ActiveBandPassFilter -- Overview

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OBJECTIVES:

At the end of performing this experiment, learners would be able to:
• Describe the concept of active Wide Band Pass Filter
• Obtain the 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
• +/- 15V DC Power Supply
• Digital Storage Oscilloscope & probes
• Connecting wires & Bread Board

DESIGN:

• Given second order active wide-band-pass filter with a lower cut-off frequency 3KHz, and the upper cut-off-frequency of 30 KHz, having voltage gain of 25.

• Given the lower cut-off frequency fl Hz, compute the values of the resistor and the capacitor of the HPF, Choose C = 0.1µF, compute Rl

$$f_{H\text{-}BPF} = \frac{1}{2\pi R_l C_l}$$

• Given the upper cut-off frequency fh Hz, compute the values of the resistor and the capacitor of the LPF, Choose C = 0.1µF, compute Rh

$$f_{L\text{-}BPF} = \frac{1}{2\pi R_h C_h}$$

• Given the gain of the BPF, assume R1 and compute R2 using

equation

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

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.

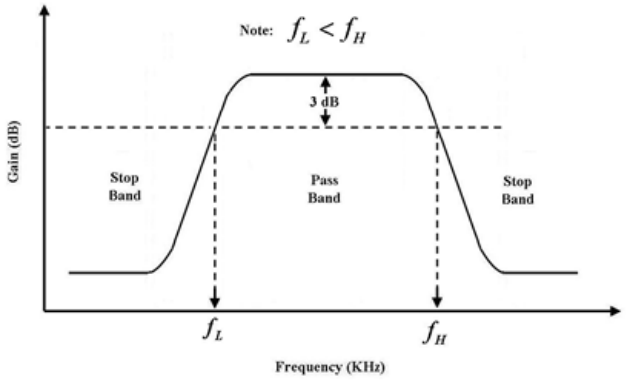


Figure 1: Frequency response of a band-pass filter

• Wide-BPF can be realized by cascading a low-pass and a high-pass filter as shown in figure 2. This method is not economical in terms of use of components, and also when the bandwidth is narrow.

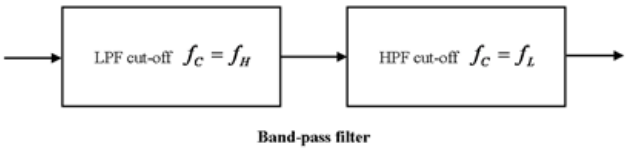


Figure 2: Realization of a band-pass filter

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

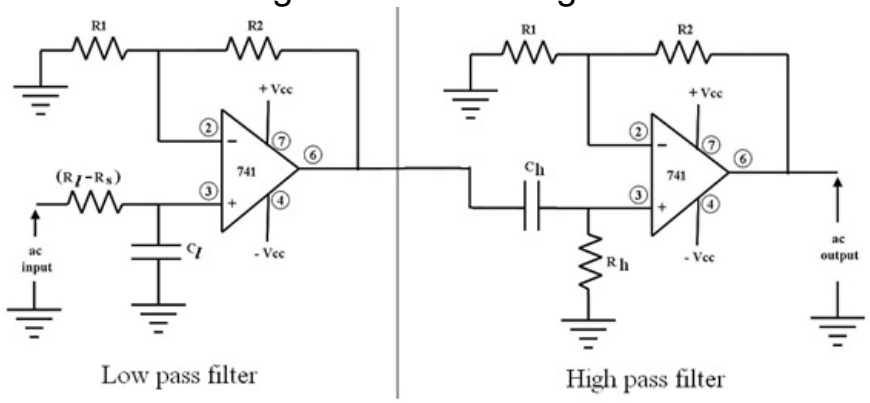
Mr.Shreenivas B for converting laboratory experiment to Tektronix courseware format

ActiveBandPassFilter -- Procedures

Step 1

Circuit setup:

Build the following circuit with designed values



Realization of a wide-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 of LPF and verify it

Step 4

• Perform Autoset on DSO and capture the output signal of HPF and verify it

Step 5

• Cascade the two circuit then capture the output signal of BPF

Step 6

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

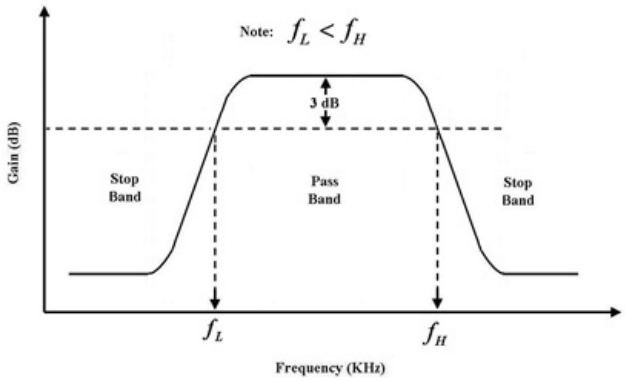
Step 7

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)
100 Hz			
200 Hz			
1MHz			

Step 8

Plot the frequency response of the designed filter (Plot of Frequency Vs. Gain on a semi-log sheet), and hence obtain the lower and upper cut-off frequencies



Step 9

Observations:

i) The designed filter has a lower cut-off frequency(fl) ……Hz
ii) The designed filter has aupper cut-off-frequency (fh) ……Hz
iii) The designed filter has a Bandwidth ……Hz

Step 10

Open-ended Question / Can you answer this?

What will be the result if:
1) We increase the gain of the BPF ?
2) We take capacitor value 1μF instead of 0.1μF?