

Experiment no.11

§ Differentiator Op-amp §

11.1 Objective:

To design and study the differentiator operational amplifier.

11.2 Theory:

The basic operational amplifier differentiator circuit produces an output signal, which is the first derivative of the input signal.

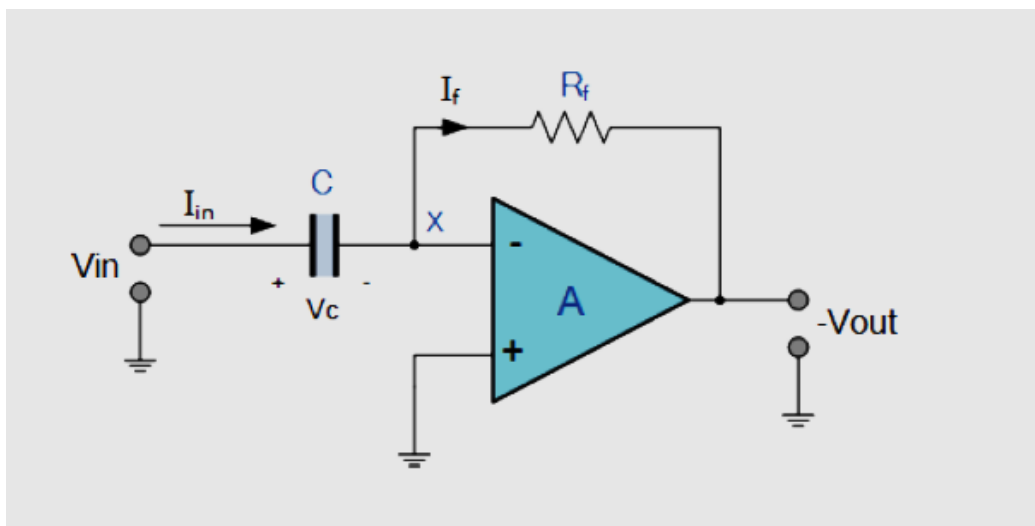


Figure (1)

Here, the position of the capacitor and resistor have been reversed and now the reactance, X_C is connected to the input terminal of the inverting amplifier while the resistor, R_f forms the negative feedback element across the operational amplifier as normal.

This operational amplifier circuit performs the mathematical operation of Differentiation, which is it “produces a voltage output which is directly proportional to the input voltage’s rate-of-change with respect to time“. In other words the faster or larger the change to the input voltage signal, the greater the input current, the greater will be the output voltage change in response, becoming more of a “spike” in shape.

As with the integrator circuit, we have a resistor and capacitor forming an RC Network across the operational amplifier and the reactance (XC) of the capacitor plays a major role in the performance of an Op-amp Differentiator.

An ideal voltage output for the op-amp differentiator is given as:

$$V_{OUT} = -R_F C \frac{dV_{IN}}{dt}$$

- **Differentiator OP-amp Waveforms:-**

If we apply a constantly changing signal such as a Square-wave, Triangular or Sine-wave type signal to the input of a Differentiator amplifier circuit the resultant output signal will be changed and whose final shape is dependent upon the RC time constant of the Resistor/Capacitor combination.

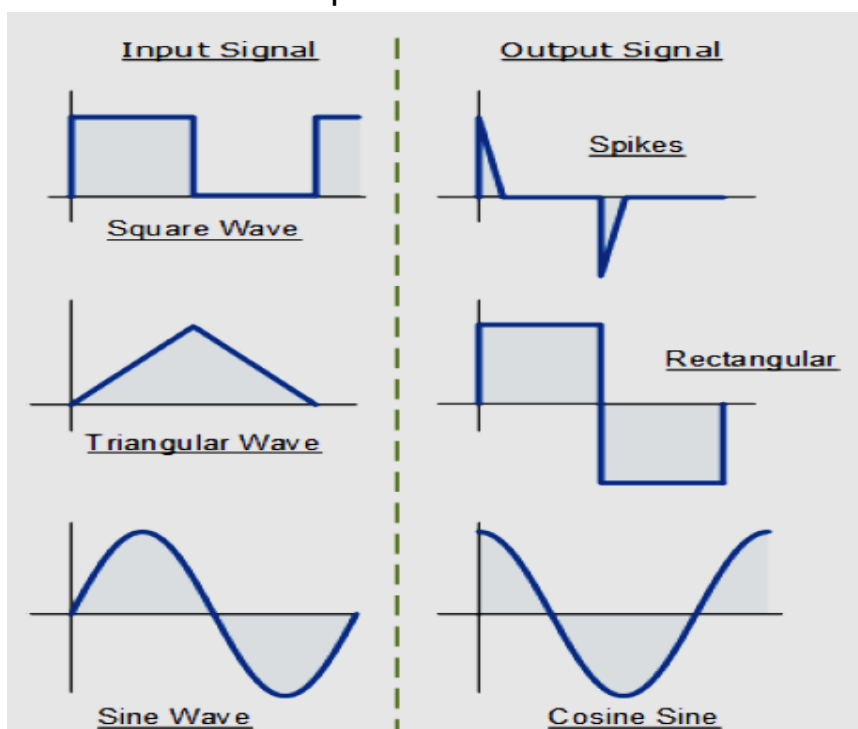


Figure (2)

11.3 Procedure:

1. Enter specific (input voltage) (4V) and frequency (300Hz) from the power supply device and draw input waveform (triangle wave) by using Oscilloscope.
2. Connect the circuit shown in the figure (3).

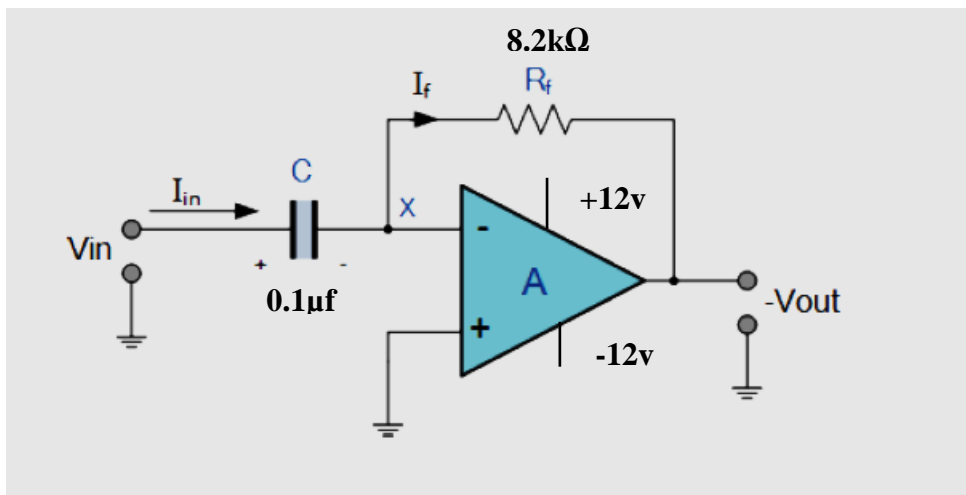


Figure (3)

3. Connect the first terminal of **OSC** to the output terminal of op-amp and second terminal of **OSC** to the ground.
4. Turn on the circuit and Draw output waveform (must be square wave) by using Oscilloscope. (Must be 4v opposite to the in/p waveform)

11.4 Discussion:

1. Calculate the value of the (Vout) theoretically?
2. What is the differentiator operational amplifier?