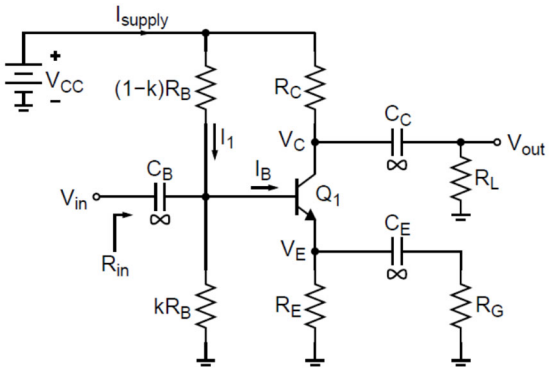
January 19, 2022

ECEN 326 Lab 1
Design of a Common-Emitter BJT Amplifier

Calculations and Simulations

Design the following Common-Emitter BJT Amplifier with the 2N3904 BJT to satisfy the following constraints.



- $V_E \geq 0.5V$
- $V_{CC} = 5V$
- $R_L = 10k\Omega$
- $R_{in} \geq 5k\Omega$
- $|A_V| \geq |-15|$
- $I_{supply} \leq 4mA$
- $v_{omax} = 1V_{pk}$ with harmonic distortion below 5% (-26.0dB)
- Nominal operating frequency = 5kHz

Note, for the I_C necessary to meet the R_{in} spec the transistor will have a **Beta near 150**.

Use the graphical design approach outlined in the class notes. On **one graph**, plot 5 curves which capture the following constraints.

- Negative v_{omax} Swing and R_{in} constraints
- Positive v_{omax} Swing constraint
- A_V and R_{in} constraint
- v_{omax} harmonic distortion constraint
- I_{supply} constraint

Color in the design space area and choose an acceptable design point.

Verify the design in PSpice. Provide the following 5 plots

- AC Plots from 100Hz to 100kHz: A_V, R_{in}, R_{out}
- Transient plot of output signal with 5kHz sine wave of amplitude sufficient for $1V_{pk}$ output swing. Check your gain value for the appropriate input amplitude.
- Frequency domain plot of above transient which shows the harmonic distortion. Note, to verify the -26.0dB harmonic distortion spec, the harmonic distortion for a given harmonic is the ratio of the harmonic power over the fundamental power. **Include the portion of the Multisim output file that details the harmonic distortion**

Measurements

1. Construct the common-emitter amplifier you designed.
2. Measure I_C, V_E , V_C, and V_B. If any DC bias value is significantly different than the one obtained from simulations, modify your circuit to get the desired DC bias before you move onto the next step.
3. Measure I_{supply}, A_v , R_{in}, and R_{out} .
4. Measure the maximum unclipped output signal amplitude.
5. Find the input signal amplitude resulting in 5% THD measurement at the output.

Report

1. Include calculations, schematics, simulation plots, and measurement plots.
2. Prepare a table showing calculated, simulated and measured results.
3. Compare the results and comment on the differences.

Demonstration

1. Construct the common-emitter amplifier you designed on your breadboard and bring it to your lab session.
2. Your name and UIN must be written on the side of your breadboard.
3. Submit your report to your TA at the beginning of your lab session.
4. Measure I_{supply}, A_v, R_{in}, and R_{out}.
5. Apply the input signal resulting in 5% THD at the output from your earlier measurements. Show the input and output waveforms, and THD measurement at the output.