Activenarrowbandpass -- Overview

Dr. B Kanmani
Department Head,
Telecommunication Engineering

BMS College of Engineering (BMSCE),
Bangalore, India

OBJECTIVES:

At the end of performing this experiment, learners would be able to:
• Describe the concept of Resonant filter
• Obtain the Quality factor,Bandwidth and cutoff frequency of the filter designed
• Compare the designed cut-off frequency with the desired cut-off frequency
• Understand the working of µA741 IC (Op Amp)

EQUIPMENT:

• IC µA741
• Signal generator
• Resistors
• Capacitor
• Inductor
• +/- 15V DC Power Supply
• Digital Storage Oscilloscope & probes
• Connecting wires & Bread Board

DESIGN:

• Given second order active Bandpass filter with a centre frequency 5KHz, quality factor 10, and voltage gain 25
• Centre frequency

$$f_0 = \frac{1}{2\pi\sqrt{LC}}\ \text{Hz}$$ Choose L, compute C

• Given voltage gain Ao, choose R1 and compute R2

$$A_O = \left(1 + \frac{R_2}{R_1}\right)$$

• Given quality factor Q , compute resistor R, using

$$R = \frac{1}{Q}\sqrt{\frac{L}{C}}$$

THEORY:

• The µA741 device is a general-purpose operational amplifier featuring offset-voltage null capability

• Band pass filters have a frequency response as shown in figure 1. The difference between the two cut-off frequencies fl (the lower cut-off) and fh(the upper cut-off) is known as the bandwidth Bw.

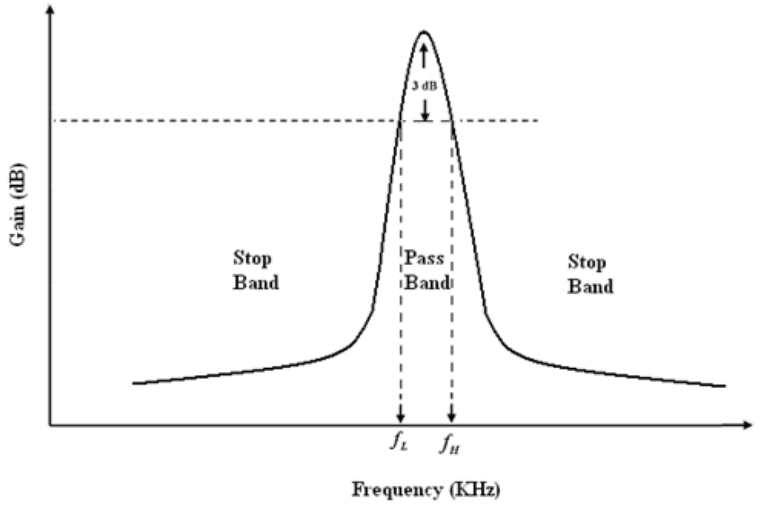


Figure 1: Frequency response of a narrow band-pass filter

• When the bandwidth Bw is small compared to either fl or fh the circuit is known as a resonant circuit with frequency response shown in figure 1.

• Resonant filters are characterized by the center or resonant frequency fo, and a high quality factor Q, where,

$Q = f_0 / Bw$ and $f_0 = \sqrt{f_L f_H}$

Reference reading:

1) Theory and application of Digital SIgnal Processing, by Lawrence R Rabine and Bernard Gold, Prentice Hall, Easter Economy Edition
2) Integrated Electronics, by Millman and Halkias, Tata McGraw-Hill

Acknowledgement

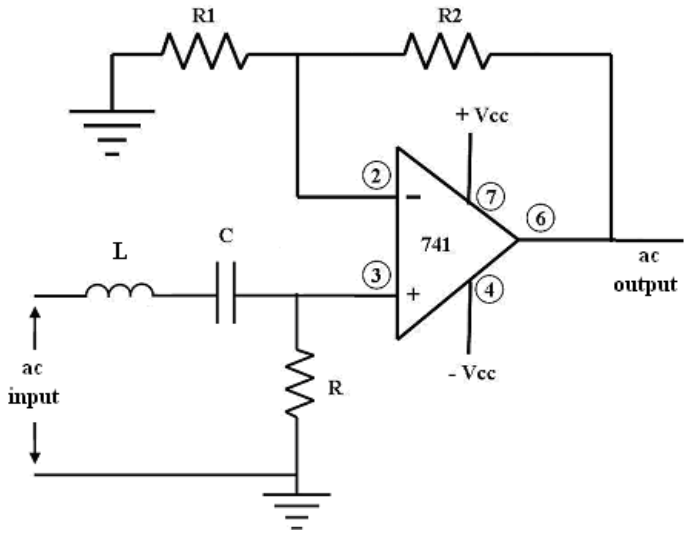
Mr.Shreenivas B for converting laboratory experiment to Tektronix courseware format

Activenarrowbandpass -- Procedures

Step 1

Circuit setup:

Build the following circuit with designed values



Active resonant/narrow band pass filter

Step 2

• Use a signal generator to generate analog input . The analog input will be set to 1 Vpp Sine wave
• Turn on the supply of the circuit and enable signal generator that is feeding signal to the circuit.

Step 3

• Connect the DSO probe – CH1 at analog input (Sine wave), CH2 at output (pin # 6 of μA741 IC)
• Perform Autoset on DSO and capture the output signal.

Step 4

• Configure PEAK-to-PEAK measurement on the input and output signal
• Observe and record the signal – input and output.

Step 5

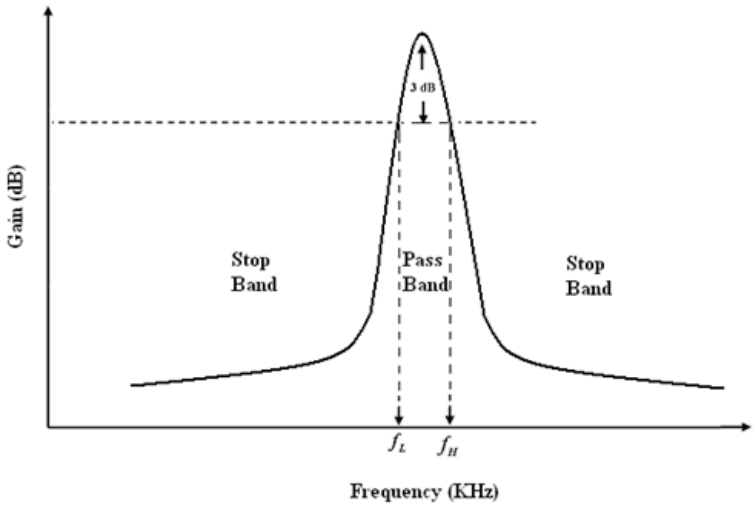
Record the input and output peak-to-peak voltage for various input frequencies, and complete the table below.

Frequency (Hz)	Vin(v)	Vout(v)	Gain (dB)= 20 log (Vout / Vin)
100Hz			
200Hz			

1MHz			

Step 6

Plot the frequency response of the designed filter (Plot of Frequency Vs. Gain on a semi-log sheet)



Step 7

Observations:

i) The lower cut-off frequency f_L and the higher cut-off frequency f_H

ii) The bandwidth $Bw = f_H - f_L$

iii) The quality factor, $Q = f_0 / Bw$

iv) The voltage gain $A_0 = (V_0 / V_i)$, in the pass band of the filter

Step 8

Open-ended Question / Can you answer this?

If the designed parameters are not equal to the desired ones, give reasons.