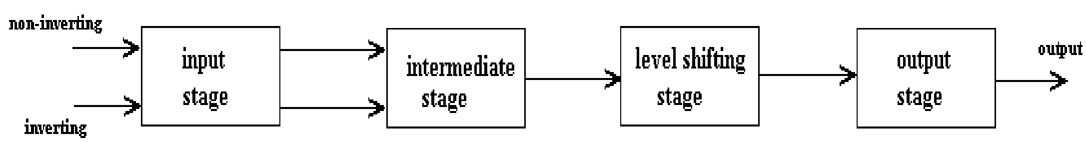
IC 741 OP-AMP

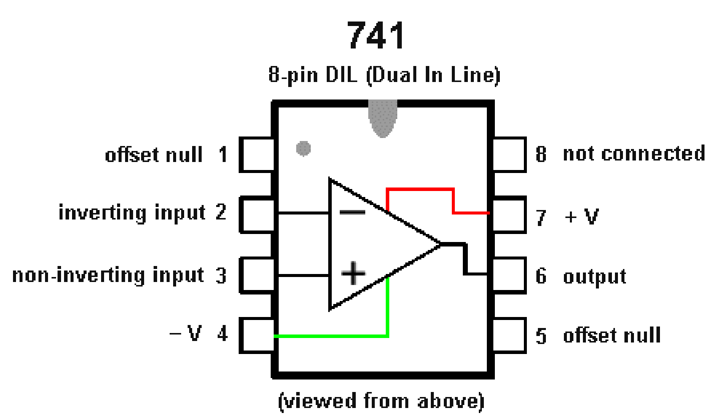
General Description:

The operational amplifier is a versatile device that can be used to amplify DC as well as AC input signals and was originally designed for performing mathematical operations such as addition, subtraction, multiplication, and integration. Thus the name operational amplifier seems from its original use for these mathematical operations and is abbreviated to op-amp. With the addition of suitable external feedback components, the modern day op-amp can be used for a variety of applications, such as AC and DC signal amplification, active filters, oscillators, comparators, Schmitt trigger, regulator, integrator, differentiator.
Generally, operational amplifiers are extremely high voltage gain circuits and they are standard building blocks of analogue circuits. The most commonly used op-amp is IC741.

Block Diagram Of Op-Amp:



Let's see the pin configuration and testing of 741 op-amps. Usually, this is a numbered counter clockwise around the chip. It is an 8 pin IC. They provide superior performance in integrator, summing amplifier and general feedback applications.



It is a 8-pin dual-in-line package with a pinout shown above.
Pin 1: Offset null.
Pin 2: Inverting input terminal.
Pin 3: Non-inverting input terminal.
Pin 4: –VCC (negative voltage supply).
Pin 5: Offset null.
Pin 6: Output voltage.
Pin 7: +VCC (positive voltage supply).
Pin 8: No Connection.

Features:

1. No frequency compensation required.
2. Short circuit protection
3. Offset voltage null capability
4. Large common mode and differential voltage ranges
5. Low power consumption
6. No latch-up

Specifications:

1. Voltage gain A = α typically 2,00,000
2. I/P resistance R_L = α Ω, practically 2MΩ
3. O/P resistance R =0, practically 75Ω
4. Bandwidth = α Hz. It can be operated at any frequency
5. Common mode rejection ratio = α (Ability of op amp to reject noise voltage)
6. Slew rate + α V/μsec (Rate of change of O/P voltage)

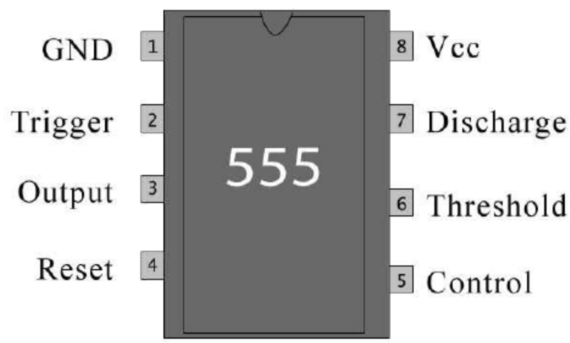
Applications:

1. AC and DC amplifiers
2. Active filters
3. Oscillators
4. Comparators and Regulators

IC 555-TIMER

555-Timer is a very commonly used IC for generating accurate timing pulses. Let's see the pin configuration of 555 Timer. Usually, this is a numbered counter clockwise around the chip. It is an 8 pin IC packed in dual-in-line package.

Pin Configuration:



Function of Various Pins of 555 IC:

Pin (1) of 555 is the ground terminal; all the voltages are measured with respect to this pin.

Pin (2) of 555 is the trigger terminal, If the voltage at this terminal is held greater than one-third of V_{CC}, the output remains low. A negative going pulse from V_{cc} to less than $V_{ec}/3$ triggers the output to go High. The amplitude of the pulse should be able to make the comparator (inside the IC) change its state. However the width of the negative going pulse must not be greater than the width of the expected output pulse.

Pin (3) is the output terminal of IC 555. There are 2 possible output states. In the low output state, the output resistance appearing at pin (3) is very low (approximately 10 Ω). As a result the output current will goes to zero , if the load is connected from Pin (3) to ground , sinк a current I $_{Sink}$ (depending upon load) if the load is connected from Pin (3) to ground, and sinks zero current if the load is connected between $+V_{CC}$ and Pin (3).

Pin (4) is the Reset terminal. When unused it is connected to $+V_{cc}$. Whenever the potential of Pin (4) is drives below 0.4V, the output is immediately forced to low state. The reset terminal enables the timer over-ride command signals at Pin (2) of the IC.

Pin (5) is the Control Voltage terminal.This can be used to alter the reference levels at which the time comparators change state. A resistor connected from Pin (5) to ground can do the job. Normally 0.01μF capacitor is connected from Pin (5) to ground. This capacitor bypasses supply noise and does not allow it affect the threshold voltages.

Pin (6) is the threshold terminal. In both astable as well as monostable modes, a capacitor is connected from Pin (6) to ground. Pin (6) monitors the voltage across the capacitor when it charges from the supply and forces the already high O/p to Low when the capacitor reaches $+2/3\ V_{CC}$.

Pin (7) is the discharge terminal. It presents an almost open circuit when the output is high and allows the capacitor charge from the supply through an external resistor and presents an almost short circuit when the output is low.

Pin (8) is the $+V_{cc}$ terminal. 555 can operate at any supply voltage from +3 to +18V.

Features of 555 IC

1. The load can be connected to o/p in two ways i.e. between pin 3 & ground 1 or between pin 3 & V_{CC} (supply)

2. 555 can be reset by applying negative pulse, otherwise reset can be connected to $+V_{cc}$ to avoid false triggering.
3. An external voltage effects threshold and trigger voltages.
4. Timing from micro seconds through hours.
5. Monostable and bistable operation
6. Adjustable duty cycle
7. Output compatible with CMOS, DTL, TTL
8. High current output sink or source 200mA
9. High temperature stability
10. Trigger and reset inputs are logic compatible.

Specifications:

1. Operating temperature	:	SE 555--	$-55^{o}C$ to $125^{o}C$
		NE 555--	0^{o} to $70^{o}C$
2. Supply voltage	:	+5V to +18V	
3. Timing	:	µSec to Hours	
4. Sink current	:	200mA	
5. Temperature stability	:	50 PPM/^{o}C change in temp or 0-005% /^{o}C.	

Applications:

1. Multivibrators
2. dc-ac converters
3. Digital logic probes
4. Waveform generators
5. Analog frequency meters
6. Infrared transmitters and Tachometers
7. Temperature measurement and control

Exp.No.1

INVERTING AMPLIFIER

AIM:

To design and construct a Inverting amplifier using IC741 Op-amp.

APPARATUS:

1. Operational Amplifier mA 741 IC –1No.
2. Resistors 1KOhm and 10KOhm
3. Dual Power supply(0-20V)
4. Regulated Power Supply.(0-20V)
5. Multimeter
6. CRO and Probes
7. Funtion Signal Generator.
8. Bread board
9.Connecting wires

THEORY:

INVERTING AMPLIFIER:

An op-amp connected as an inverting amplifier with a controlled amount of voltage gain is shown in fig.

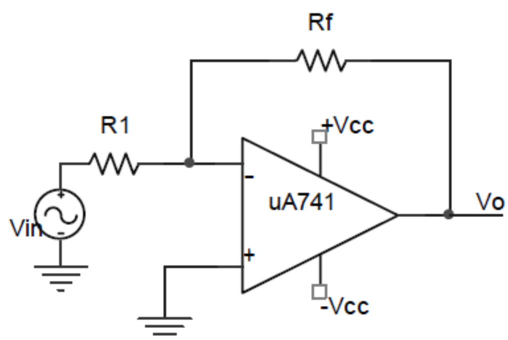


Fig: Inverting amplifier configuration of op-amp

The input signal is applied through a series input resistor R1 to the inverting input. The Non inverting input terminal is grounded. Also, the output is fed back through Rf to the same input. The non-inverting input is grounded. Rf and R1 together sets the gain of the amplifier. An expression for the output voltage of the inverting amplifier is written as

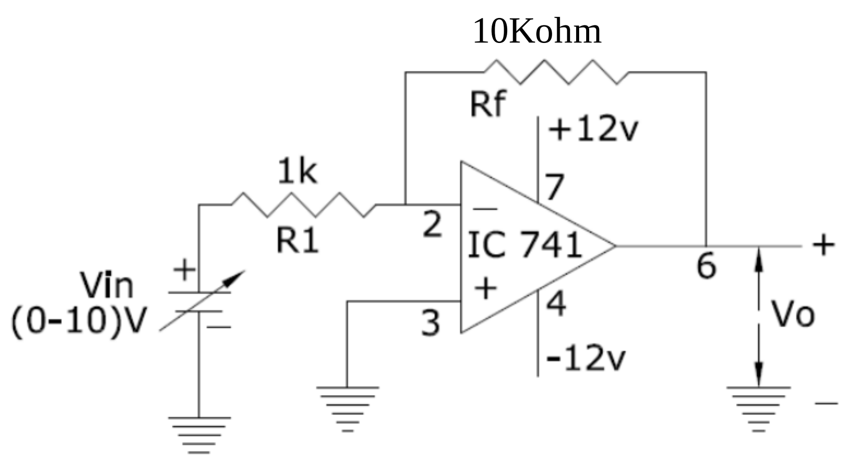
$$V_O = -\frac{R_f}{R_1} V_{in}$$

The –ve sign indicates inversion and the output voltage is 180^0 out of phase with respect to the input and amplified by gain A. The closed-loop gain of the inverting amplifier is, thus

$$A_{CL(I)} = -\frac{R_f}{R_1}$$

Assuming Rf is a 5k ohm resistor and R1 is a 1k ohm resistor, and Vin is +/- 1 volt triangle input, then Av would be -5 and Vout would be +/- 5volts triangle wave that is 180° out of phase compared to the input as shown in Expected Graph. Note how the output signal is 5 times larger than the input signal. For the special case, when Rf = R1 , Vout = - Vin a 180° phase shifted version of the input.
The interesting item about the inverting amplifier is that the gain is only a function of the ratio of the two resistors of R1 and R2.

CIRCUIT DIAGRAM:



PROCEDURE:

1.Initially set +Vcc = 12 volts and -Vcc to -12 volts.

2.Measure all resistors that are used in the amplifier circuits using the multimeter and record these values

3. As shown in the circuit diagram connect the circuit for Inverting amplifier on a breadboard

4.Before turning any power on, double check the wiring to make sure that it is correct. Make sure that the power supply to the op-amp is correctly wired as not to apply the incorrect polarity to the op-amp.
5. Input may be AC or DC voltages from function generator or DC power supply.

6. For DC input apply a 1-volt DC input to inverting input terminal of IC741 for Vin from the dc supply and check the output voltage Vo at the output terminal using the multimeter.

7.Compare practical Vo with the theoretical output voltage Vo = (-Rf /R1) Vin

8.For AC input connect the inverting input terminal of IC741 op-amp to function generator and output terminal to CRO.

9. Feed input from function generator and observe the output on CRO.

10. Draw the input and output waveforms on graph paper.

11. Compare the phase between the input and output waveforms.

TABULAR COLUMN:

S.NO	Vin	Vo = (-Rf /R1) Vin		Gain = Vo/Vin
		Theoretical	Practical	

EXPECTED GRAPH:

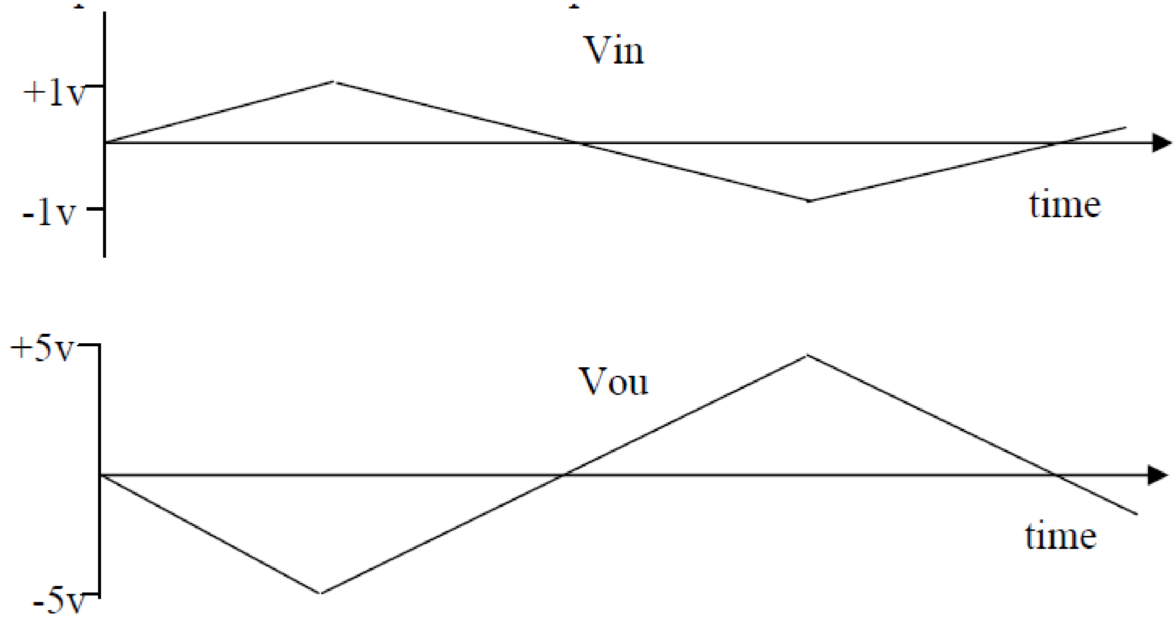


Fig: Output for -5 Gain Inverting Amplifier with a +/- 1 volt triangle wave input. R1=1k & R2=5k

WORKSHEET:

Input Waveform:

Output Waveform:

RESULT:

The Practical Values of V_o observed are equal to the Theoritical values. From this we can conclude that the Inverting Amplifier using 741 OP-AMP is satisfying its function properly. And it is also noticed that gain is depending on R_2 or R_f feedback Resistor.