భారతీయ సాంకేతిక విజ్ఞాన సంస్థ హైదరాబాద్
भारतीय प्रौद्योगिकी संस्थान हैदराबाद
Indian Institute of Technology Hyderabad

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# Low pass and High pass filter

## 1 Aim

To plot Frequency response of low pass and high pass filters

## 2 Apparatus

### 2.1 Equipments

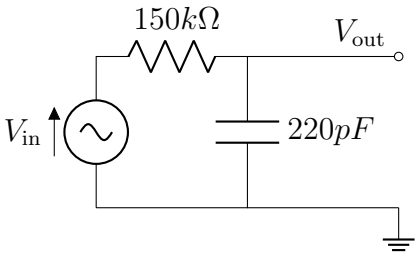
1. Function Generator
2. Bread Board
3. Oscilloscope
4. Multimeter

### 2.2 Components

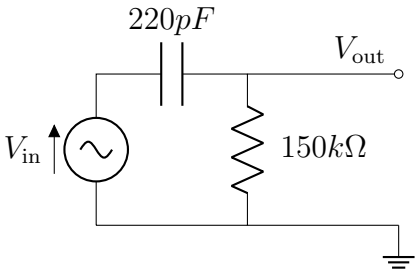
1. Resistor(150 kΩ)
2. Capacitor(220 pF)

## 3 Circuit Diagram

### 3.1 Low pass



### 3.2 High Pass




# 4 Theory

1. An RC low-pass filter allows signals with frequencies below a certain cutoff frequency to pass through while attenuating higher frequencies.
2. As the frequency of the input signal approaches the cutoff frequency, the output amplitude of the low-pass filter gradually decreases.
3. Conversely, an RC high-pass filter allows signals with frequencies above a certain cutoff frequency to pass through while attenuating lower frequencies.
4. As the frequency of the input signal increases beyond the cutoff frequency, the output amplitude of the high-pass filter gradually increases.

# 5 Procedure

1. Set up the circuit as shown taking the output across the capacitor (resistor for high pass filter).
2. The input for the filter is taken from output of function generator. It is connected to channel 2 of oscillator.
3. Vary the frequency of the input signal over a wide frequency range (keeping the input amplitude fixed). Note the value of each frequency.
4. Plot the values of gain vs Frequency and find out cut-off frequency from it. (higher cutoff for low pass filter and lower cutoff for high pass filter.)

# 6 Calculations

1. Firstly, let us find the cutoff frequency theoretically:

$$f = \frac{1}{2\pi RC} \tag{1}$$

$$= \frac{1}{2\pi \cdot 150 \cdot 10^3 \cdot 220 \cdot 10^{-12}} \tag{2}$$

$$= 4825.32\text{Hz} \tag{3}$$

2. Now find corresponding $V_{\text{out}}$ for corresponding frequencies and note it down in a table as shown below.
   Let $V_{\text{in}}$ be 5V.

| **Frequency** | $V_{\text{out}}$**(in V)** | $A(gain) = \frac{V_{\text{out}}}{V_{\text{in}}}$ | **Frequency response=**$20logA$**(in dB)** |
|---|---|---|---|
| 500Hz | 4.984 | 0.997 | -0.17 |
| 1KHz | 4.970 | 0.994 | -0.34 |
| 2KHz | 4.942 | 0.988 | -0.68 |
| 4KHz | 4.887 | 0.976 | -1.36 |
| 5KHz | 4.849 | 0.970 | -1.70 |
| 6KHz | 4.810 | 0.963 | -2.03 |
| 10KHz | 4.704 | 0.941 | -3.40 |

Table 1: Observation Table for Low Pass

| **Frequency** | $V_{\text{out}}$**(in V)** | $A(gain) = \frac{V_{\text{out}}}{V_{\text{in}}}$ | **Frequency response=20logA(in dB)** |
|---|---|---|---|
| 500Hz | 1.86 | 0.372 | -19.81 |
| 1KHz | 2.53 | 0.506 | -13.64 |
| 2KHz | 3.30 | 0.66 | -8.33 |
| 4KHz | 4.10 | 0.82 | -3.96 |
| 5KHz | 4.37 | 0.874 | -2.68 |
| 6KHz | 4.51 | 0.902 | -2.05 |
| 10KHz | 4.80 | 0.96 | -0.79 |

Table 2: Observation Table for High Pass

3. Now plot a graph of frequency response versus frequency

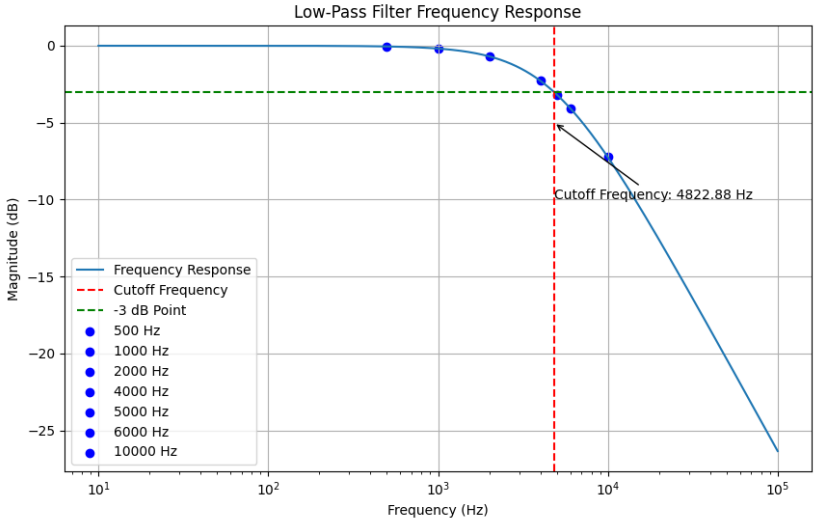



Figure 1: For Low pass filter

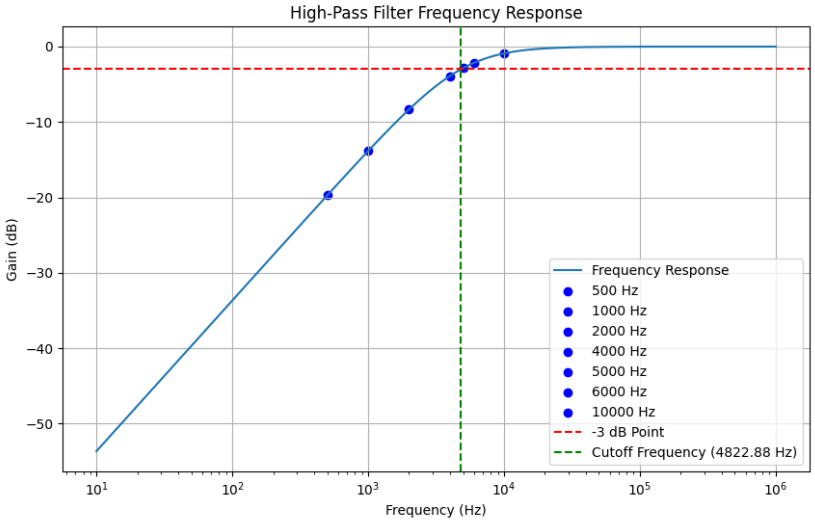



Figure 2: For High pass filter

4. Cutoff frequency now corresponds to frequency response being -3dB i.e. 4822.88Hz.

# 7 Result

| caculated | measured |
|---|---|
| 4825.32Hz | 4822.88Hz |

Table 3: Result