Simulation 6

Comparison of frequency response of Common-Emitter (CE) and Common-Base (CB) amplifiers

Objective – Compare the frequency response of Common-Emitter (CE) and Common-Base (CB) amplifiers

Introduction – An amplifier has always a frequency-dependant gain. In the mid-band region the gain is largest and at lower frequency the gain starts to decrease. The point at which the gain reduced to 71% of the highest value is called lower 3dB point (f_L). At high frequencies also the gain goes down and the point where the gain is reduced to 71% of the highest value is called upper 3dB point (f_H).

The mid-band gain for CE amplifier is given by the expression $A_v = -g_m R_C // R_L$. Here, R_C and R_L are collector and load resistance respectively. The negative sign in the gain indicates that the input and output are out of phase.

The mid-band gain for CB amplifier is given by the expression $A_v = g_m R_C // R_L$. Here, the gain is same as the case of CE configuration except for the negative sign.

The lower 3 dB frequency is determined by Coupling and bypass capacitors. The upper 3 dB frequency is determined by the internal capacitance of the BJT. These capacitors arise because of junction capacitors. More specifically, these capacitors are emitter-base capacitance (C_π) and collector-base capacitance (C_μ). The expression of gain for mid-band region (A_v) is no longer correct because the small-signal model for BJT includes junction capacitors such as C_μ and C_π. In this experiment we would like to see the frequency response of CE and CB amplifiers through simulation and then actual measurement.

Experimental Procedure –

CE amplifier (Simulation) – Assemble the circuit in Fig.1 using PSPICE capture. Do the following steps after the schematic has been assembled.

1. Make sure that the ground is set to the value of 0.
2. Do a PSPICE bias point analysis and determine if the BJT is in the active region (i.e. $V_{CE} > 0.3V$). Measure I_C and determine g_m ($g_m = I_C/V_{TH}$).
3. Attach a "dB Magnitude of Voltage" probe by going to [PSPICE→Markers→Advanced→dB Magnitude of Voltage].
4. Do the simulation profile as follows: [PSPICE→New Simulation Profile]. In the new screen for simulation setting choose the following:
- Analysis type – AC sweep/Noise
- AC Sweep type – Logarithmic
- Start frequency – 100

- End frequency -10MEG (This denotes 10 MHz)
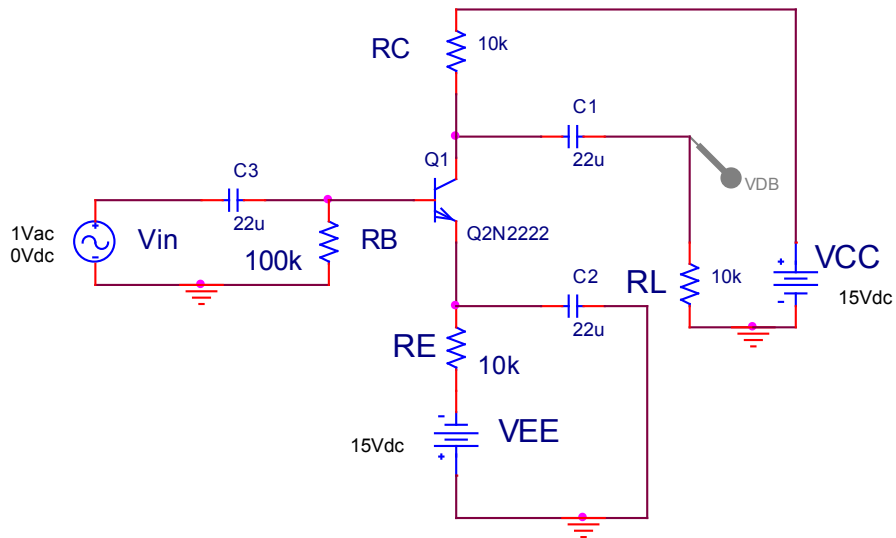- Points/Decade – 11

Fig. 1

5. Run the simulation to observe the frequency response. What you see is the overall gain (G_v) in dB. Save the graph for your lab-report.
6. In this graph note midband gain (G_v), f_L, and f_H.

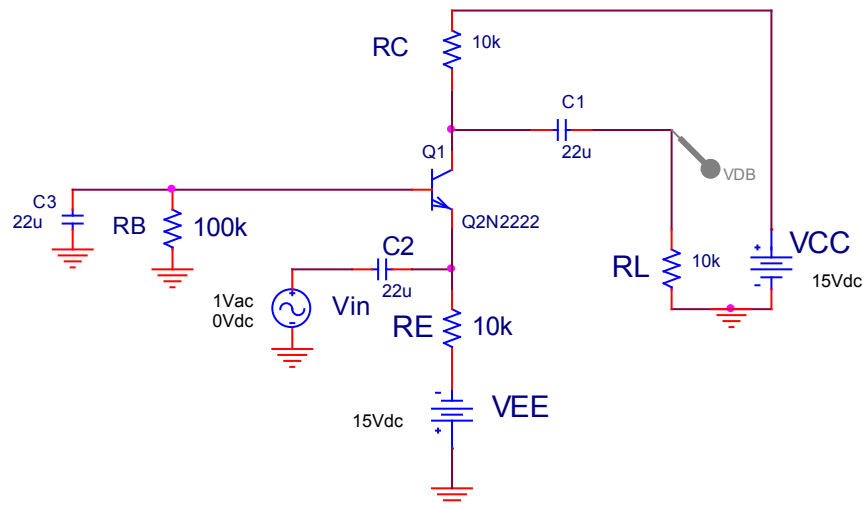**CB amplifier (Simulation) –** Use PSPICE Capture to draw the CB amplifier shown in Fig. 2.

Fig. 2

Repeat the steps 1 – 6 and obtain midband gain (G_v), f_L, and f_H.