Common-Base Amplifier Example - Summer 2000

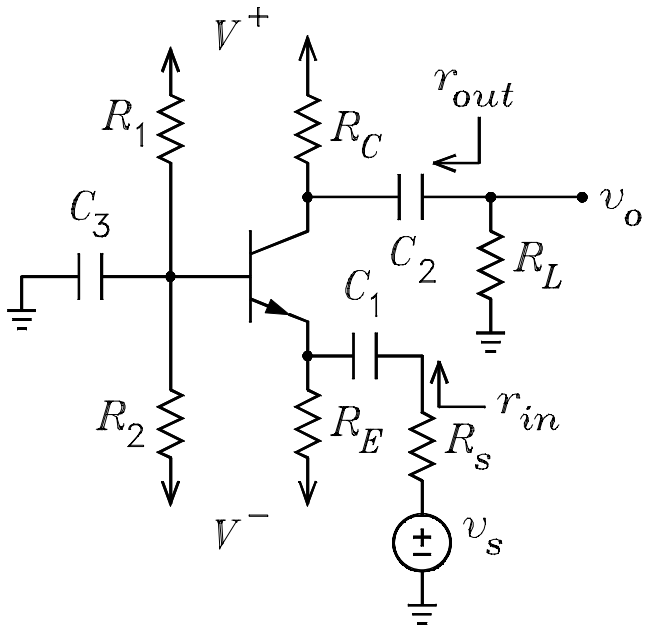
$R_p(x,y) := \frac{x \cdot y}{x + y}$ Function for calculating parallel resistors.

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

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

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

$v_s := 1$ With v_s = 0, the voltage gain is equal to v_o.



DC Bias Solution

$V_{BB} := \frac{V_p \cdot R_2 + V_m \cdot R_1}{R_1 + R_2}$ $V_{BB} = 1.364$

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

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

$V_C := V_p - \alpha \cdot I_E \cdot R_C$ $V_C = 4.115$

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

AC Solution

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

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

$R_{tb} := 0$ $R_{tb} = 0$

$r_{ie} := \frac{R_{tb} + r_x}{1 + \beta} + r_e$ $r_{ie} = 9.977$

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

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

$i_{csc} := \frac{-v_{te}}{R_{te} + R_P(r_{ie}, r_0)} \cdot \frac{\alpha \cdot r_0 + r_{ie}}{r_0 + r_{ie}}$ $i_{csc} = -8.987 \cdot 10^{-3}$

$v_o := -i_{csc} \cdot R_P(R_C, R_P(r_{ic}, R_L))$ $v_o = 26.862$ This is the voltage gain.

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

$r_{ieo} := r_{ie} \cdot \frac{r_0 + R_{tc}}{r_{ie} + r_0 + \frac{R_{tc}}{1 + \beta}}$ $r_{ieo} = 10.569$

$r_{in} := R_P(r_{ieo}, R_E)$ $r_{in} = 10.549$

The following solution is based on the r_{ic} approximations.

$i_{csc} := -v_{te} \cdot \frac{\alpha}{r_{ie} + R_{te}}$ $i_{csc} = -8.987 \cdot 10^{-3}$

$v_c := -i_{csc} \cdot R_P(R_C, R_P(r_{ic}, R_L))$ $v_c = 26.861$ This is the voltage gain. It is 0.004% lower than the exact solution.

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

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