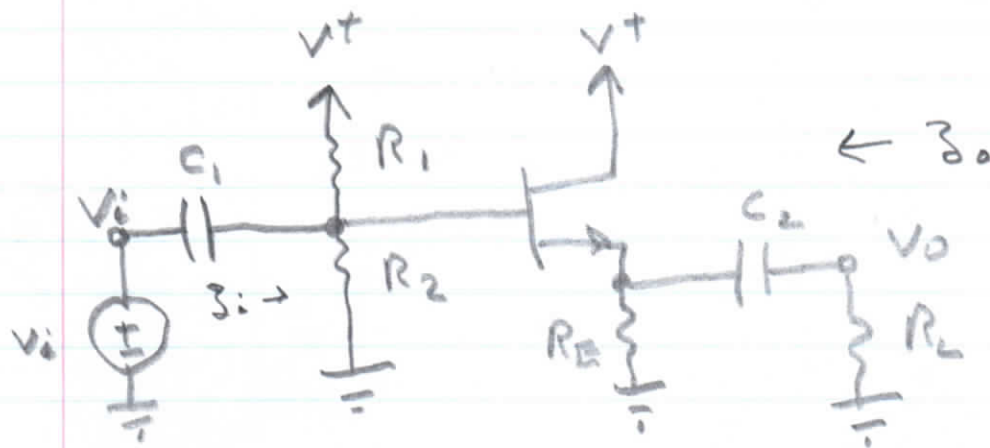
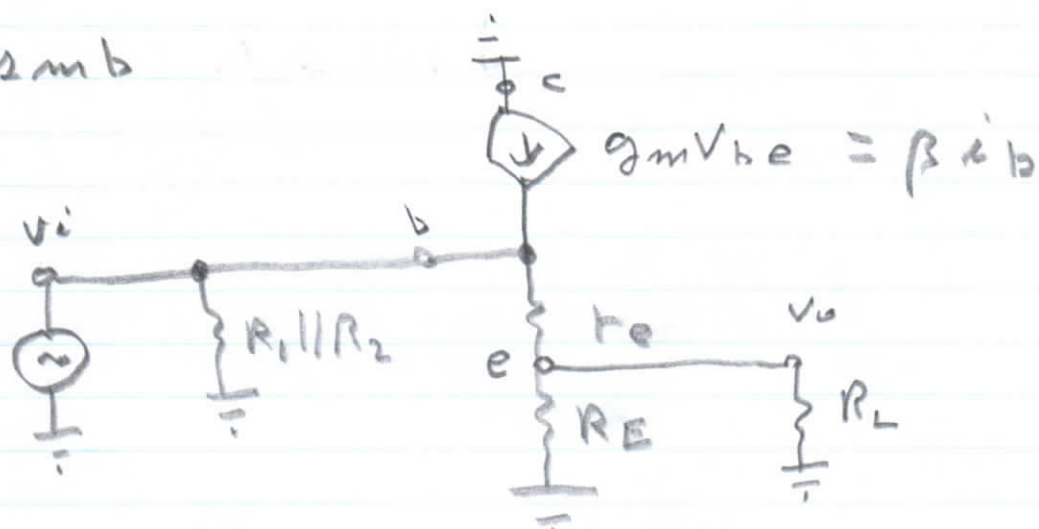


# Common collector also

Emitter Follower (Typical Ckt)



Small signal



$$T(\omega) = \frac{v_o}{v_i} = \frac{R_E \parallel R_L}{r_e + R_E \parallel R_L} \approx 1 \quad \text{if } R_E \parallel R_L \gg r_e$$

$$Z_i = R_1 \parallel R_2 \parallel [(\beta + 1)(r_e + R_E \parallel R_L)]$$

$$Z_o = r_e \parallel R_E$$

# CC Symmetric Clipping

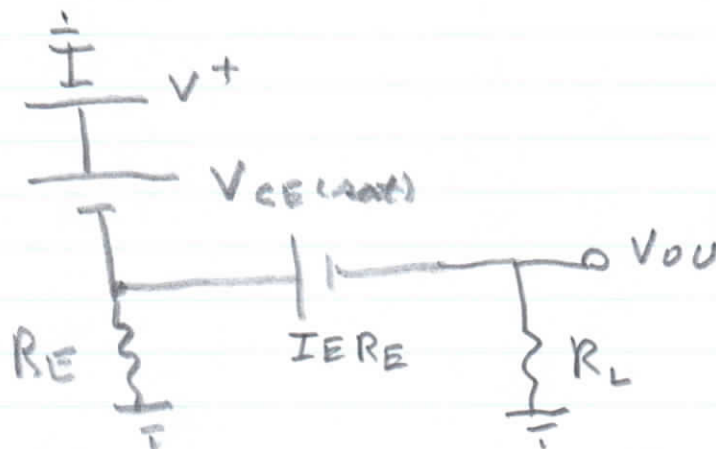
cut-off

$$I_E = 0$$



$$V_{OL} = -I_E R_E \frac{R_L}{R_L + R_E} = -I_E R_E \parallel R_L$$

Saturation



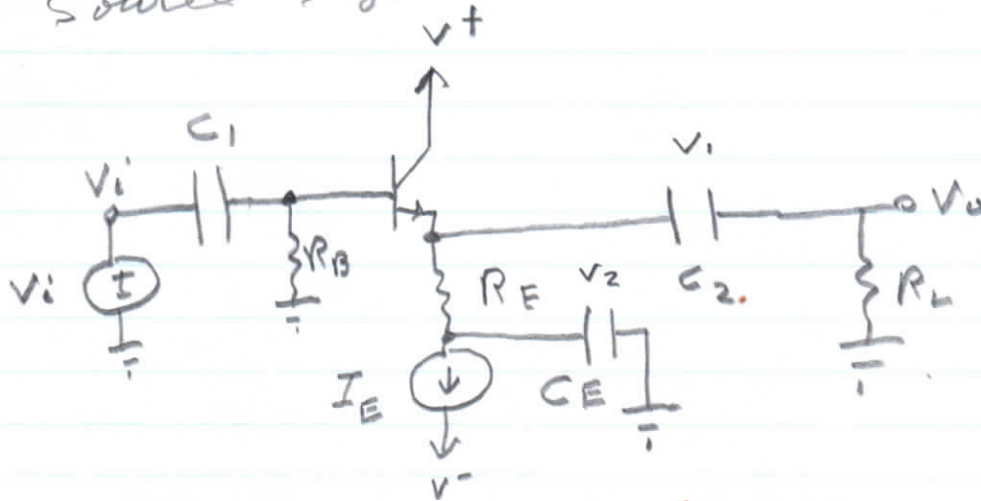
$$V_{OUT} = V^+ - V_{CE(sat)} - I_E R_E$$

For symmetric clipping  $V_{OUT} = -V_{OL}$

$$I_E R_E \parallel R_L = V^+ - V_{CE(sat)} - I_E R_E$$

$$I_E = \frac{V^+ - V_{CE(sat)}}{R_E + R_E \parallel R_L}$$

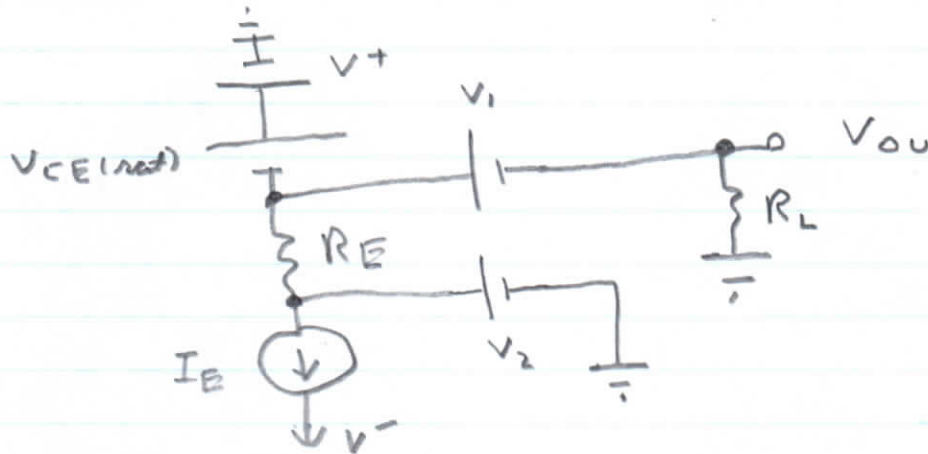
Common Collector Biased by Current Source Symmetric Clipping



$$V_1 = -I_B R_B - V_{BE}$$

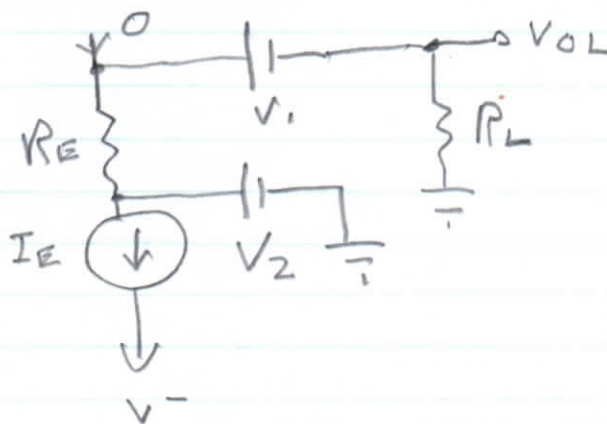
$$V_2 = -I_B R_B - V_{BE} - I_E R_E$$

Saturation  $V_{CE} = V_{CE( sat )} \approx 0.2 \rightarrow 0.3 V$



$$V_{ou} = V^+ - V_{CE( sat )} + I_B R_B + V_{BE}$$

Cut-off  $I_E = 0$



$$V_{OL} = (V_2 - V_1) \frac{R_L}{R_L + R_E} = -I_E R_L \parallel R_E$$

For symmetric clipping

$$V_{OL} = -V_{OO}$$

$$I_E R_L \parallel R_E = V^+ - V_{CE(sat)} + I_B R_B + V_{BE}$$

$$\left[ R_L \parallel R_E - \frac{R_B}{\beta + 1} \right] I_E = V^+ - V_{CE(sat)} + V_{BE}$$

$$I_E = \frac{V^+ - V_{CE(sat)} + V_{BE}}{R_L \parallel R_E - \frac{R_B}{\beta + 1}}$$

Symmetric  
clipping  
current  
source

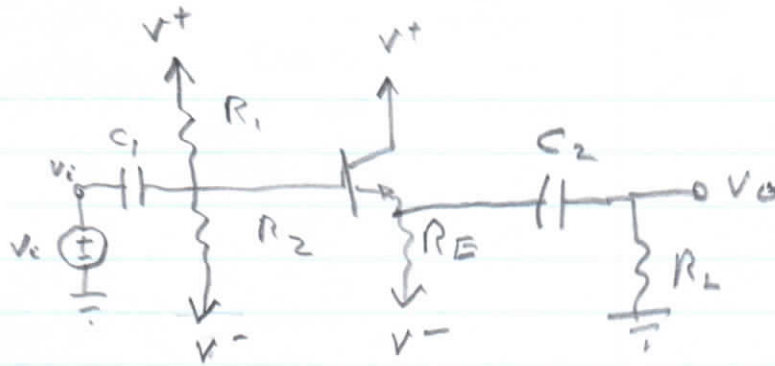
Compare with the result for  
the circuit with no current  
source

$$I_E = \frac{V^+ - V_{CE(sat)}}{R_E} \quad \frac{R_L + R_E}{2R_L + R_E} =$$

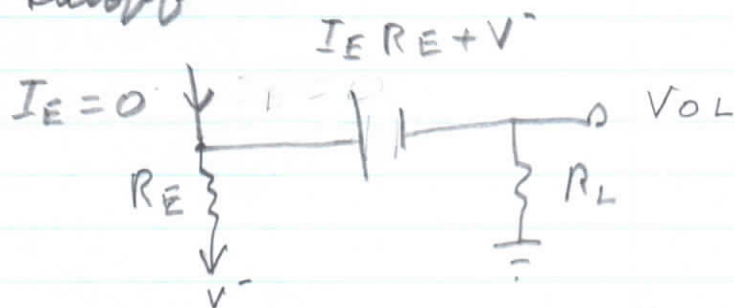
$$I_E = \frac{V^+ - V_{CE(sat)}}{R_E \parallel R_L} \quad \frac{R_L}{2R_L + R_E}$$

for  $\beta = \infty$

## CC Symmetric Clipping



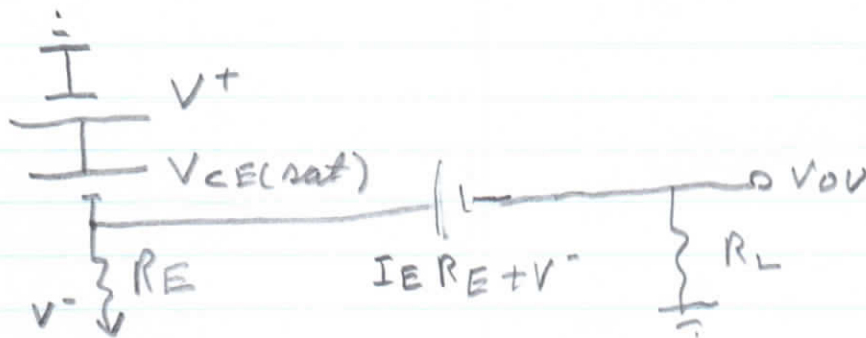
Cutoff



$$V_{OL} = - [I_E R_E + V^-] \frac{R_L}{R_E + R_L} + V^- \frac{R_L}{R_E + R_L}$$

$$V_{OL} = -I_E [R_E || R_L]$$

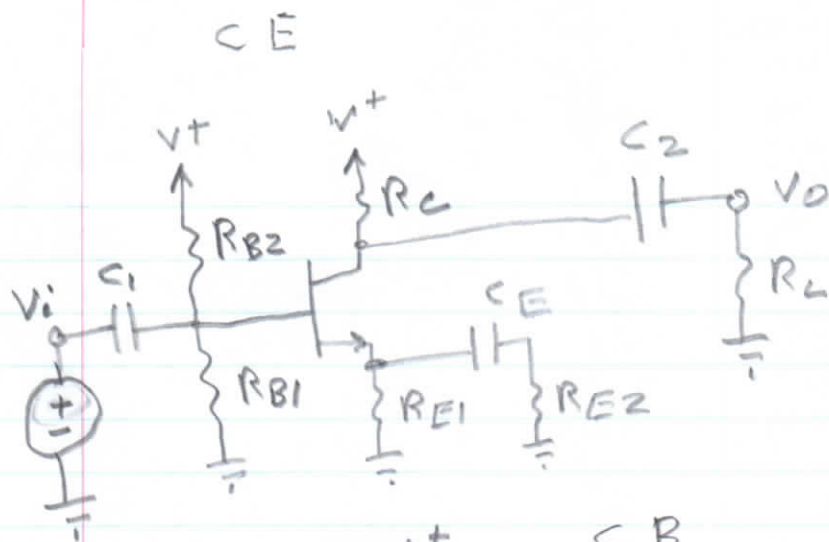
Saturation



$$V_{0V} = V^+ - V_{CE(sat)} - [I_E R_E + V^-]$$

Symmetric Clipping  $V_{0V} = -V_{OL} \Rightarrow$

$$I_E = \frac{V^+ - V^- - V_{CE(sat)}}{R_E} \frac{R_L + R_E}{2R_L + R_E}$$

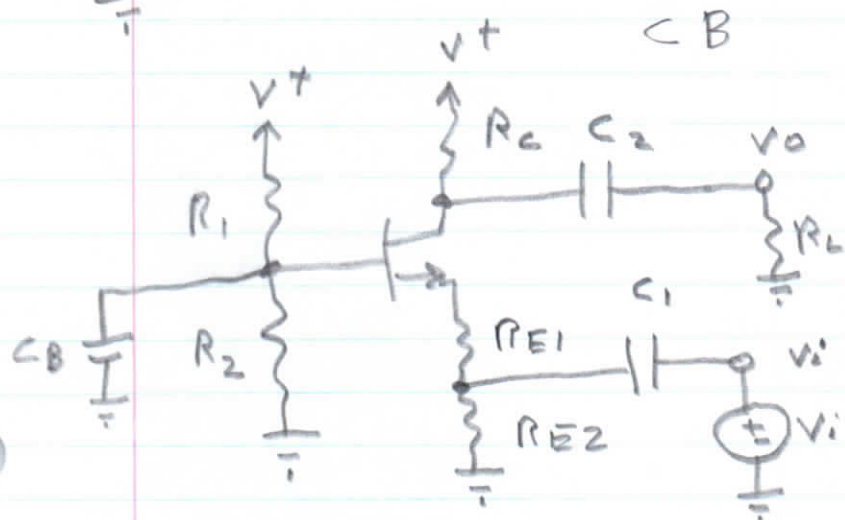


Neglect  $r_o, r_x$

$$A_v = -\alpha \frac{R_{\pi c}}{r_e + R_{\pi c}}$$

$$r_{in} \approx R_{B1} \parallel R_{B2}, r_o = r_c$$

Inverting

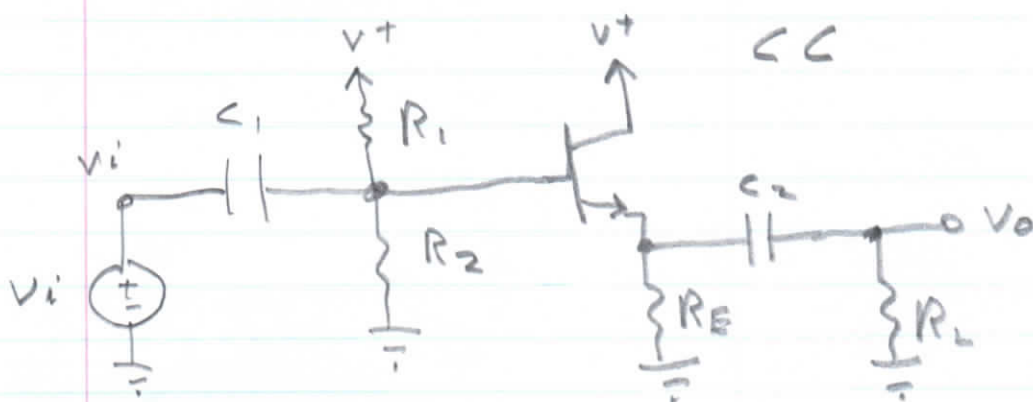


$$A_v = \alpha \frac{R_{\pi c}}{r_e + R_{\pi c}}$$

Non Inverting

$$r_{in} = R_{E2} \parallel (R_{E1} + r_e)$$

$$r_o = R_c$$



$$A_v = \frac{R_{\pi e}}{r_e + R_{\pi e}} < 1, \approx 1$$

Non Inverting

$$r_{in} = R_1 \parallel R_2$$

$$r_o = R_E \parallel r_e$$