EEE210: Electronic Circuits and Devices

Lab #8: Common emitter with unbypassed emitter resistor amplifier

Experimental work: Use the NPN transistor 2N3904 or an equivalent. The pin out of the 2N3904 is presented in figure 1.

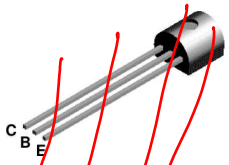

Figure 1:

Using Falstad circuit simulator and the supplied circuit file, disconnect all capacitors and measure the BJT's Q-point.

1. Build the DC biasing circuit of the transistor in figure 2. Measure V_{BE} and V_{CE} using a DC voltmeter. Calculate I_C from those noting that when the transistor is active and $\beta \gg 1$:

$$I_C \approx \frac{V_A - V_{CE}}{R_C + R_E}$$

where $V_A = 15$ V, $R_E = 291\ \Omega$ and $R_C = 1$ kΩ. Before going any further, make sure that the BJT is biased in the active region.

Reconnect the capacitors.

2. Complete the wiring of the circuit in figure 2. Adjust the `TMAX` simulation parameter to 1 μs using:

`Simulate > Simulation Settings > Interactive Simulation Settings`

500 Hz

Adjust the function generator for $v_i(t)$ to be a 0-DC sinewave of frequency ~~10 kHz~~ and peak-peak voltage of 300 mV (amplitude of 150 mV; confirm this with the oscilloscope).

If necessary, select the menu "File > Find DC Operating Point". This will immediately "charge" the capacitors to their steady state value instead of having to wait for the simulation to reach steady state.

Use Falstad circuit simulator and the supplied circuit file.

Set β = 80+(2 LSD of college #)

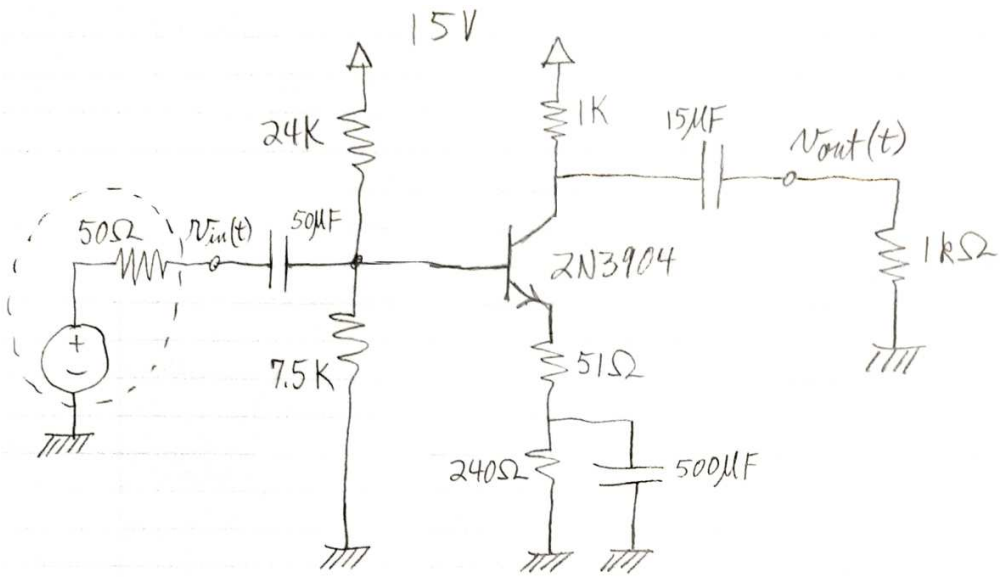

Figure 2:

3. Measure the voltage gain (refer to previous labs for the procedure).
4. Measure the output impedance (refer to previous labs for the procedure).
5. Measure the input impedance (refer to previous labs for the procedure).
6. Increase the amplitude of $v_i(t)$ to drive the amplifier into clipping. Measure the input voltage range (*voltage swing*): use the oscilloscope cursors to measure the values of $v_{in}(t)$ at the clipping points of $v_{out}(t)$.

Report:

1. Using $\beta =$ ~~180~~ 100, calculate the Q-point of the BJT in the circuit of figure 2 and compare to the measured Q-point.
2. Using $h_{fe} =$ ~~180~~ 125, $h_{ie} = 1$ kΩ, calculate the voltage gain, the input impedance and the output impedance of the amplifier of figure 2. Compare to the measured values.

3. Calculate the voltage swing of the amplifier and compare to the measured values.

allowable range of $v_{in}(t)$