Kathmandu University
Department of Electrical and Electronics Engineering
ANALOG ELECTRONICS LABORATORY WORK

EXPERIMENT 5: Frequency Response of an Amplifier

Objectives: To understand the frequency limitation of an amplifier.

Software:
Multisim 8

Theory:
Based on signal frequency an amplifier can be classified into four types. *DC amplifier* amplifies very low frequency. *Audio amplifiers* have good frequency response over the audio frequency range*. Video amplifiers* (wide band amplifiers) have frequency range from DC to few MHz *RF amplifiers* (Front end amplifiers) have tuned or wideband type of frequency response.
Amplifiers are limited in the higher portion of spectrum because of stray and parasitic capacitance effect (which is unavoidable☹). For example when the operating frequency increases, C_i shunts most of the signal current to ground though C_i and C_o have very low value of capacitance. Gain of amplifier reduces in the higher portion of spectrum.

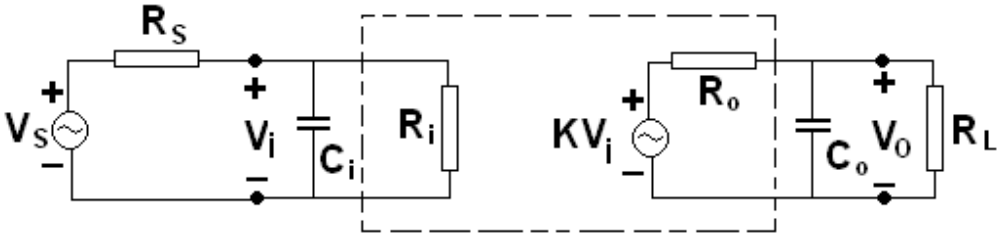

Fig 1

Amplifiers are limited in the lower portion of spectrum because of the blocking capacitances though the value of blocking capacitances is in the range of uF.

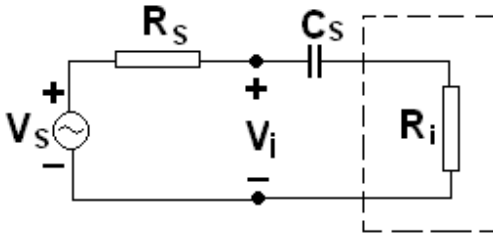

Fig 2

The gain of a STC (Single Time Constant) network rolls-off by 20dB/decade or 6dB/octave in the stop band. There will be a phase lag between the output voltage and input voltage waveform.
In Multisim® software package, one can use Bode plotter to view the frequency response of any amplifier. In this lab we will see the frequency response of a VCVS.

STC Network

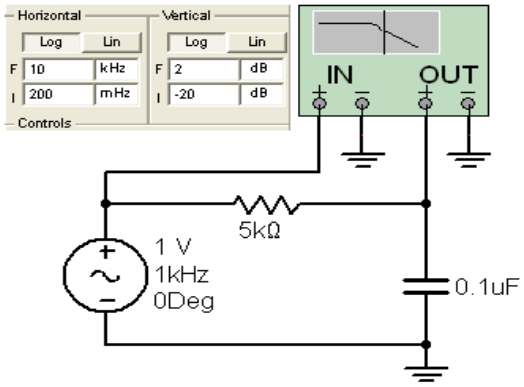

Fig 3

Procedure

1. Connect the circuit as shown in fig 3.
2. Feel free to use various controls of the Bode plotter. (Especially Cross-hair)
3. Determine the break frequency. (-3dB point)
4. Notice the phase shift. (Positive or negative? ☺)
5. Change the resistor by capacitor and capacitor by resistor.
6. Determine the break frequency.
7. Notice the phase shift. (Positive or negative? ☺)

High Frequency Response of an Amplifier

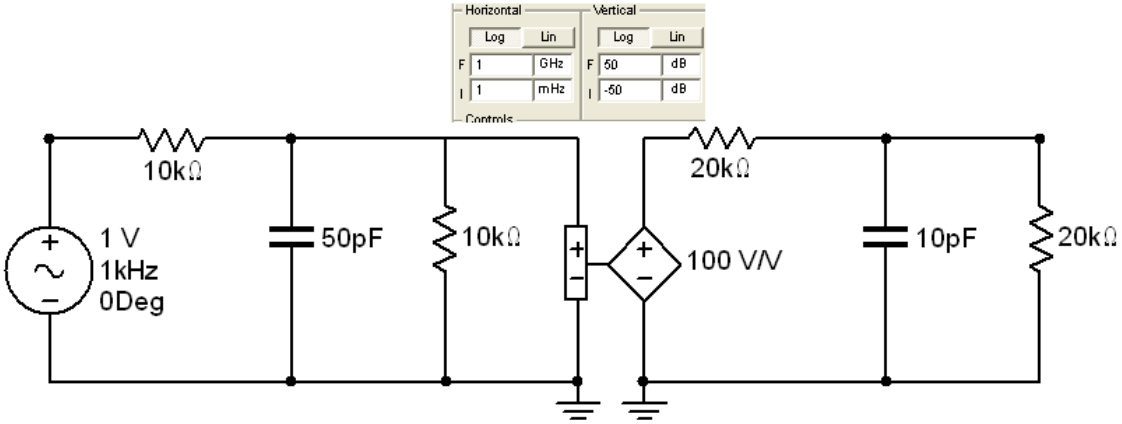

Fig 4

Procedure

1. Connect the circuit as shown in fig 4.
2. Feel free to use various controls of the Bode plotter.
3. Sketch the magnitude response of the amplifier.
4. Find the DC gain of the amplifier.
5. Find the bandwidth of the amplifier (3dB point). Compare it with the theoretical result.

6. Sketch the phase response.
7. Remove the capacitors and again find the DC gain of the amplifier (K_O).
8. Note the phase plot.
9. Decrease the input capacitance to 5pF and find the bandwidth of the amplifier. Compare it with 5.
10. Increase the input capacitance to 100pF and find the bandwidth of the amplifier. Compare it with 5.
11. Decrease R_i to 5K and find the bandwidth and DC gain of amplifier.
12. Remove the output 10pF capacitance and find the BW of the amplifier. Compare it with the theoretical result.
13. Connect the 10pF capacitor in its own place. Increase its value to 100pF and find the BW of the amplifier.

Low Frequency Response of an Amplifier

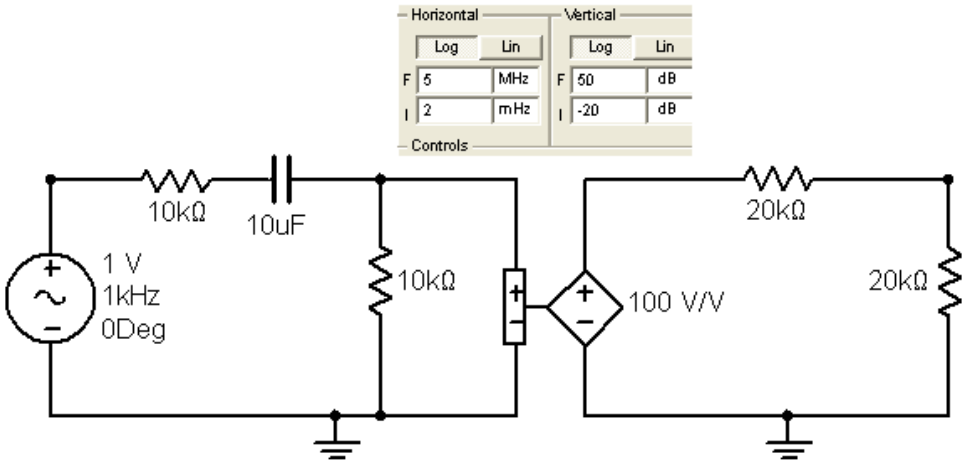

Fig 5

Procedure

1. Connect the circuit as shown in fig 5.
2. Sketch the magnitude response and the phase response.
3. Determine the break frequency. $f = \frac{1}{2\pi(R_S + R_i)C}$.Please note that $R_S + R_i$ is the effective resistance across the capacitor.