LAB REPORT NO 11

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CS-II lab

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Lab 11

High Pass Filter

It is a frequency selective circuit, which passes signals of frequencies above its low cut off frequency (f_L) and attenuates signals of frequencies below f_L.

Objectives:

To study the Active High pass filter and to evaluate:

- Low cutoff frequency of High pass filter.
- Pass band gain of High pass filter.
- Plot the frequency response of High pass filter.

Equipment:

1. DC power supplies +15V, −15V from external source
2. Function generator
3. Oscilloscope
4. Digital Multimeter

Components:

1. Resistance 10kΩ
2. Resistance 22kΩ
3. Capacitor 0.01µF
4. LM 741

Equation of High pass filter

$$\frac{Vout}{Vin} = \frac{A_F}{1+j(f/f_l)} \qquad 1$$

$$\frac{Vout}{Vin} = \frac{A_F}{\sqrt{1+\left(\frac{f}{f_l}\right)^2}} \qquad 2$$

V_{in} =Input signal Voltage

V_{out} = Output signal Voltage

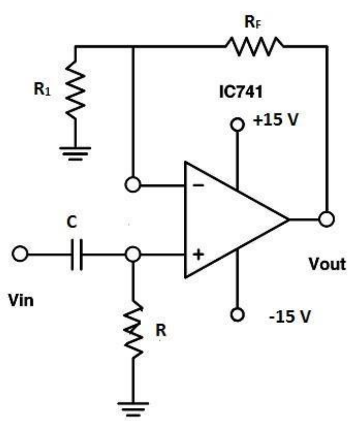
$| V_{out}/V_{in} |$= Gain of filter as a function of frequency
$A_F = 1+R_F/R_1$ = pass band gain of filter f

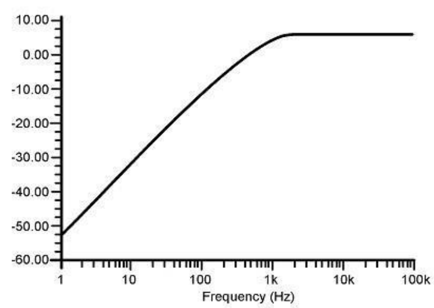
= frequency of input signal

$f_L = 1/2\pi RC$ =Low cut off frequency, 3-dB frequency, corner frequency
Operation of high pass filter using equation 2 1.

At low frequencies $f < f_L$: $| V_{out}/V_{in} | < A_F$

2. At $f=f_L$ $| V_{out}/V_{in} | = 0.707*A_{F(Approx.)}$
3. At $f > f_L$ $| V_{out}/V_{in} | = A_F$





In ideal high pass filter, when $f < f_L$ gain is increased at a constant rate with an increase in frequency. At f_L the gain is 0.707*AF, and above f_L it has constant gain of AF. Below f_L when input frequency is increased tenfold (one decade), the voltage gain is multiplied by 10.

Gain (dB) = 20 log | Vout / Vin |

i.e. Gain Roll off rate is −20db / decade.

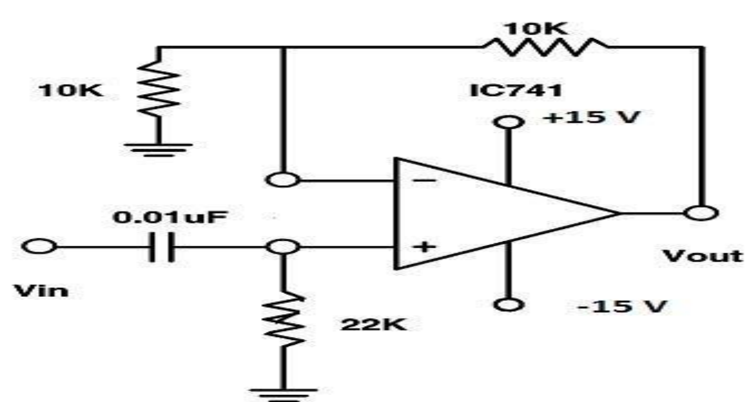


Figure 2

Procedure:

1. Connect the circuit as shown in Figure 2.
2. Switch ON the power supply.
3. Connect a sinusoidal signal of amplitude 1V (p-p) of frequency 1KHz to Vin of High pass filter from function generator.
4. Connect Ch-1 of oscilloscope to the signal source.
5. Observe output on Ch-2 of oscilloscope.
6. Increase the frequency of input signal step by step and observe the effect on output V_{out} on oscilloscope.
7. Tabulate values of V_{out}, gain, gain (dB) at different values of input frequency shown in observation Table 2.
8. Plot the frequency response of High pass filter using the data obtained at different input frequencies.

Theoretical Calculations:

Calculate all the following values

1. Pass band gain of High pass filter $A_F = 1 + R_F / R_1$
2. Pass band gain (dB) = $20 \log |V_{out} / V_{in}|$
3. Low cutoff frequency $f_L = 1/2\pi RC$
4. Gain at Low cutoff frequency $f_L = 0.707 * A_F$
5. Roll off rate = −20db/decade

Results:

	Theoretical	**Practical**
Pass band gain(At)	2	2.09
Pass band gain (At) in db	6.02	6.02
Low cutoff frequency(fL)	723.7	719.5
Gain at 3db frequency fH in db	3	2.922

For V_{in} = 1v (peak to peak): -

Sr. No.	Input Frequency (Hz)	V_{out}	$\lvert V_{out}/V_{in} \rvert$ = Gain	Gain (dB) = 20 log $\lvert V_{out} / V_{in} \rvert$
1	300	1	1	0
2	500	1.2	1.2	1.5
3	700	1.5	1.5	3.52
4	1k	1.9	1.9	5.575
5	5k	2.09	2.09	6.40
6	10k	2.00	2.00	6.02
7	15k	2.00	2.00	6.02

Table 2