DEPARTMENT OF PHYSICS

MAR THOMA COLLEGE FOR WOMEN, PERUMBAVOOR

RC HIGH PASS FILTER

Aim To design and set up a high-pass RC filter for a 3-dB frequency of 1 kHz and study its frequency response.

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

Theory An high pass filter can be made from the low pass filter by merely interchanging its resistance and capacitor. Since the reactance of the capacitor decreases with increase in frequency, the higher frequency components in the input signal appear at the output with less attenuation than the lower frequency components. In other words, lower frequencies are attenuated by the circuit. At high frequencies, the capacitor acts almost as a short circuit and virtually the input amplitude appears at the output. Hence, this kind of circuit is called a high pass filter.

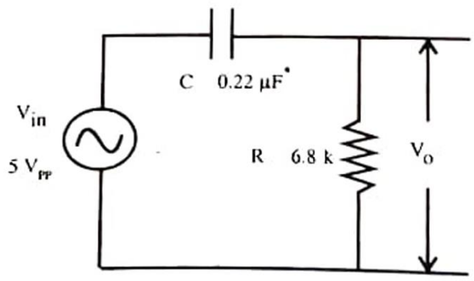
The magnitude of the ratio of output voltage to input voltage of the circuit is given by

$$A = \frac{1}{\sqrt{1 + (f_L/f)^2}} \quad \text{where } f_L = \frac{1}{2\pi RC} \text{ and } f = \text{input signal frequency.}$$

When $f = f_L$, $A = 1/\sqrt{2} = 0.707$.

It means that when input frequency becomes f_L, output becomes 70.7 % of its maximum level. 29.3% reduction in voltage corresponds to a gain reduction of 3 dB in dB scale. f_L is called half power frequency, resonant frequency or 3 dB frequency.

Circuit diagram



Design Let the lower cut off frequency f_L be 1 KHz.

We have $f_L = 1/2\pi RC$.

To avoid loading, as a thumb rule, select R = ten times the output impedance of the function generator. i.e., R = 6000 Ω. Use 6.8 k std.

Substituting this in the above expression we get, C = 0.023 μF. Use 0.022 μF.

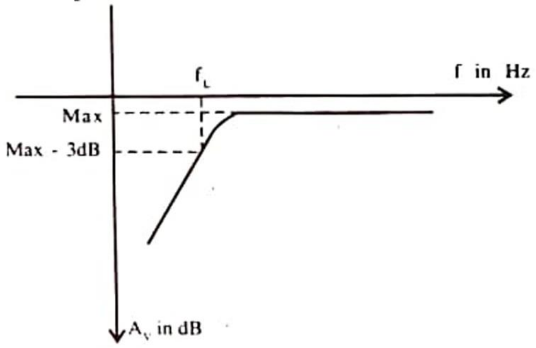
Procedure

1. Set up the circuit after testing all components.
2. Observe the signal generator output (a sine wave with 5 V peak to peak) on one channel of the CRO.
3. Connect the input signal to the circuit and output to the other channel of CRO so that input and output can be observed simultaneously.
4. Vary the input frequency from 10 Hz to 100 kHz or more and note down the output voltage in tabular column.
5. Plot the graph on semilog graph sheet with frequency f (or log f) on x-axis and gain in dB on y-axis.
6. Mark a point on the graph at 3-dB less than the maximum gain. Extend the point to x-axis and mark the lower 3-dB frequency.

Tabulation $V_{in} = 5\ V_{PP}$

f in Hz	V_O in volts	A_V in dB

Graph



Result Theoretical 3-dB frequency = ...Hz
Observed 3-dB frequency = ...Hz

Reference

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