Name of the experiment: To analyze the frequency response of a RLC Bandstop filter.

Objective: After completing this experiment, we will know the effect of input frequency to the output of a B.S.F. We will also know how to draw a semi-log graph of frequency vs transfer function.

Theory: A Bandstop filter is a circuit that eliminate all the frequencies within a band of frequencies $(\omega_1 < \omega < \omega_2)$. A B.S.F is formed when the output of a RLC series circuit is taken off LC series combination. shown in figuire(1).

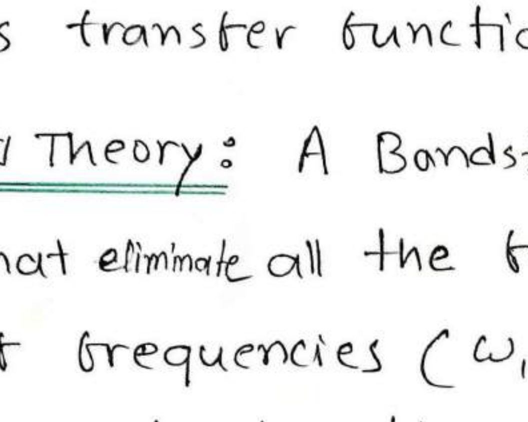


Fig:(1)

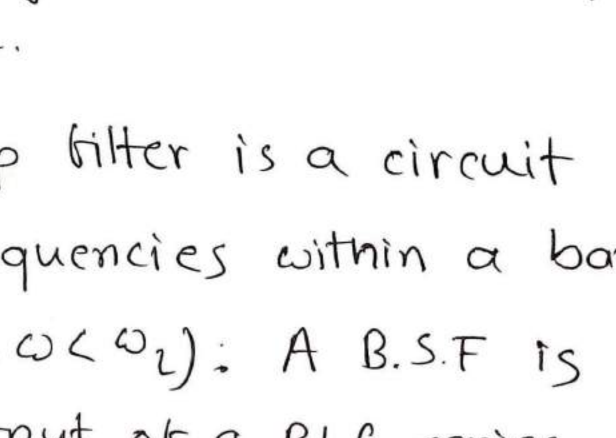


Fig:(2)

In fig.(2), the frequency vs gain graph showing the ideal and actual frequency response of a Bandstop filter.

For a B.S.F, the center frequency,

$$\omega_0 = \frac{1}{\sqrt{LC}} \Rightarrow f_0 = \frac{1}{2\pi\sqrt{LC}} \quad \text{--- (i)}$$

$$B = \frac{R}{L} \quad \text{--- (ii)}$$

$$\omega_1 = \omega_0 - \frac{B}{2} \qquad \omega_2 = \omega_0 + \frac{B}{2}$$

$$\Rightarrow f_1 = \frac{\omega_1}{2\pi} \quad \text{--- (iii)} \qquad \Rightarrow f_2 = \frac{\omega_2}{2\pi} \quad \text{--- (iv)}$$

Taking $V(t) = 5V$, $L = 330\mu H$, $C = 30\mu F$, $R = 2.4\Omega$ the required circuit will be same as fig(3)

Apparatus:

Fig:(3)

1. Frequency generator
2. Oscilloscope
3. Resistor
4. Capacitor
5. Inductor
6. Breadboard
7. Connector

Procedure :

1. Make the circuit and connect the frequency generator to the input.

2. To measure the frequency, response, connect CH-1 and CH-2 of oscilloscope to input and output respectively.

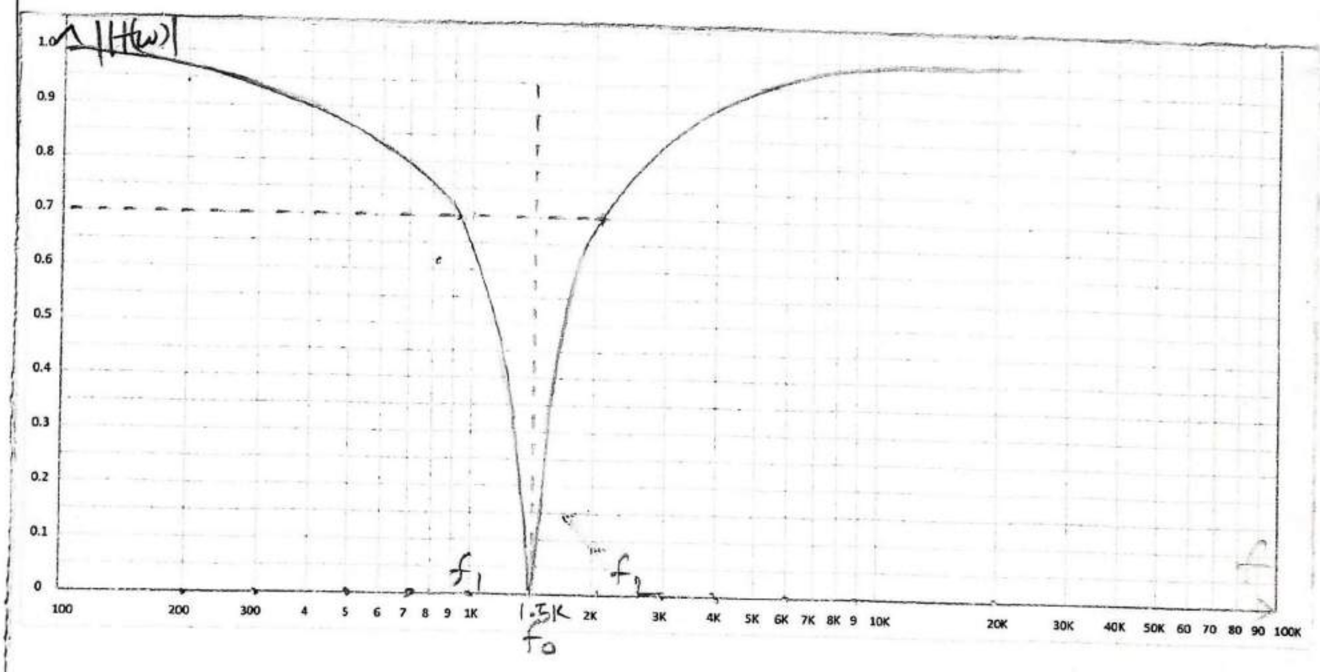
3. Go to the 'measure' function of oscilloscope and set the peak-to-peak voltages of CH-1 and CH-2 to display.

4. For a wide renge of frequency, in both side of f_1 and f_2, note the peak-to-peak voltages (VPP) of CH-1, and CH-2 and make a data table of frequency, VPP(in), VPP(out) and gain H(ω).

5. From the experimental value, draw a semi-log graph of frequency vs gain.

Data table: Bandstop

	Frequency (Hz)	Vin (Pk-Pk)	Vout (Pk-Pk)	$H(\omega) = \frac{V_o}{V_i}$
1	200	5	4.55	0.97
2	300	4.87	4.58	0.94
3	500	4.69	4.08	0.87
4	700	4.48	3.72	0.83
5	1K	4.35	2.95	0.68
6	1.5K	4.2	0.01	0.001
7	2.1K	4.01	2.76	0.69
8	3K	3.97	3.33	0.84
9	4K	3.88	3.53	0.91
10	6K	3.68	3.53	0.96
11	9K	3.58	3.5	0.98
12	20K	3.5	3.4	0.99



Calculation:

$$\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{330 \times 30 \times 10^{-12}}} = 10\,000 \text{ rad/s}$$

$$\therefore f_0 = \frac{\omega_0}{2\pi} = 1.5 \times 10^3 \text{ Hz}$$

$$B = R/L = \frac{2.4}{330 \times 10^{-6}} = 7.27 \times 10^3$$

$$\therefore \omega_1 = \omega_0 - \frac{B}{2} = 10 \times 10^3 - 3636 = 6363 \text{ rad/s}$$

$$\therefore f_1 = \frac{\omega_1}{2\pi} = 1012 \text{ Hz} \approx 1000 \text{ Hz}$$

$$\omega_2 = \omega_0 + \frac{B}{2} = 10 \times 10^3 + 3636 = 13636 \text{ rad/s}$$

$$\therefore f_2 = \frac{\omega_2}{2\pi} = 2170 \approx 2100 \text{ Hz}$$

Result:

The circuit is a RLC Bandstop filter from 1000Hz to 2100 Hz.

Precautions:

1. Make sure the sine wave is selected
2. Set both the coaxial cables of oscilloscope either 1x or 10x mood.
3. Make sure bothe channel 1 and Channel 2 are on.