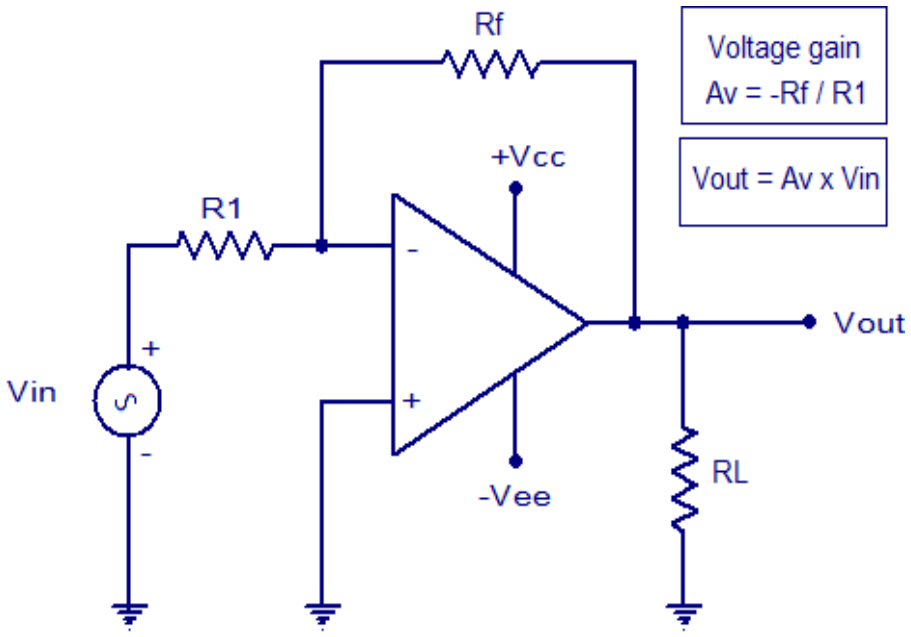
INVERTING AND NON-INVERTING AMPLIFIERS USING OP AMPS

AIM: Design and realize Inverting and Non-inverting amplifier using 741 Op-amp. Apparatus Required: Bread Board, 741 IC, ±12V supply, Resistors and connecting leads.

Theory:

An inverting amplifier using op-amp is a type of amplifier using op-amp where the output waveform will be phase opposite to the input waveform. The input waveform will be amplifier by the factor Av (voltage gain of the amplifier) in magnitude and its phase will be inverted. In the inverting amplifier circuit the signal to be amplified is applied to the inverting input of the op-amp through the input resistance R1. Rf is the feedback resistor. Rf and Rin together determine the gain of the amplifier. Inverting operational amplifier gain can be expressed using the equation Av = – Rf/R1. Negative sign implies that the output signal is negated. The circuit diagram of a basic inverting amplifier using op-amp is shown below.



opamp inverting amplifier

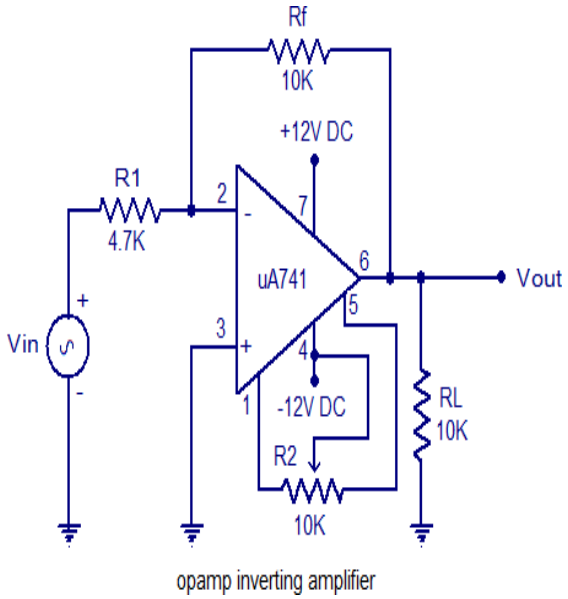
The input and output waveforms of an inverting amplifier using op-amp is shown below. The graph is drawn assuming that the gain (Av) of the amplifier is 2 and the input signal is a sine wave. It is clear from the graph that the output is twice in magnitude when compared to the input (Vout = Av x Vin) and phase opposite to the input.

Practical inverting amplifier using 741.

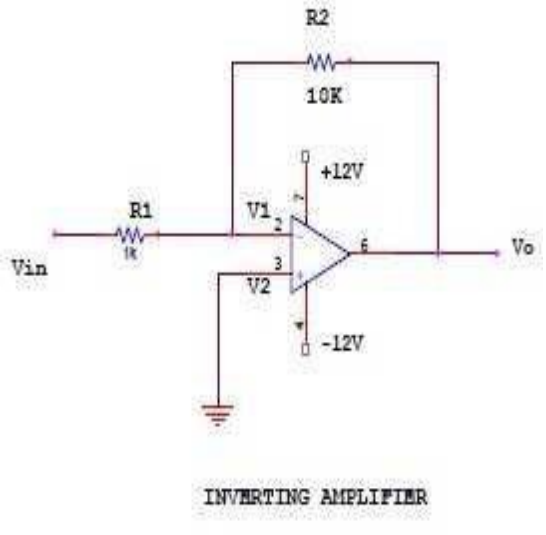
A simple practical inverting amplifier using 741 IC is shown below. uA 741 is a high performance and of course the most popular operational amplifier. It can be used in a verity of applications like integrator,

Differentiator, voltage follower, amplifier etc. uA 741 has a wide supply voltage range (+/-22V DC) and has a high open loop gain. The IC has an integrated compensation network for improving stability and has short circuit protection. Signal to be amplified is applied to the inverting pi (pin2) of the IC. Non inverting pin (pin3) is connected to ground. R1 is the input resistor and Rf is the feedback resistor. Rf and R1 together sets the gain of the amplifier. With the used values of R1 and Rf the gain will be 10

10K/1K = 10). RL is the load resistor and the amplified signal will be
available across it. POT R2 can be used for nullifying the output offset voltage. If you are planning to assemble the circuit, the power supply must be well regulated and filtered. Noise from the power supply can adversely affect the performance of the circuit. When assembling on PCB it is recommended to mount the IC on the board using an IC base.



opamp inverting amplifier



- For Gain 1

  R_1 =10K , R_2 = 10K $\left[Vout = -\frac{R2}{R1}Vin\right]$

V_{IN}	V_{OUT}
0V 0.1V 0.3V 0.5V 0.7V 0.9V	

- For Gain 10

R_1 =10K , R_2 = 100K

V_{IN}	V_{OUT}
0V 0.1V 0.3V 0.5V 0.7V 0.9V	

In the inverting amplifier only one input is applied and that is to the inverting input ((V2) terminal. The Non inverting input terminal (V1) is grounded.

Since, V1=0

V& V2=Vin

Vo= -A Vin

The negative sign indicates the output voltage is 1800 out of phase with respect to the input and amplified by gain A.

Practical Non-inverting amplifier using 741:

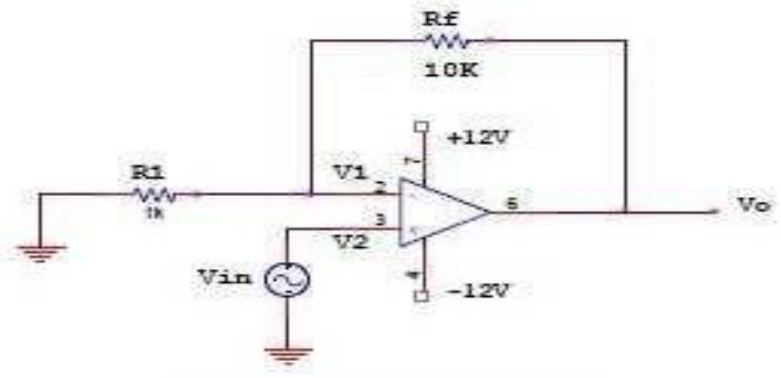
The input is applied to the non-inverting input terminal and the Inverting terminal is connected to the ground.

V1= Vin &

V2=0 Volts

Vo= A Vin

The output voltage is larger than the input voltage by gain A & is in phase with the input signal.



NON-INVERTING AMPLIFIER

Formula- $V_0 = \left(1 + \frac{R_2}{R_1}\right) V_{IN}$

$R^* = \frac{R_1 R_2}{R_1 + R_2}$

For Gain 2

R_1=10K , R_2=10K

V_{IN}	V_{OUT}
0V 0.1V 0.3V 0.5V 0.7V 0.9V	

For Gain 10

R_1=10K , R_2=90K

V_{IN}	V_{OUT}
0V 0.1V 0.3V 0.5V 0.7V 0.9V	

Procedure:

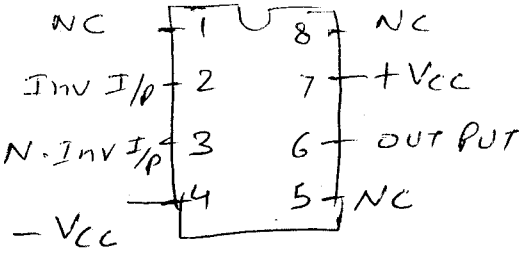
1) Connect the circuit for inverting, non inverting amplifier on a breadboard.
2) Connect the input terminal of the op-amp to function generator and output terminalto CRO.
3) Feed input from function generator and observe the output on CRO.
4) Draw the input and output waveforms on graph paper.

VIVA VOICE QUESTIONS:

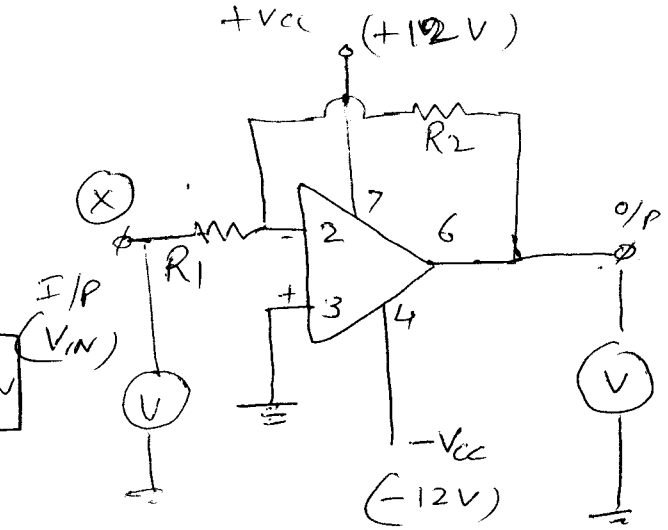
1. Define an integrated circuit and classify them.
2. What is an op-amp and what are its types?
3. How to define the symbol of op-amp?
4. What are the various terminals of op-amp 741 IC?
5. What is the operating voltage range of IC 741?

Inverting Amplifier using Op-Amp IC-741

741

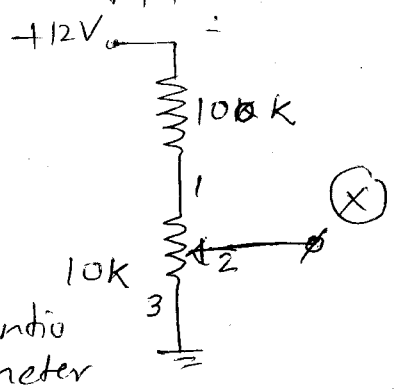


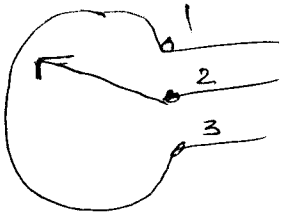
Formula $\left[V_0 = -\frac{R_2}{R_1} V_{IN} \right]$



How to Input Connect

~~Input~~





① for Gain 1

$R_1 = 10K$, $R_2 = 10K$

V_{IN}	V_{OUT}
0	
0.1V	
0.3V	
0.5V	
0.7V	
0.9V	

for Gain 10

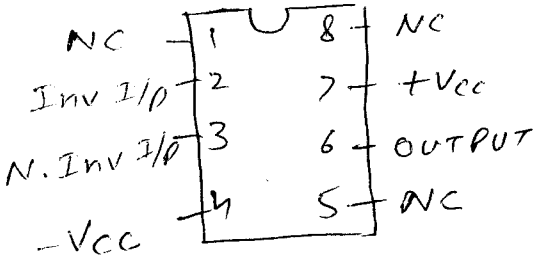
$R_1 = 10K$ $R_2 = 100K$

V_{IN}	V_{OUT}
0	
0.1	
0.3	
0.5	
0.7	
0.9	

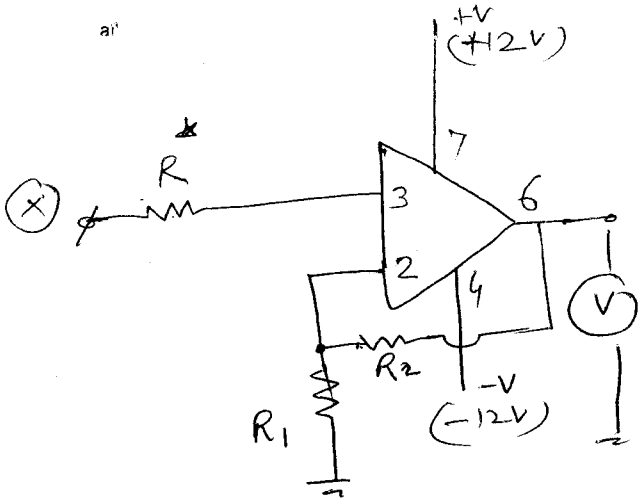
~~Gain~~

Non Inverting Amplifier using op Amp IC 741

741

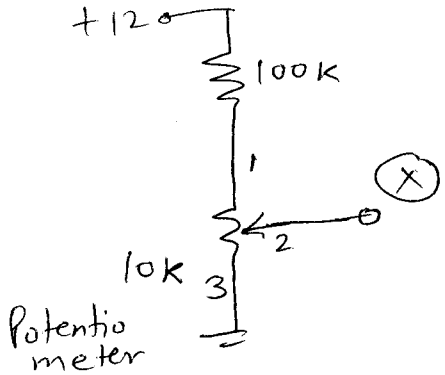


formula $V_0 = 1 + \frac{R_2}{R_1} V_{IN}$



$R = \frac{R_1 R_2}{R_1 + R_2}$

How to Input Connect



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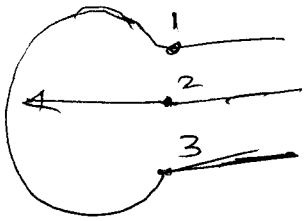

for Gain 2

$R_1 = 10k$, $R_2 = 10k$

V_{IN}	V_{OUT}
0	
0.1V	
0.3	
0.5	
0.7	
0.9	

for Gain 10

$R_1 = 10k$, $R_2 = 90k$

V_{IN}	V_{OUT}
0	
0.1V	
0.3	
0.5	
0.7	
0.9	