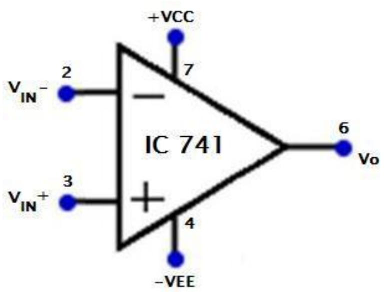
EXPERIMENT #4 SQUARE AND TRIANGULAR WAVEFORM GENERATOR

I OBJECTIVES

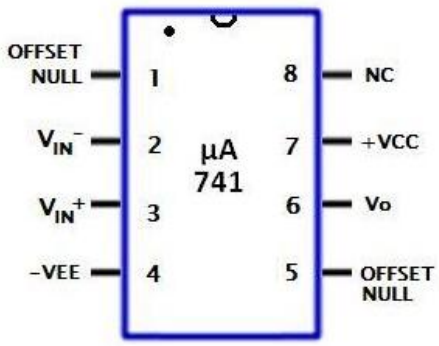
The broad objective of this experiment is to familiarize the student with some general ideas concerning the generation of waveforms which employ op amp.

II COMPONENTS AND INSTRUMENTATION

The general purpose op amp µA 741 will be used. You require two supplies, ±15 V for short. As well, you need a variety of resistors. For measurement, use a bench multimeter, a two channel oscilloscope and a waveform generator.



(a) Symbol



(b) Pin diagram

Fig 4.1. OP-AMP µA 741

III PREPARATION

Formulae used in design calculations

$$R_1 = \frac{R_3}{4 * f * R_2 * C} \qquad R_3 = \frac{2 * R_2 * V_{SAT}}{V_{o(P-P)}}$$

Q1. In the circuit of Fig.4.2., $V_{z1}=V_{z2}=6.3$V, $V_F=0.7$V, $R_1=5$kΩ and $R_f=100$kΩ. Find the expression for output voltage when

i) $V_{in}=0.3\sin t$ ii) $V_{in}=0.6\sin t$ iii) $V_{in}=3\sin t$

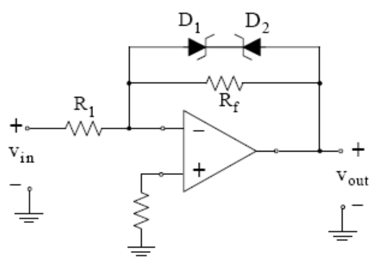


Fig.4.2

Q2. What are the nominal limiting levels at node V_{01} of the circuit of Fig 4.3. What frequency of oscillation do you expect if $R_1=4.7$kΩ, $R_2=10$kΩ, $R_3= 30$kΩ and $C=0.2$µF?

Q3. What simple change would double the frequency while maintaining the amplitude at node V_0?

Q4. What simple change would double the frequency and half the amplitude at node V_0?

IV EXPERIMENTATION

4.1 – Square and Triangular Waveform Generator

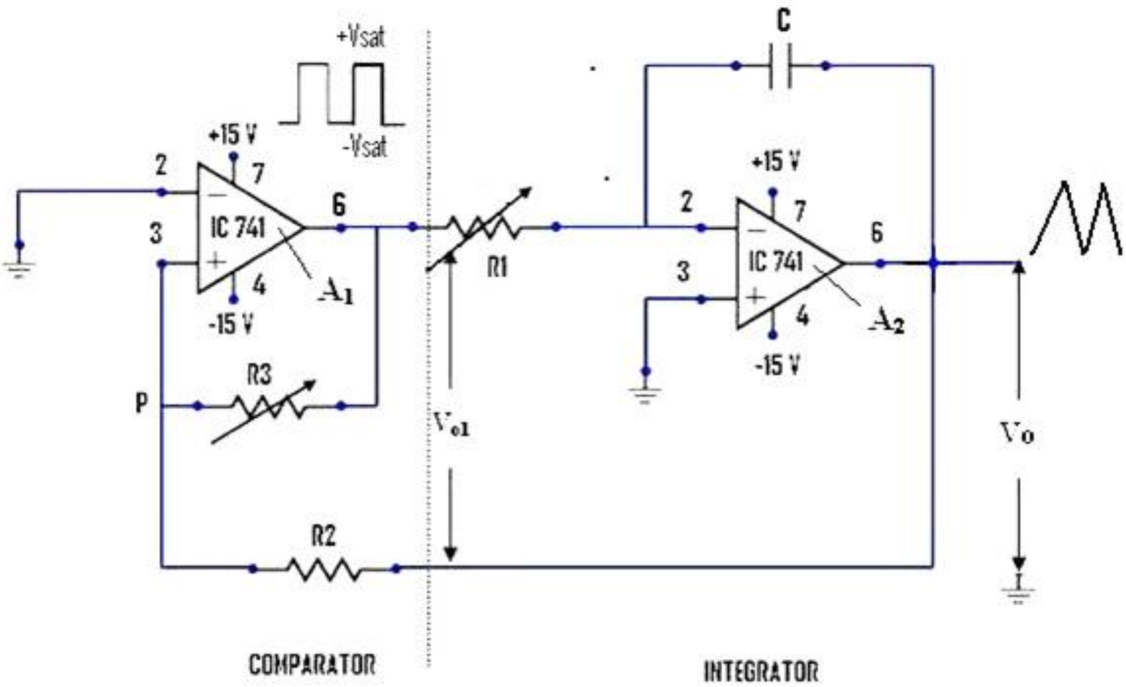


Fig 4.3. Circuit Diagram of Square and Triangular waveform generator

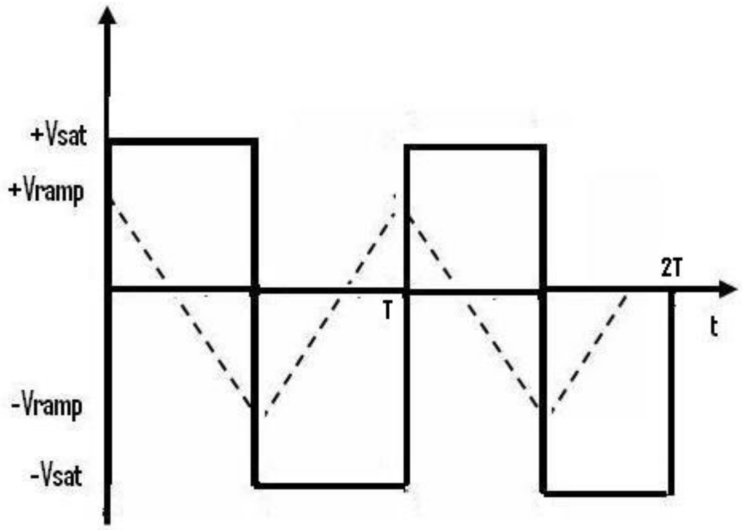


Fig 4.4 Typical waveforms

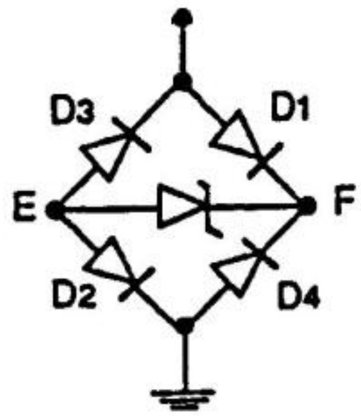


Fig 4.5 Voltage limiting circuit

4.2

Design the circuit of triangular waveform generator for ________V (peak to peak of triangle waveform) at ________Hz. Draw the circuit diagram in the space provided and indicate the component values.

1) Build the circuit.

2) Observe the signals at nodes V_{01} and V_0. Note the two waveforms, their peak to peak values and the frequency.

Signal	Measured		Calculated	
	Peak to peak (V)	Frequency (Hz)	Peak to peak (V)	Frequency (Hz)
V_{01}				
V_0				

3) In turn, shunt R_1, R_2, C by components of equal value, and note the effects on signal amplitudes and frequencies.

R_1 Shunted by equal value ($R_{1effective}$=)

Signal	Measured		Calculated	
	Peak to peak (V)	Frequency (Hz)	Peak to peak (V)	Frequency (Hz)
V_{01}				
V_0				

R_2 Shunted by equal value ($R_{2effective}$=)

Signal	Measured		Calculated	
	Peak to peak (V)	Frequency (Hz)	Peak to peak (V)	Frequency (Hz)
V_{01}				
V_0				

C_1 Shunted by equal value ($C_{effective}$=)

Signal	Measured		Calculated	
	Peak to peak (V)	Frequency (Hz)	Peak to peak (V)	Frequency (Hz)
V_{01}				
V_0				

Comment on your observations:

4) Connect the sub circuit shown in the Fig. 4.5 at the output of the comparator and note the amplitude and frequency.

Signal	Peak to peak (V)	Frequency (Hz)
V_{01}		
V_0		

5) While displaying the waveforms at nodes V_0 and V_{01}, short-out the zener Z intermittently, noting the changes in amplitude and frequency.

Signal	Peak to peak (V)	Frequency (Hz)
V_{01}		
V_0		

6) While displaying nodes V_0 and V_{01}, open circuit the zener and observe the overall effect. Note that without zener the operation depends on the relative saturation voltages of A_1 and A_2. Comment on **the effect of zener.**

Signal	Peak to peak (V)	Frequency (Hz)
V_{01}		
V_0		

Consider the variety of waveforms available and the means for control. Prepare an organized and well-labeled timing sketch, including at least the three node voltages P, V_0, V_{01}. (Use the ordinary graph sheet provided).

V INFERENCE \ CONCLUSIONS