DEPARTMENT OF PHYSICS

MAR THOMA COLLEGE FOR WOMEN, PERUMBAVOOR

RC INTEGRATOR

Aim Design and set up an RC integrator and study its response to pulses and square waves.

Components and equipments required Capacitor, resistor, signal generator, bread board and CRO.

Theory If the time constant of the circuit is very large in comparison with the time period of the input signal, the circuit is called an integrator. Under this condition the voltage drop across C will be very small in comparison to the drop across R.

The current is V_{in}/R since almost all V_{in} is appearing across R.

Output voltage across C is $V_O = (1/C) \int i.dt = 1/C \int V_{in}\, dt$.

The output is proportional to the integral of the input. Voltage drop across C increases as time passes. For satisfactory integration, it is necessary that $RC \geq 15T$, where T is the period of input square wave.

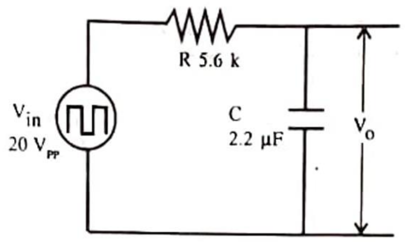
When a pulse waveform is given at the input, capacitor charges through R and output voltage builds up. Capacitor continues to charge as long as input voltage is present. When input is terminated, capacitor discharges and output falls to zero. As the value of RC increases the amplitude of the output decreases and the output waveform becomes linear. This happens because the charging current does not vary much through a high value resistor. Constant current through a capacitor gives a linear output.

If the input is a square wave capacitor charges and discharges from the negative voltage to the positive voltage input.

Procedure

1. Set up the circuit after testing the components.
2. Switch ON the pulse generator and set the pulse train output of 5 V, 1 kHz.
3. Observe the input and output on two channels of the CRO.
4. Note down the output waveforms for the following conditions using a potentiometer.
   i) RC = T, ii) RC << T and iii) RC >> T
5. Repeat the above steps for a square wave input of 10 V_{PP}, 1 kHz.

Circuit diagram



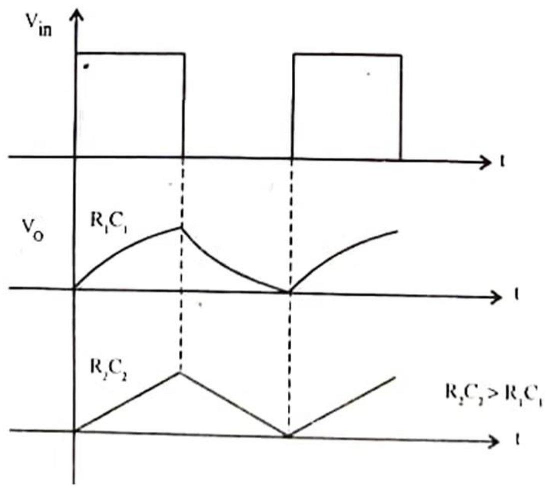
Design Let the input be a pulse train of 1 kHz. Then T = 1 ms.

For an integrator RC ≥ 15T.

To avoid loading, as a thumb rule, select R = ten times the output impedance of the pulse generator. i.e., R = 6000 Ω if Z_0 = 600 Ω. Use 5.6 k std.

Substituting this in the above expression we get, C = 2.2 μF.

Waveforms



Response of the RC integrator to a pulse train input

Reference

Electronics Lab Manual Volume I, K.A. Navas, **Rajath Publishers**

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