

Experiment No: 5

Aim

Verify the operation of a differentiator circuit using op amp 741.

Apparatus Required:

CRO, Function Generator, and 741 IC, +12V supply, Resistors, Capacitors and Connecting leads.

Theory:

Differentiator circuits as its name implies, performs the mathematical operation of differentiation, that is, the output waveform is the derivative of the input. The differentiator may be constructed from a basic inverting amplifier when an input resistor R_1 is replaced by a capacitor C .

$$V_{out} = -RC \frac{dV_{in}}{dt}$$

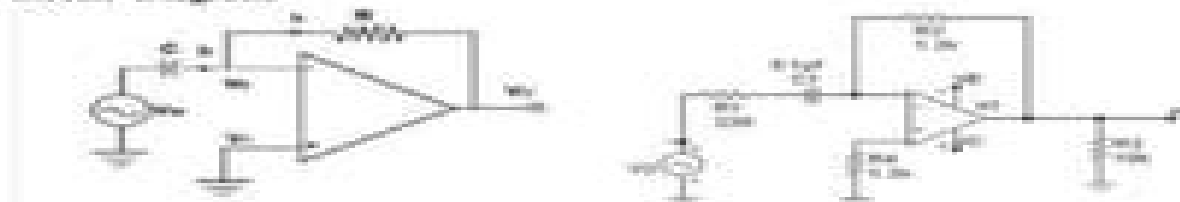
Thus, the output V_o is equal to the RC times the negative instantaneous rate of change of the input voltage V_{in} with time.

The right-hand side of the capacitor is held to a voltage of 0 volts, due to the "virtual ground" effect. Therefore, current "through" the capacitor is solely due to a change in the input voltage. A steady input voltage won't cause a current through C , but a changing input voltage will.

Capacitor current moves through the feedback resistor, producing a drop across it, which is the same as the output voltage. A linear, positive rate of input voltage change will result in a steady negative voltage at the output of the op-amp. Conversely, a linear, negative rate of input voltage change will result in a steady positive voltage at the output of the op-amp. This polarity inversion from input to output is due to the fact that the input signal is being sent (essentially) to the inverting input of the op-amp, so it acts like the inverting amplifier mentioned previously. The faster the rate of voltage change at the input (either positive or negative), the greater the voltage at the output. The formula for determining voltage output for the differentiator is as follows:

$$V_{out} = -RC \frac{dV_{in}}{dt}$$

Circuit Diagram



Procedure:

- 1) Connect the circuit as per the circuit diagram.
- 2) Apply the input signals i.e. Sinusoidal, Square waves.
- 3) Check the output waveform i.e. the wave shape of the signal.
- 4) Note that the output will be the differentiation of the applied signal or not.
- 5) Plot various input output wave shapes.

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Jianjun Gao



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