Common-Base Amplifier Example

using the r_0 approximatons.

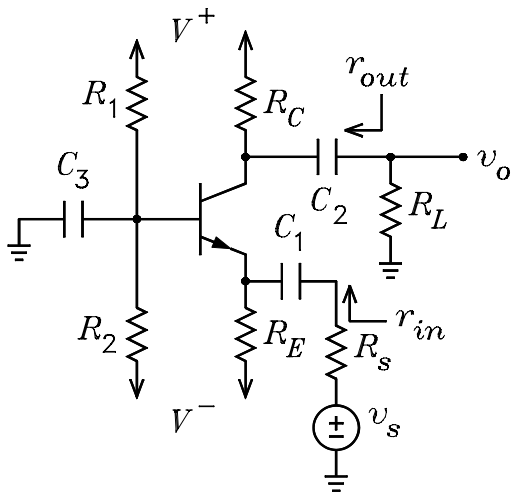
$R_P(x,y) := \frac{x \cdot y}{x + y}$ Function for calculating parallel resistors.

$R_1 := 100000$ $R_2 := 120000$ $R_C := 4300$ $R_E := 5600$ $R_S := 100$ $R_L := 10000$

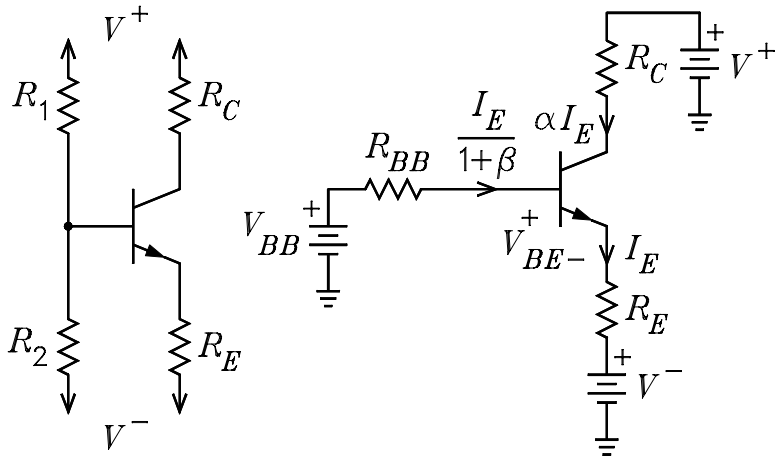
$V_{plus} := 15$ $V_{minus} := -15$ $V_{BE} := 0.65$ $V_T := 0.025$ $\beta := 99$ $\alpha := 0.99$

$r_x := 20$ $r_0 := 50000$

$v_s := 1$ With v_s = 1, the voltage gain is equal to v_o.



DC Bias Circuit



$$V_{BB} := \frac{V_{plus} \cdot R_2 + V_{minus} \cdot R_1}{R_1 + R_2} \qquad V_{BB} = 1.364$$

$$R_{BB} := R_P(R_1, R_2) \qquad R_{BB} = 5.455 \cdot 10^{4}$$

$$I_E := \frac{V_{BB} - V_{BE} - V_{minus}}{\frac{R_{BB}}{1+\beta} + R_E} \qquad I_E = 2.557 \cdot 10^{-3}$$

$$r_e := \frac{V_T}{I_E} \qquad r_e = 9.777$$

Test for Active Mode

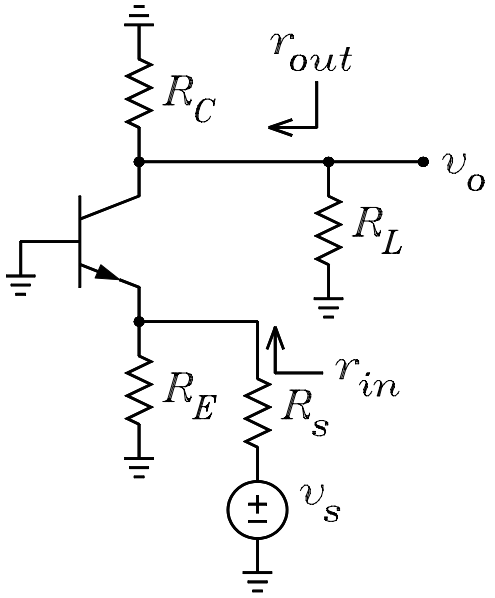
$$V_C := V_{plus} - \alpha \cdot I_E \cdot R_C \qquad V_C = 4.115$$

$$V_B := V_{BB} - \frac{I_E}{1+\beta} \cdot R_{BB} \qquad V_B = -0.031$$

$$V_{CB} := V_C - V_B \qquad V_{CB} = 4.146$$

This is >0, thus active mode.

AC Signal Circuit



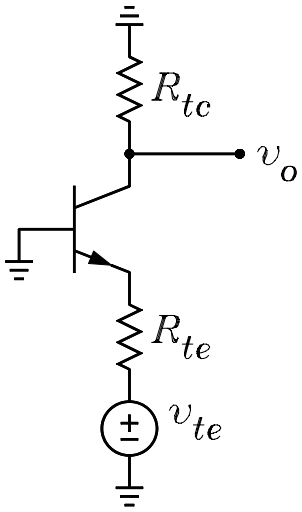
$v_{te} := v_s \cdot \frac{R_E}{R_S + R_E}$ $v_{te} = 0.982$

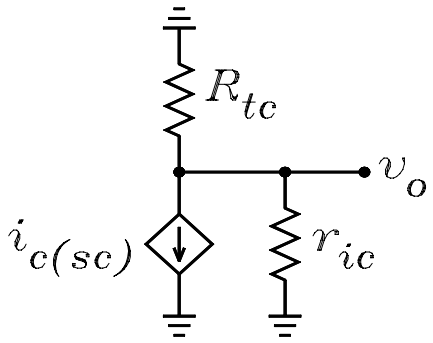
$R_{te} := R_P(R_E, R_S)$ $R_{te} = 98.246$

$R_{tb} := 0$

$r'_e := \frac{R_{tb} + r_x}{1 + \beta} + r_e$ $r'_e = 9.977$

Circuits for v_o





$R_{tc} := R_P(R_C, R_L)$ $R_{tc} = 3.007 \cdot 10^{3}$

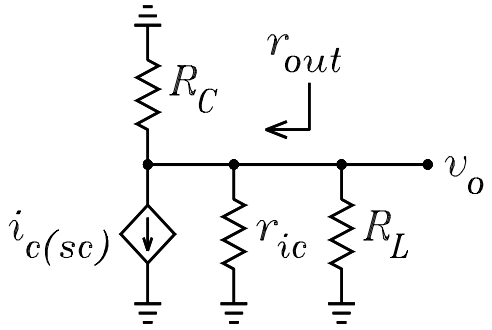
$i'_e := \frac{-v_{te}}{r'_e + R_{te}}$ $i'_e = -9.078 \cdot 10^{-3}$

$r_{ic} := \frac{r_0 + R_P(r'_e, R_{te})}{1 - \frac{\alpha \cdot R_{te}}{r'_e + R_{te}}}$ $r_{ic} = 4.938 \cdot 10^{5}$

$i_{csc} := \alpha \cdot i'_e \cdot v_{te}$ $i_{csc} = -8.83 \cdot 10^{-3}$

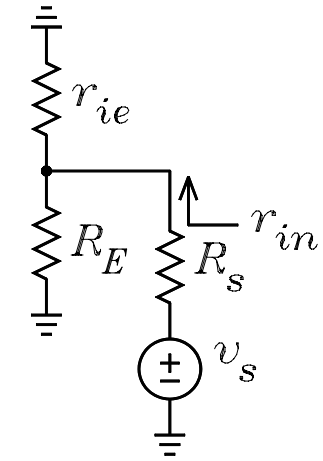
$v_o := -i_{csc} \cdot R_P(R_{tc}, r_{ic})$ $v_o = 26.39$ This is the voltage gain.

Circuit for r_{out}



$r_{out} := R_P(R_C, r_{ic})$ $\quad r_{out} = 4.263 \cdot 10^3$

Circuit for r_{in}



$r_{ie} := r'_e$ $\quad r_{ie} = 9.977$

$r_{in} := R_P(r_{ie}, R_E)$ $\quad r_{in} = 9.96$