BJT Amplifier
Common Collector Amp (H.12)

20170630

References

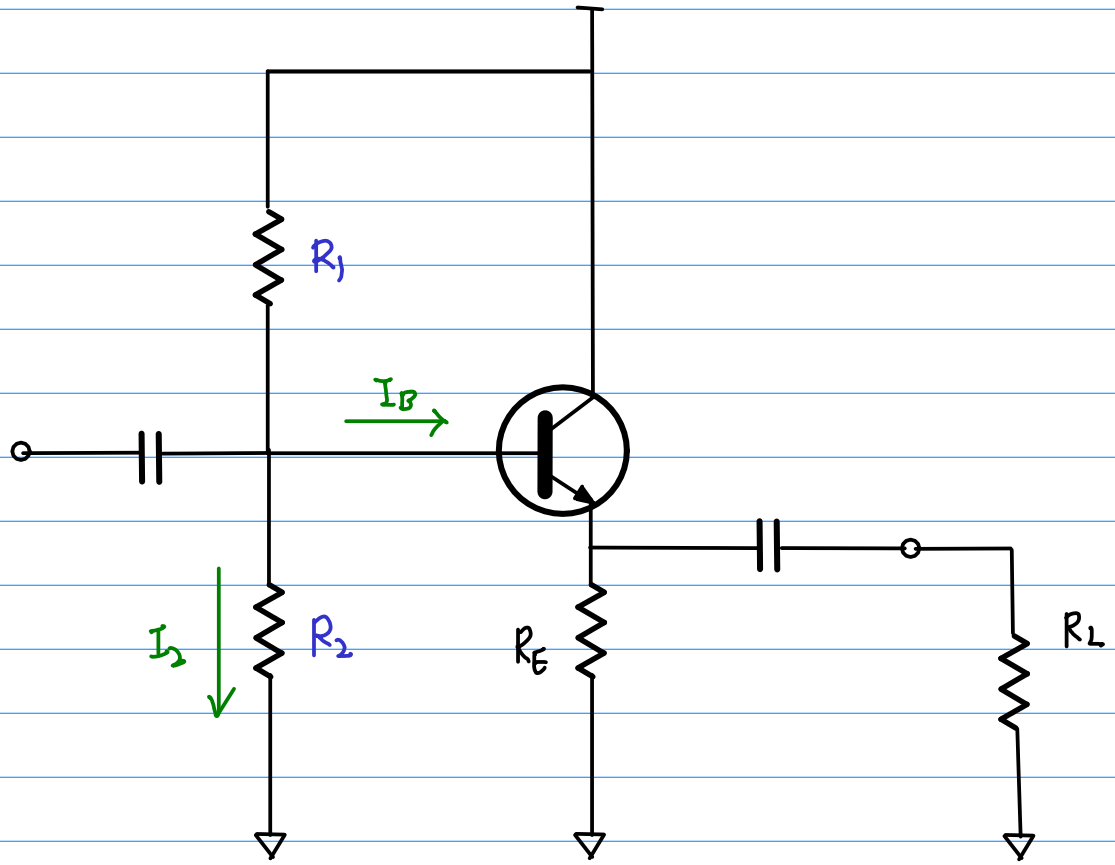
Based

[1] Floyd, Electronic Devices 7th ed
[2] Cook,

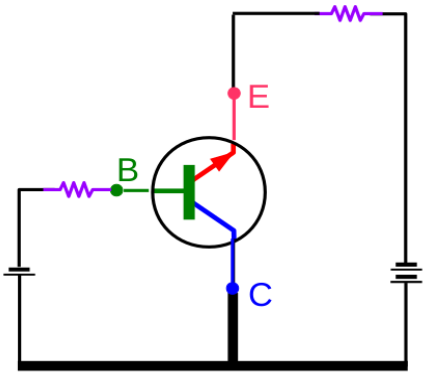
[2] en.wikipedia.org

	Common Base	Common Emitter	Common Collector
Z_{in}	CB : low $r_e \| \| R_E \approx r_e$	CE : med $R_1 \| \| R_2 \| \| \beta r_e$	CC : high $R_1 \| \| R_2 \| \| \beta(r_e + R_E)$
Z_{out}	CB : high R_C	CE : med R_C	CC : low $(r_e + \frac{R_s}{\beta}) \| \| R_E = \frac{R_s}{\beta} \| \| R_E$
A_v	CB : high $\frac{R_C}{r_e}, \frac{R_C \| \| R_L}{r_e}$	CE : med $\frac{R_C}{r_e}, \frac{R_C \| \| R_L}{r_e}$	CC : unity $\frac{R_E}{(r_e + R_E)} \approx 1$
A_i	CB : unity	CE : med	CC : high

VDB

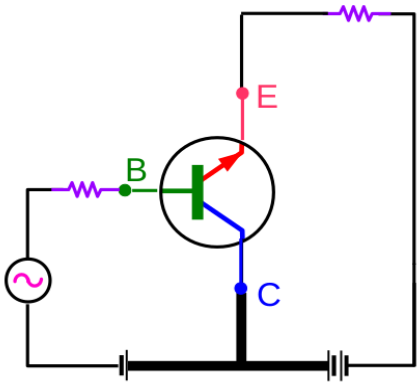

R1
IB
I2
R2
RE
RL

Common Collector Configuration



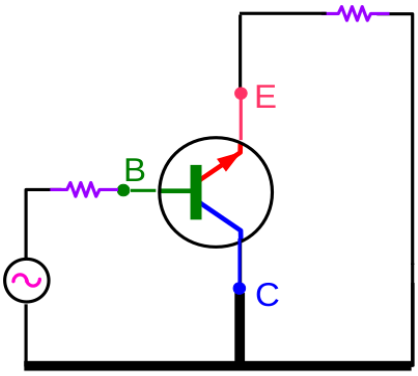
Common Collector

DC Bias



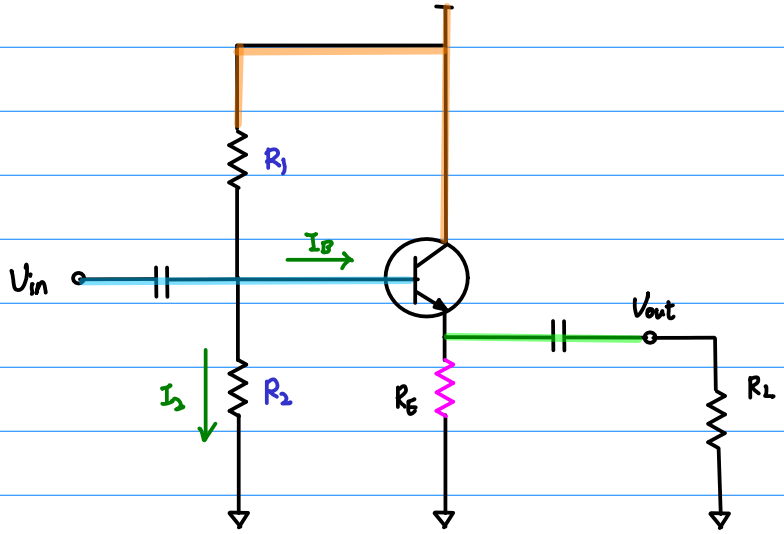
Common Collector

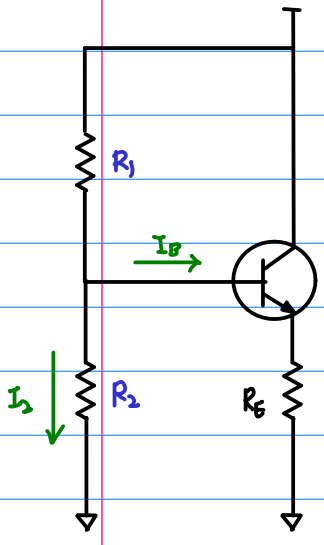
DC Bias + AC Signal

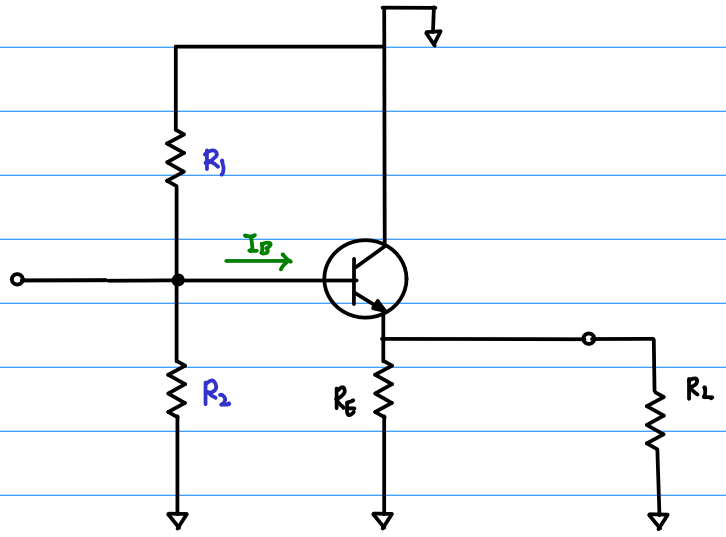


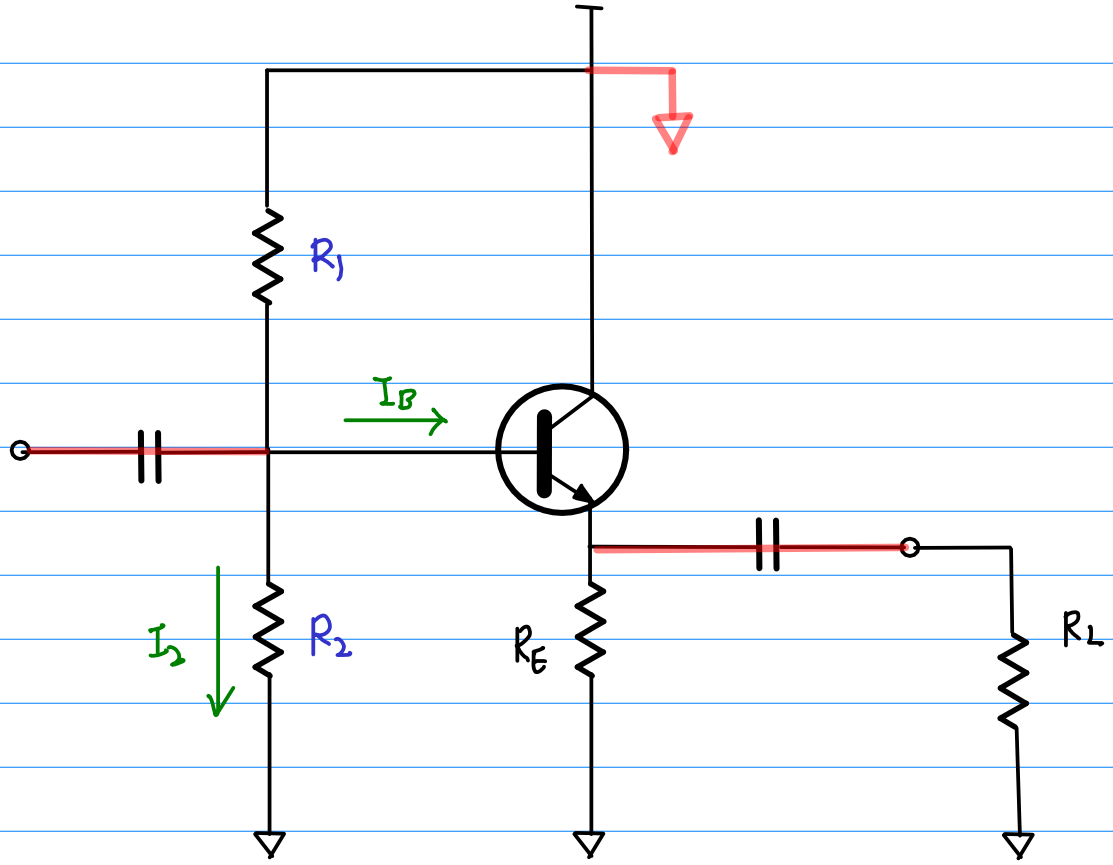
Common Collector

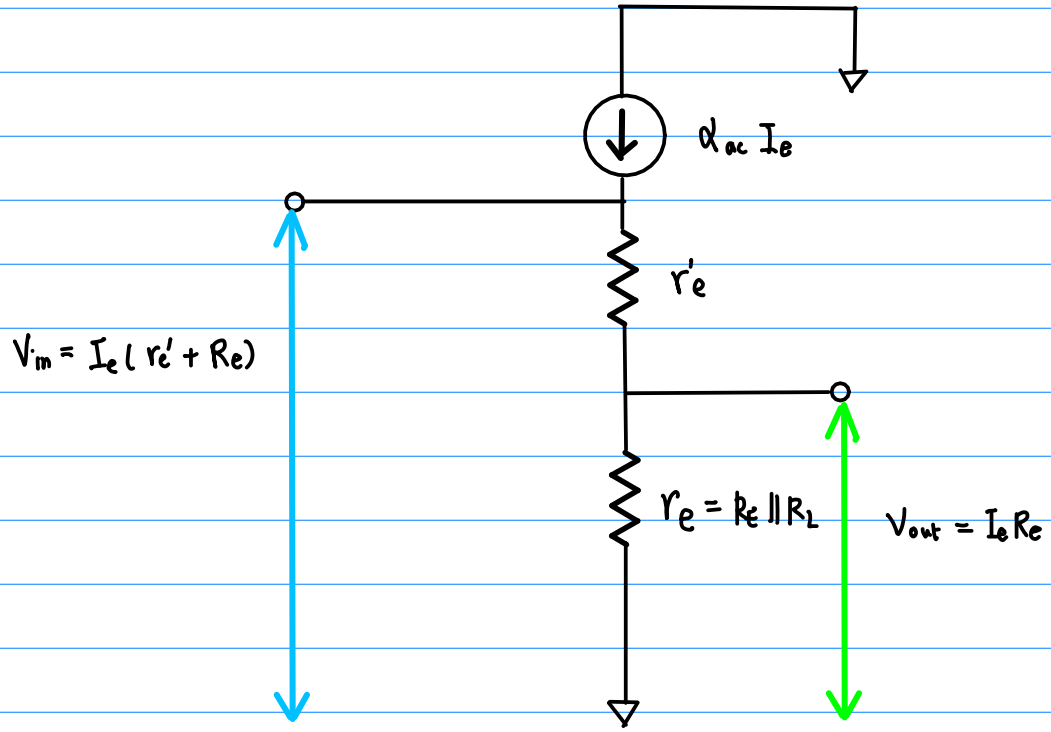
AC Signal



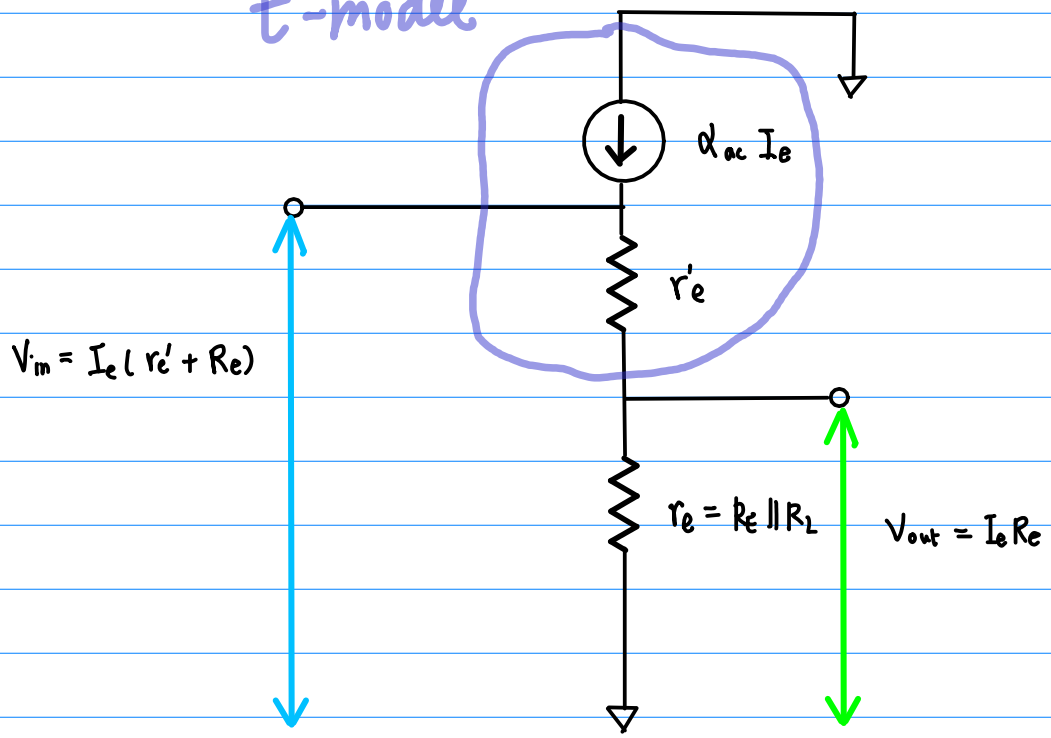




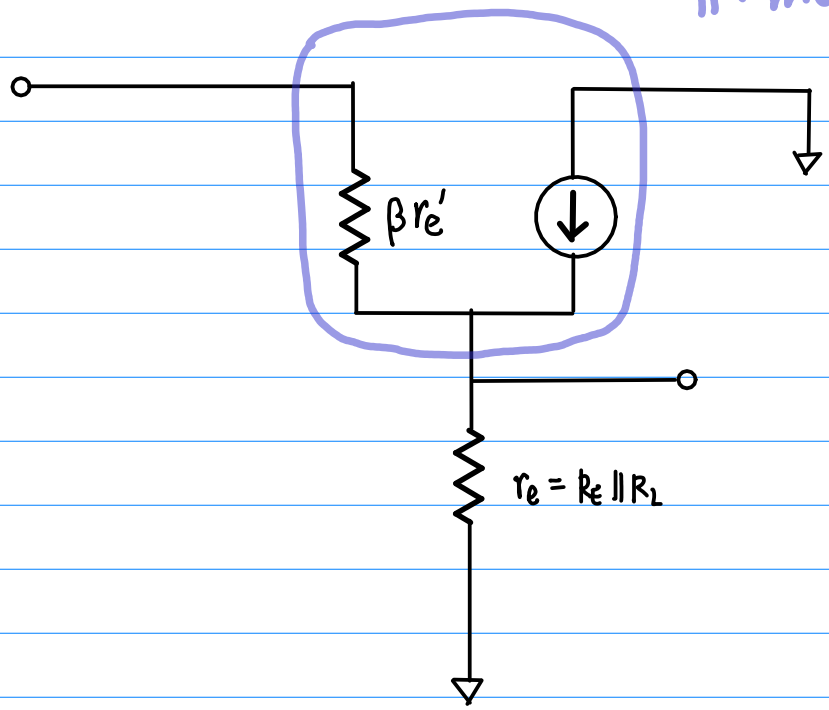

R_1
I_B
I_2
R_2
R_E
R_L

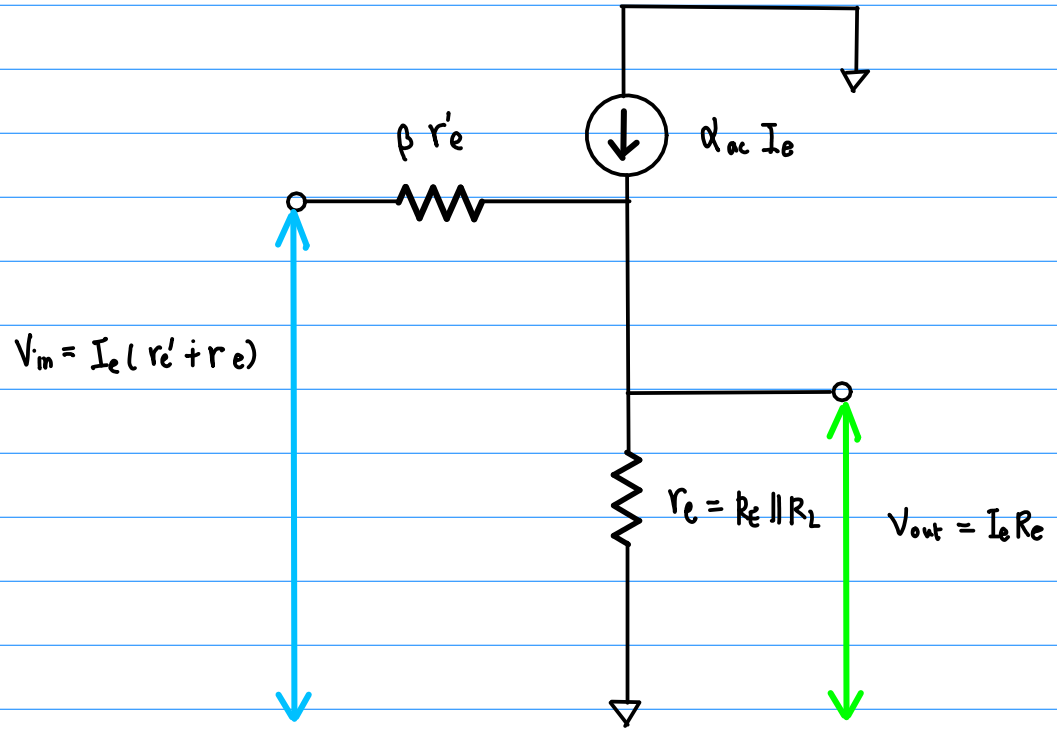

$\alpha_{ac} I_e$
r'_e
$V_{in} = I_e (r'_e + R_e)$
$r_e = R_E \| R_L$
$V_{out} = I_e R_e$

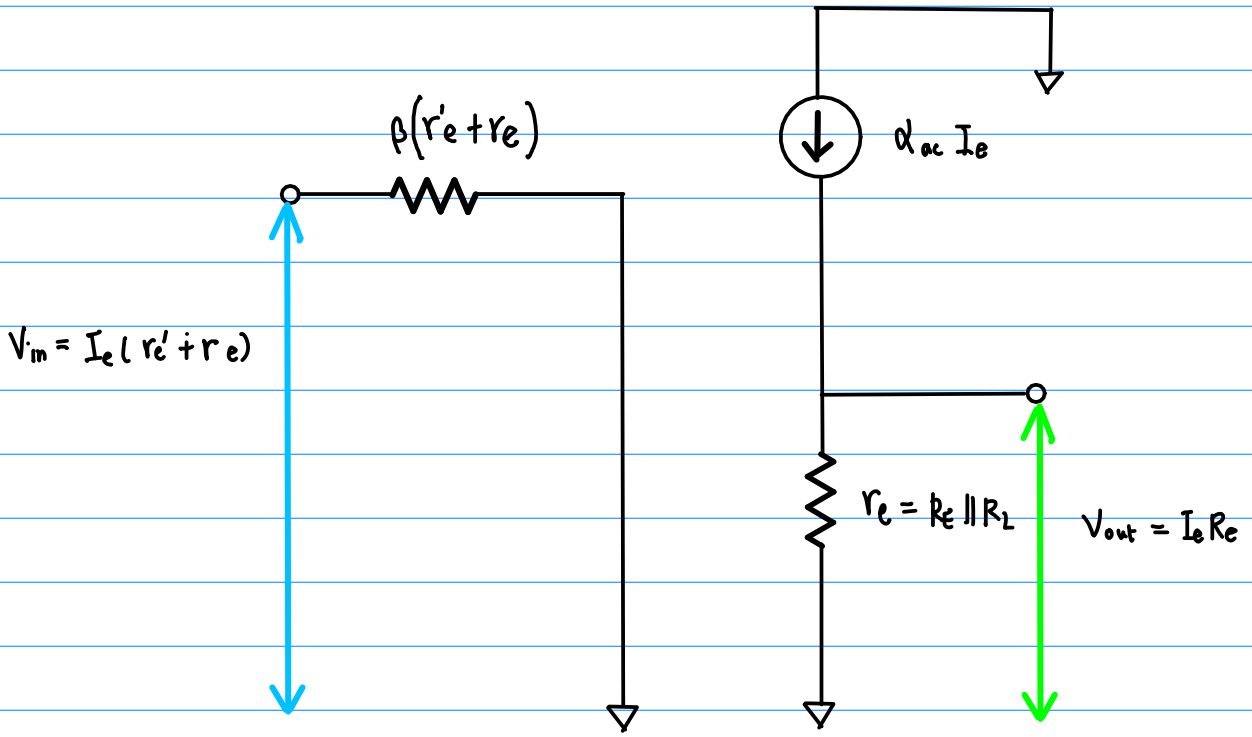
t-model



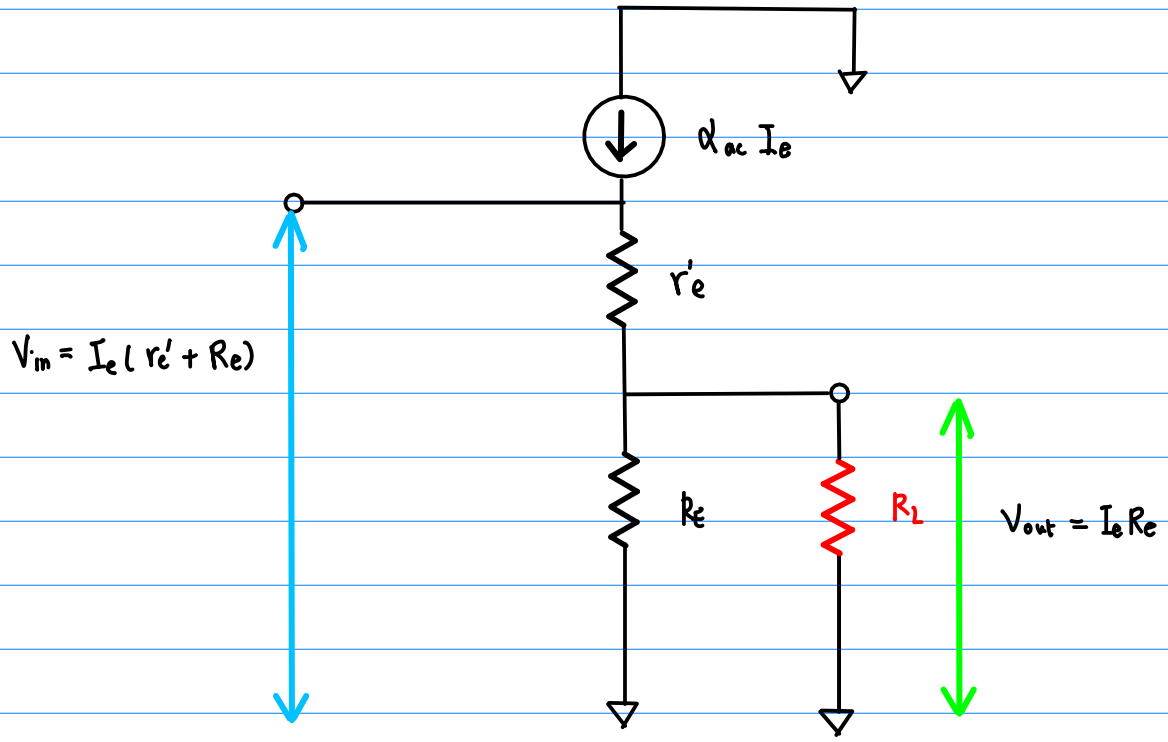
π-model

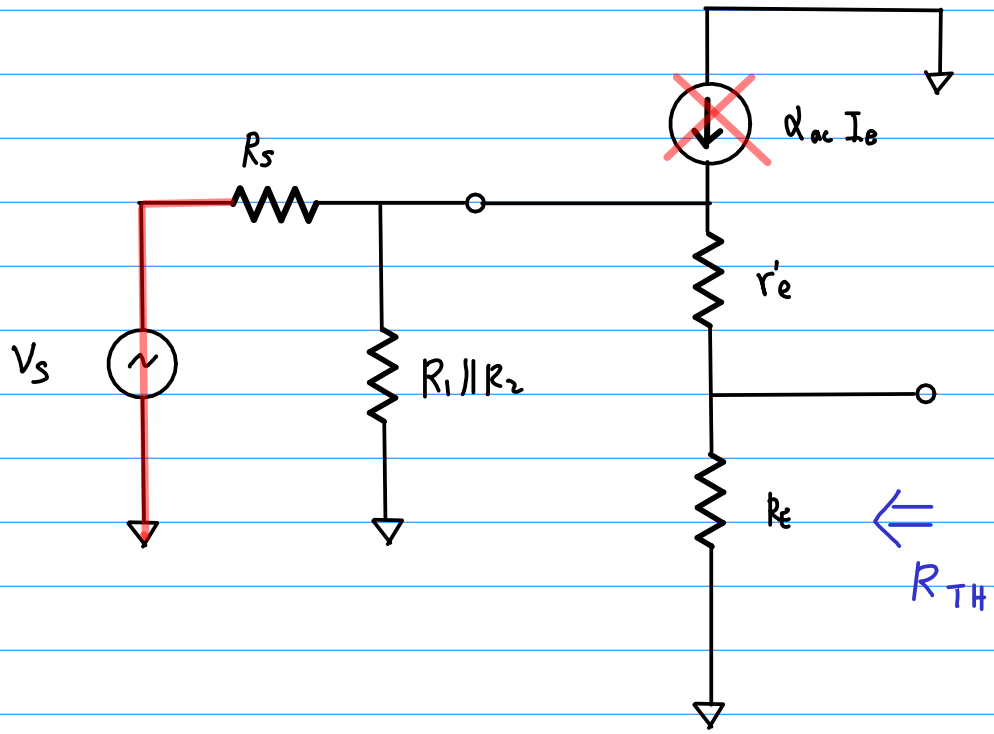


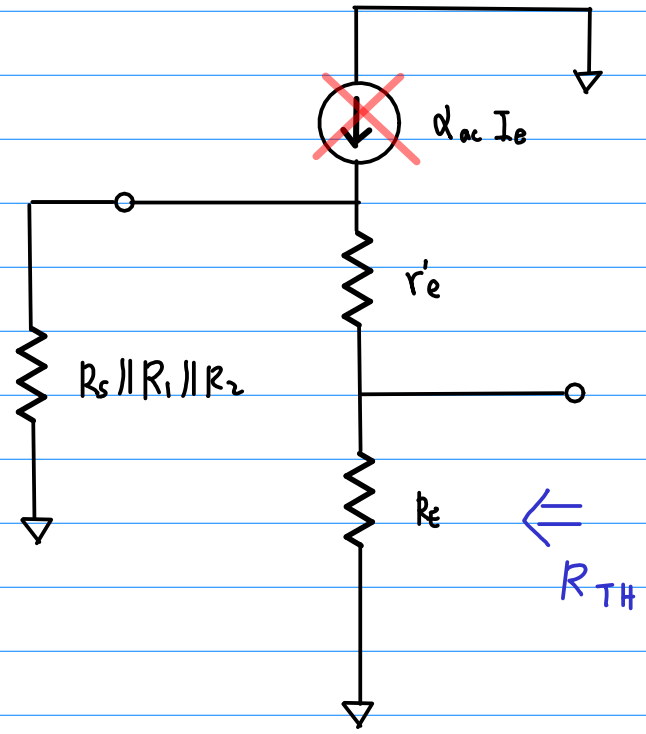


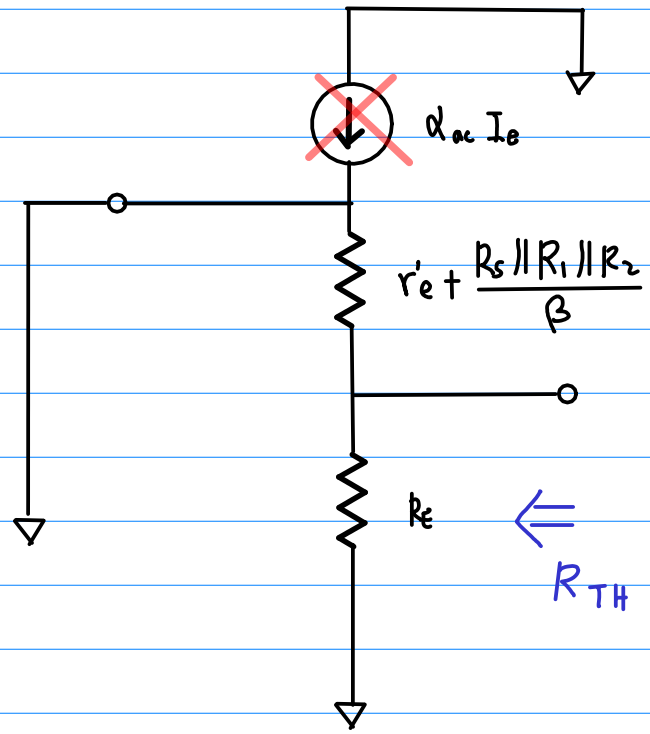


$Z_{in\ (base)} = \beta\ (r_e' + r_e)$


$\alpha_{ac} I_e$
r'_e
$V_{in} = I_e (r'_e + R_e)$
R_e
R_L
$V_{out} = I_e R_e$


$\alpha_{ac} I_e$
R_s
r'_e
V_s
$R_1 \| R_2$
R_e
R_{TH}





$$Z_{out} = R_E \| \left(r'_e + \frac{R_S \| R_1 \| R_2}{\beta} \right)$$

A_v

$$V_{out} = I_e R_e$$

$$V_{in} = I_e (r_e' + R_e)$$

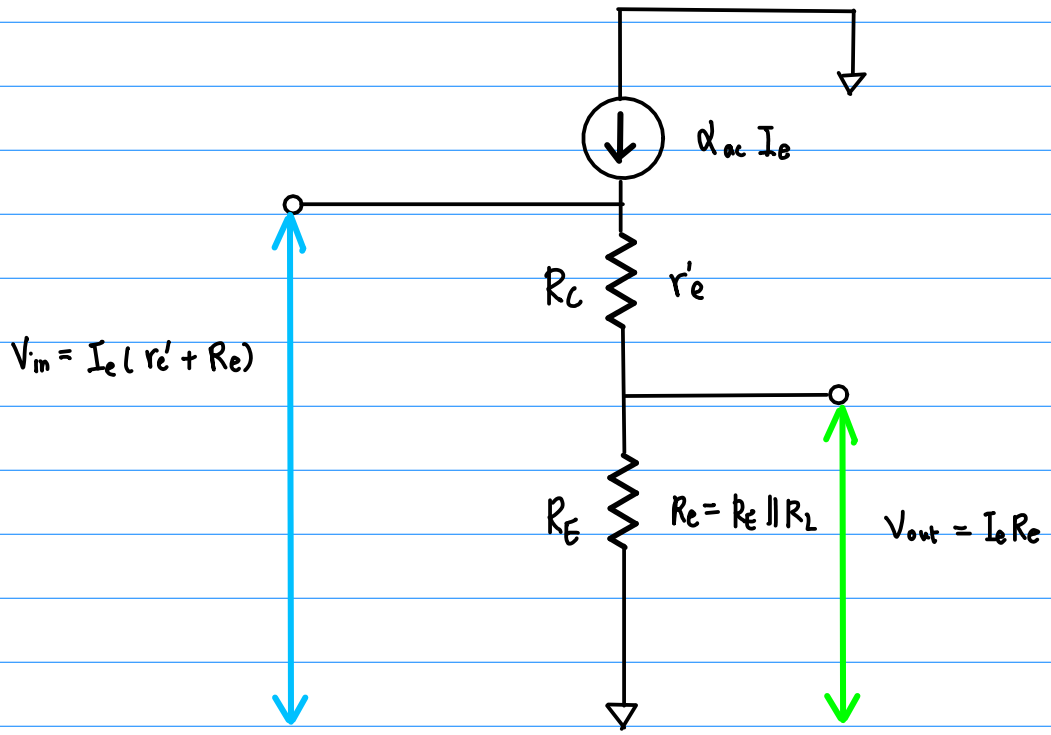
$$A_v = \frac{I_e R_e}{I_e (r_e' + R_e)} = \frac{R_e}{(r_e' + R_e)}$$

$R_e = R_E \parallel R_L$

$R_e = R_E$ no load

$A_v < 1$ always

if $R_L >> r_e'$ $\Rightarrow$ $A_v = 1$



Z_i

$$R_{in(base)} = \frac{V_{in}}{I_{in}} = \frac{V_b}{I_b} = \frac{I_e(r_e' + R_e)}{I_b} = \frac{\beta I_b (r_e' + R_e)}{I_b}$$

$$R_{in\ (base)} = \beta (r_e' + R_e)$$

$R_e \gg r_e'$

$$R_{in\ (base)} = \beta R_e$$

$$R_{in\ (total)} = R_1 \parallel R_2 \parallel R_{in(base)} = R_1 \parallel R_2 \parallel \beta R_e$$

A_i

$$I_{in} = \frac{V_{in}}{R_{in(total)}}$$

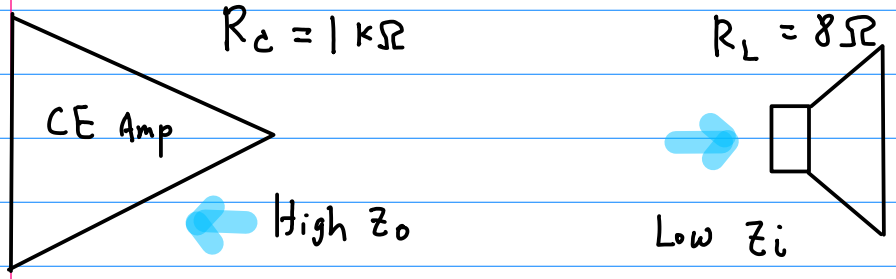
$$A_i = \frac{I_e}{I_{in}}$$

$$R_1, R_2 \gg R_{in(base)}$$

$$R_1 \| R_2 \gg \beta R_e$$

$$A_i = \frac{I_e}{I_{in}} = \beta$$

Driving Low Resistance Load



$$R_c = R_c \,||\, R_L = 1000 \,||\, 8 = 7.94\,\Omega$$

$$A_v = \frac{R_c}{r_e'} = \frac{1000}{5} = 200$$ without load

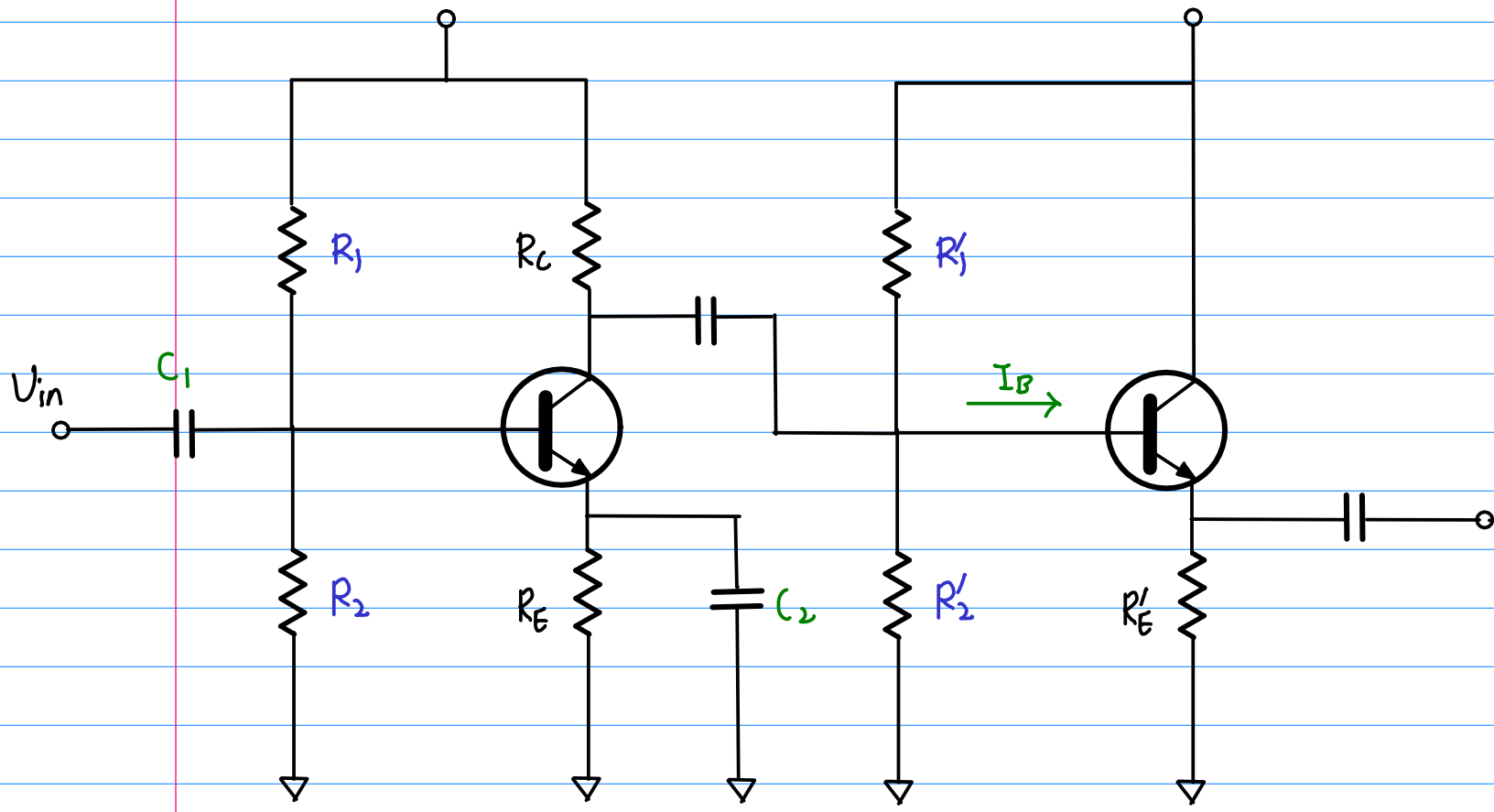
$$A_v = \frac{R_c}{r_e'} = \frac{7.94}{5} = 1.59$$ with $8\,\Omega$ load

Darlington pair

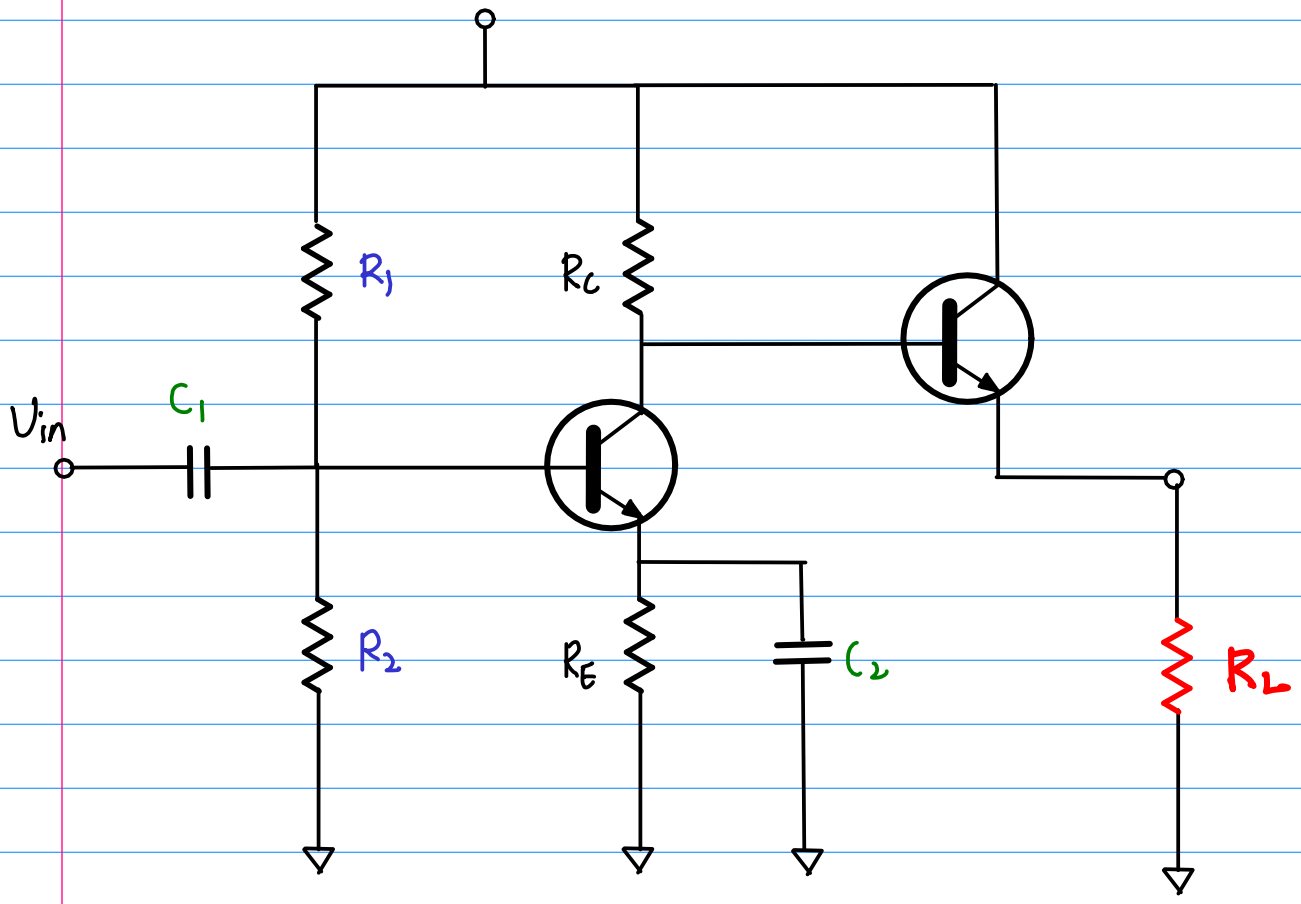
interface (buffer)

high output resistance & low resistance load

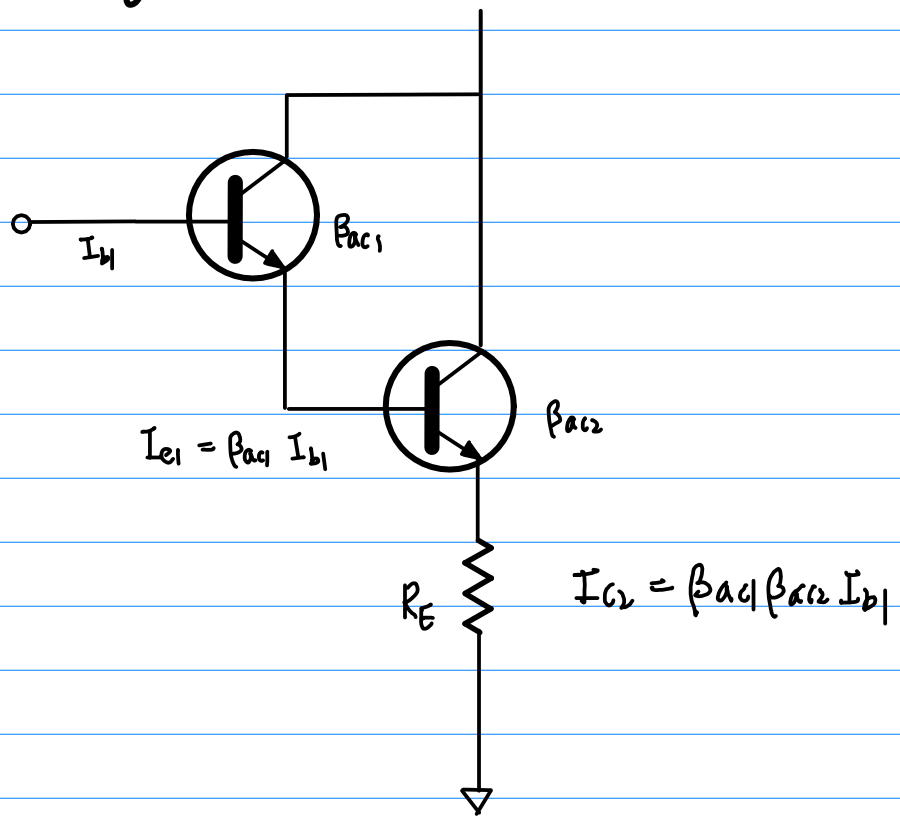
CE + CC



Direct Coupled Output Stage



The Darlington Pair



$$\beta_{ac} = \beta_{ac1} \cdot \beta_{ac2}$$

$R_{in} = \beta_{ac1} \beta_{ac2} R_E$ → high input resistance