Experiment #9 Op Amp as Integrator and Differentiator

Objective

To implement and analyze the operational amplifier integrator and differentiator

Equipment

Function generator with probes
DMM
Dc supply
Oscilloscope
Trainer IT-2006
Resistor
capacitor

Theory

An operational Amplifier is a DC coupled high gain electronic voltage Amplifier with a differential input and usually single ended output .in this Amplifier differential input consist of non-inverting input and inverting input. Ideally op amp amplifies only the difference in voltage between the two which is called differential input Voltage.

9.1 Integrator Op Amp

The operational Amplifier Integrator is an electronic integration circuit based on op-amp it performs mathematical operation of integration with respect to time. Its output voltage is proportional to input Voltage integrated over time. Its input current is offset by negative feedback current flowing in capacitor which is generated by increase in Vo Amplifier.

So output Voltages are dependent an input current as shown in (9.1). It has to offset and inverse of value of feedback capacitor. Greater capacitor value less has to be generated to produce a particular feedback current flow.

$$V_o = -\frac{1}{RC}\int V_i dt \qquad (9.1)$$

Circuit Diagram

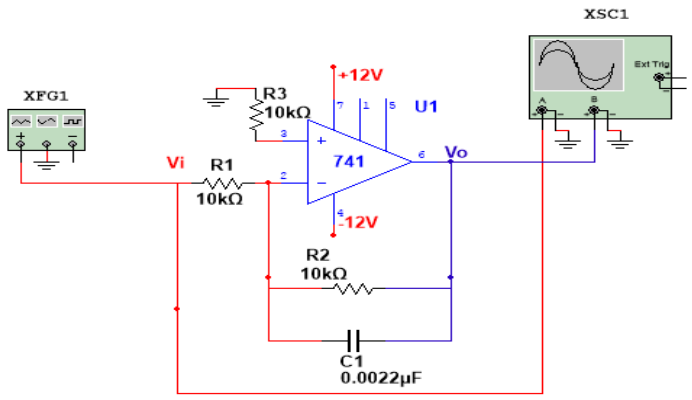


Figure 9.1: Operational Amplifier Integrator

Procedure

1. Connect circuit diagram according to given circuit shown in Figure 9.1.
2. Apply input square wave with amplitude of 1V at 10Khz. Observe the output signal measure and record signal comparing to input in oscilloscope.
3. Measure value of Vo p-p/
4. Measure duration of output signal t1 and t2.
5. Calculate Vo by using (9.1)
6. Measure Vo from oscilloscope.
7. Repeat the experiment by adjusting oscilloscope adjust input frequency to 100Khz.
8. Observe the change of output signal comparing with input signal.

Waveform

Differentiator Op Amp

The operational amplifier differentiator is an electronic differentiation circuit based on op-amp it performs mathematical Operation of differentiation that it produces voltage output directly proportion to input Voltage rate of change with respect to time. In other words, the faster or longer change in input signal the greater the input current the greater will be output voltage change in responding becoming more of spike in shape. It is opposite of op-amp integrator.

$$V_o(t) = -RC\frac{dV_{in}}{dt} \qquad (9.2)$$

Circuit Diagram

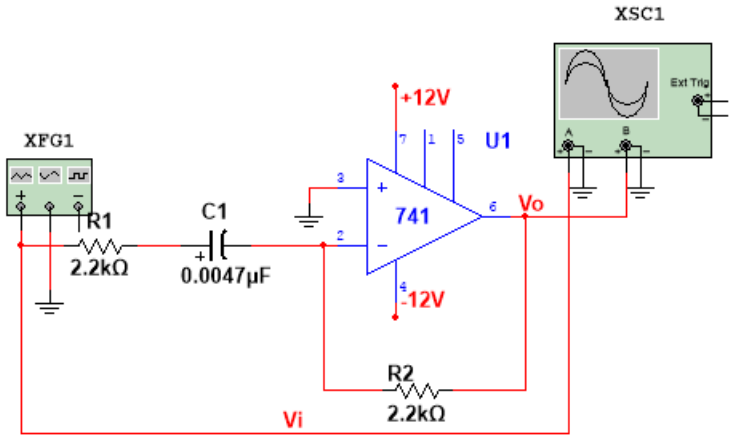
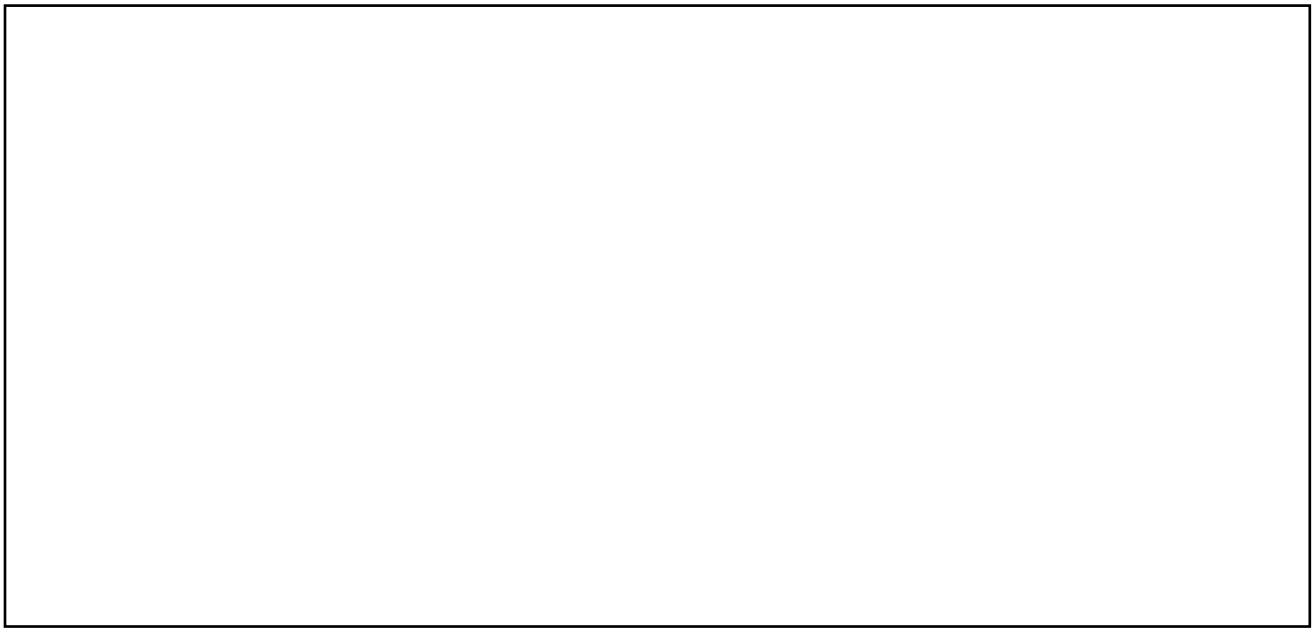


Figure 9.2: Operational Amplifier Differentiator

Procedure

1. Connect circuit diagram according to given circuit shown in Figure 9.2.
2. Apply input square wave with amplitude of 20V at 400Hz and then observe the output signal.
3. Draw pictures of output comparing to input signal.
4. Calculate +ve and -ve peak voltages.
5. Measure duration of t1 of Vo.
6. Calculate Vo peak by using (9.2).
7. Compare measured value of step 3 and describe results.
8. Adjust input frequency to 1khz
9. Repeat all steps respectively.
10. Calculate voltage gain Av.

Waveform



Conclusion