power supply limits.
5. Use the horizontal strips of the breadboard for power supply. Tap the power supply for each IC from these supply lines.
6. Keep ground terminals of the oscilloscope, probes and function generator output, and power supply common connected together throughout the experiment.
7. Use AFG in "High Z" mode.

Pre-experiment Reading:

Obtain the theoretical values of V_o / V_i for step 5 of Part A. Do this for Part B also.

PART A : INVERTING AMPLIFIER



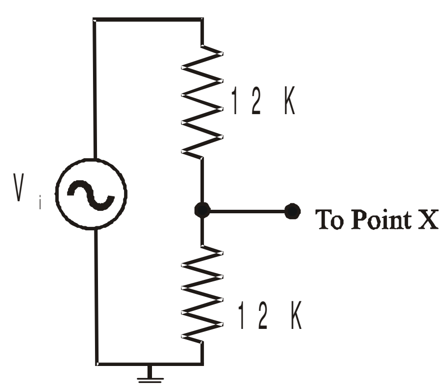


Fig. 5.1 Inverting Amplifier **Fig 5.2 Voltage Divider**

1. Assemble the circuit shown in Fig. 5.1 with R_1 = 10 kΩ and R_2 = 1 kΩ. Make sure the power supply ground is connected to the circuit ground.

2. Apply 200 mVp-p, 1 kHz sine wave at V_i from the function generator and see the output.

3. Observe V_o and V_i, and determine voltage gain $A = V_o / V_i$. Also obtain A for V_i = 100 mVp-p and 300 mVp-p.

4. Change R_1 & R_2 to 100 kΩ & 10 kΩ respectively and determine A for V_i = 100 mVp-p, 200 mVp-p and 300 mVp-p.

5. Now apply a fraction of the voltage V_i (keeping V_i at 200 mVp-p) to the point 'X' through the potential divider circuit (instead of directly connecting the source at 'X') as shown in Fig. 5.2 and note the values of V_o for

(i) $R_1/R_2 = \frac{100K\Omega}{10K\Omega}$ and (ii) $R_1/R_2 = \frac{10K\Omega}{1K\Omega}$

Compute V_o / V_i for (i) and (ii).

PART B : NON-INVERTING AMPLIFIER

1) Assemble the circuit shown in Fig. 5.3 with R_1 = 10 kΩ and R_2 = 1 kΩ. Make sure the power supply ground is connected to the circuit ground.

2) Apply 200 mVp-p, 1 kHz sine wave at V_i from the function generator and see the output.

3) Observe V_o and V_i, and determine voltage gain $A = V_o / V_i$. Also obtain A for V_i = 100 mVp-p and 300 mVp-p.

4) Change R_1 & R_2 to 100 kΩ & 10 kΩ respectively and determine A for V_i = 100 mVp-p, 200 mVp-p and 300 mVp-p.

5) Now apply a fraction of the voltage V_i (keeping V_i at 200 mVp-p) to the point 'X' through the potential divider circuit as shown in Fig. 5.2 and note the values of V_o for

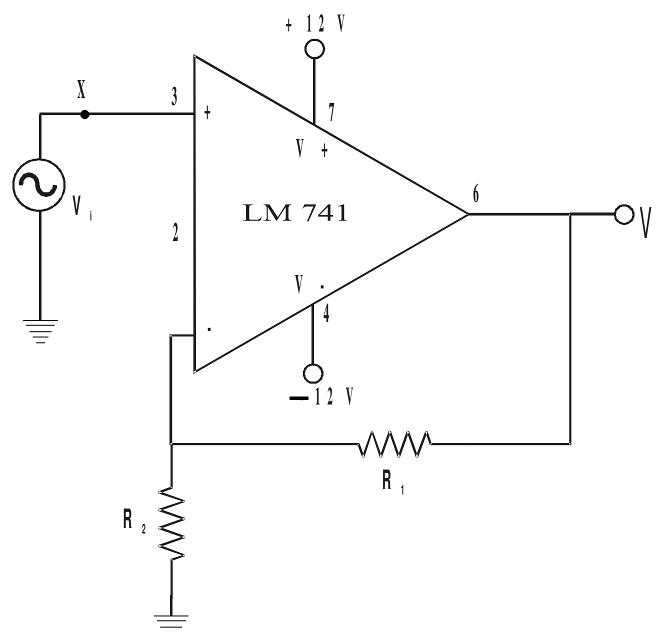


Fig. 5.3 Non-inverting amplifier

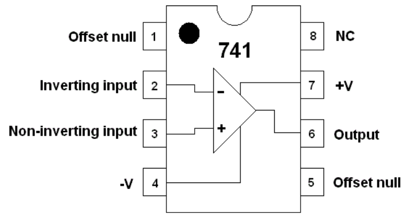
(i) $R_1/R_2 = \frac{100K\Omega}{10K\Omega}$ and

(ii) $R_1/R_2 = \frac{10K\Omega}{1K\Omega}$

Compute V_o / V_i for (i) and (ii).

Q1. For a source with high internal impedance which configuration (inverting or non-inverting) will be suitable for designing a good amplifier?

Q2. Design an Amplifier system to obtain a gain of '-50' for a source with high internal resistance. You may use combinations of inverting and non-inverting configurations. (Make use of answer of Q1.)



Operational Amplifier-I Exp.-5

Sl. No.	R1	R2	AFG (mVp-p)	DSO Ch1(mVp-p)	DSO Ch2(mVp-p)	Voltage Gain (*A*=V*o*/V*i*)
Part A : INVERTING AMPLIFIER						
1	10K	1K	100			
2	10K	1K	200			
3	10K	1K	300			
1	100K	10K	100			
2	100K	10K	200			
3	100K	10K	300			
V*in* Measure at Point 'X' (For Voltage Divider)						
1	100K	10K	200			
2	10K	1K	200			
Part B : NON-INVERTING AMPLIFIER						
1	10K	1K	100			
2	10K	1K	200			
3	10K	1K	300			
1	100K	10K	100			
2	100K	10K	200			
3	100K	10K	300			
V*in* Measure at Point 'X' (For Voltage Divider)						

1	100K	10K	200			
2	10K	1K	200			