

# Lab 7 Report: Common Collection Amplifier

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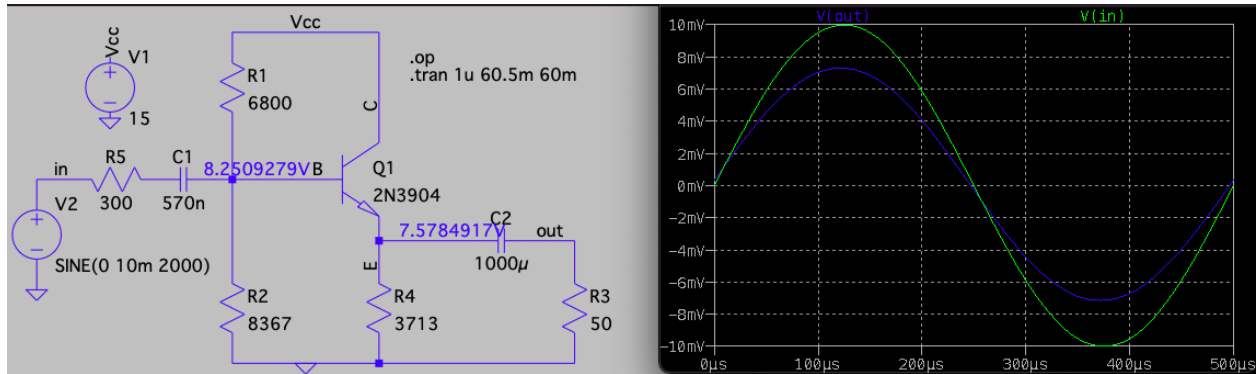
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## Introduction

This lab sets the operating point the BJT in a common collector amplifier and then uses LTspice simulations to confirm the DC operating point. I did not have enough time to prototype the circuit and measure the DC and AC characteristics.

## Design Procedure

Here are the calculated values for this biasing topology:



The formulae for the voltage ratios are:

$$\frac{v_{out}}{v_{in}} = \frac{(\beta + 1)R'_E}{r_{\pi} + (\beta + 1)R'_E} \frac{v_{in}}{v_s} = \frac{R_{in}}{R_s + R_{in}}$$

where

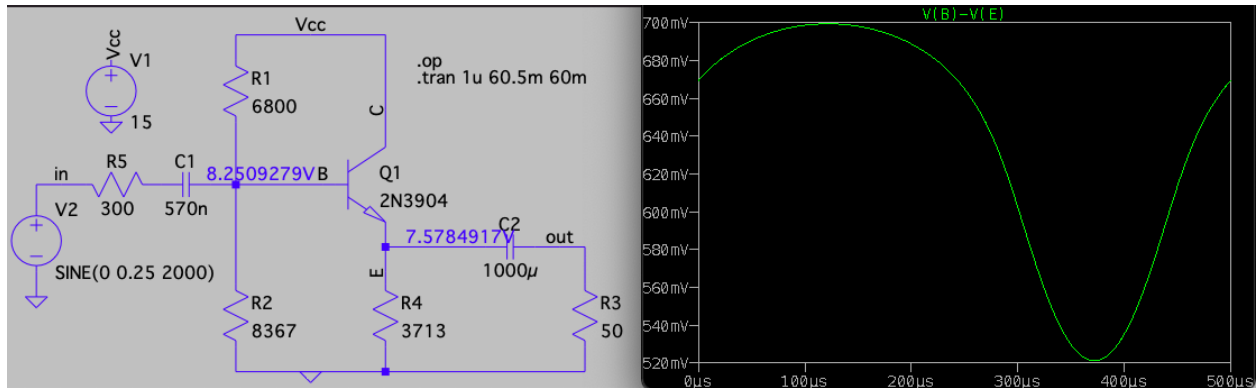
$$R'_E = R_E \parallel R_L \parallel r_o R_{in} = R_B \parallel (r_{\pi} + (\beta + 1)R'_E)$$

The calculations are  $v_{out}/v_s = (v_{out}/v_{in})(v_{in}/v_s) = (0.793)(0.926) = 0.73$  which is confirmed by the operating point plot of  $v_{out}$  vs.  $v_s$ .

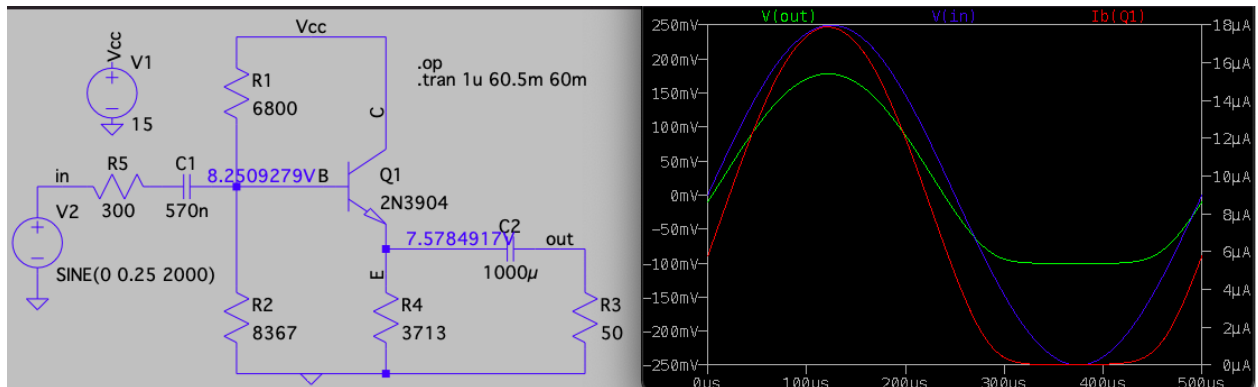
## Output waveform being sinusoidal

The output waveform has gain reduction when the base voltage is reduced by a large amount. The amount depends on the load resistor, as  $R_L = 1k\Omega$  was able to tolerate a larger negative voltage. The reason for

this is the  $v_{out}/v_{in}$  equation and its  $r_\pi = \frac{\beta V_T}{I_C}$  in the denominator. Look at how  $V_{BE}$  changes greatly when the base voltage decreases:



This change for  $V_{BE}$  explains why the current changes so much (and goes to zero if  $V_B$  is greatly reduced):



As  $r_\pi$  is inversely proportional to  $I_C$ , the reduced  $V_B$  kills the collector current which caused the voltage ratio  $v_{out}/v_{in}$  to be greatly reduced.