EE 3310L/5310L · Electronic Devices and Circuits Laboratory

Lab 6: NPN Cascode Amplifier

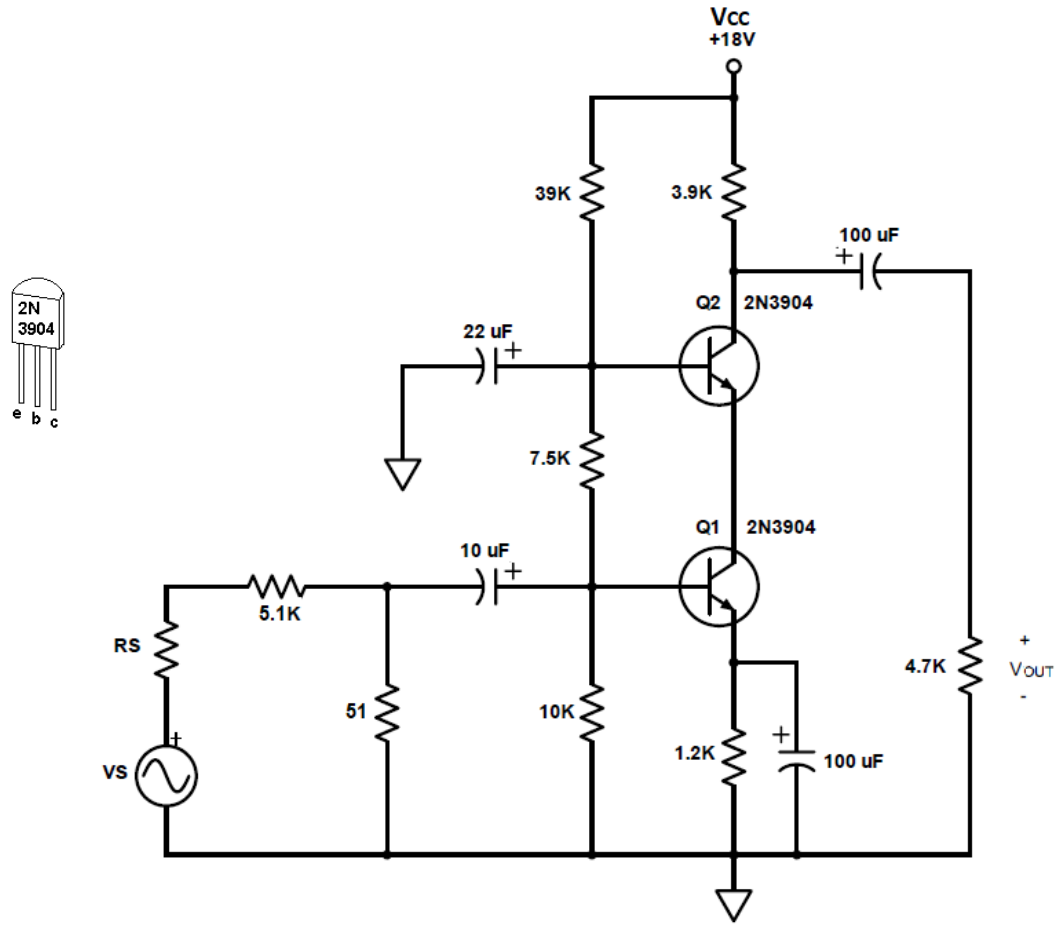
Purpose

The purpose of this lab is to construct and test an NPN cascode amplifier using 2N3904 transistors and compare its performance to the basic common-emitter amplifier analyzed in Lab 5. The cascode configuration offers the high gain and relatively high input resistance of the common-emitter amplifier plus the wide bandwidth of the common-base amplifier due to the virtual elimination of Miller Effect input capacitance.

Procedure

1) Select two 2N3904 NPN transistors and use your DMM to measure and record their h_{FE}. Discard any transistor whose value is less than 100.

2) Build the following circuit. Measure and record all transistor DC voltages before applying an AC signal. For reference, you should measure approximately 2.5 V at the emitter of the input transistor if the circuit is built properly, for a quiescent emitter current of about 2 mA.



3) Connect channel 1 of the oscilloscope to the function generator and channel 2 to the output of the amplifier (V_{OUT}).

4) Set the signal generator to 1 $V_{P\text{-}P}$, 1 kHz sine and verify this amplitude on the oscilloscope. Display both channels simultaneously; **the output waveform should be an inverted sine wave**.

5) **Measure and record the peak-to-peak output voltage shown on the oscilloscope. Use it to calculate the 1-kHz gain of the amplifier by $A_V = (V_{OUT}/V_S)$. Also compute A_V(dB).** Don't forget to divide V_S by 100, as this is the effective signal amplitude at the input of the amplifier due to the 40-dB input pad!

6) Increase the frequency of the signal generator until the output has decreased 3 dB (i.e., the peak-to-peak voltage times 0.707). **Record the frequency; this is the upper cutoff frequency, f_H.**

7) Now decrease the frequency of the signal generator (below 1 kHz) until the output drops by 3 dB. **Record the frequency; this is the lower cutoff frequency, f_L.**

8) Return the signal generator to 1 kHz. **Increase the amplitude until the output waveform is visibly clipped; record the maximum peak-to-peak output voltage at clipping.**

Postlab

1) **Analytically determine all DC and AC parameters using equations we derived in class for the cascode configuration.** Show all work!

2) Simulate the circuit using Multisim; determine the DC values, midband gain, and high- and low-frequency cutoffs.

3) Compare simulated, experimental, and analytical values.