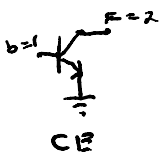
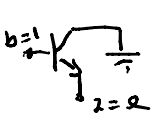
EE 303
03/11/10

pp. 484-485 Common b, c, e ⇒ CB, CC, CE





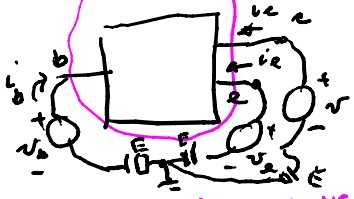
$g_m = \frac{I_C}{V_T}$

$g_\pi = g_m/\beta = 1/r_\pi$

$g_o = \frac{V_T}{V_A} \cdot g_m = 1/r_o$

$y_\pi = y(\omega) = sC_\pi + g_\pi$

$Y_{ind} = \begin{matrix} b \\ c \\ e \end{matrix} \begin{bmatrix} g_\pi & 0 & -y_\pi \\ g_m & g_o & -g_m - g_o \\ -g_m - y_\pi & -g_o & g_o + y_\pi + g_m \end{bmatrix}$ CB, CC, CE



$i_b + i_c + i_e = 0$ by KCL

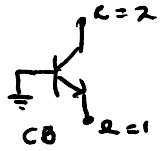
⇒ entries in a column = 0

$i = \begin{bmatrix} i_b \\ i_c \\ i_e \end{bmatrix} = Y_{ind} \begin{bmatrix} v_b + E \\ v_c + E \\ v_e + E \end{bmatrix}$

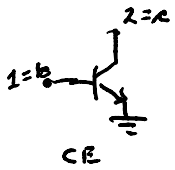
$= Y_{ind} \begin{bmatrix} v_b \\ v_c \\ v_e \end{bmatrix} + Y_{ind} \begin{bmatrix} E \\ E \\ E \end{bmatrix}$

$= 0$

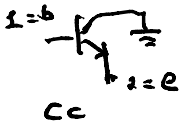
⇒ sum of entries in row = 0



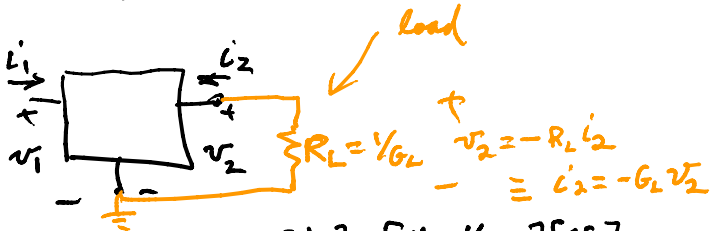
$Y_{CB} = \begin{bmatrix} g_o & -g_m - g_o \\ -g_o & g_o + y_\pi + g_m \end{bmatrix}$



$Y_{CE} = \begin{bmatrix} y_\pi & 0 \\ g_m & g_o \end{bmatrix}$



$Y_{CC} = \begin{bmatrix} y_\pi & -y_\pi \\ -g_m - y_\pi & g_m + g_o + y_\pi \end{bmatrix}$



$Y = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \Rightarrow \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \end{bmatrix}$

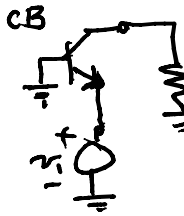
to get voltage gain when load is G_L

last row $i_2 = -G_L v_2 = y_{21} v_1 + y_{22} v_2$

and $i_1 = y_{11} v_1 + y_{12}\left(-\frac{y_{21}}{G_L + y_{22}}\right) v_1 \Rightarrow y_{in} = y_{11} - y_{12} \frac{1}{G_L + y_{22}} y_{21}$

$$\frac{v_2}{v_1} = A_v\Big|_{\substack{\text{loaded}\\ \text{in } G_L}} = \frac{-y_{21}}{y_{22}+G_L} \;;\; \text{for } \frac{i_2}{i_1}\Big|_{v_2=0} = \frac{y_{21}}{y_{11}} = A_i$$

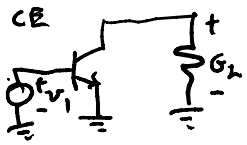
CB



$$\Rightarrow A_v = \frac{-(-g_0)}{g_0+g_m+y_\pi+G_L}$$

$$y_{in} = g_0 - \frac{(g_0)(g_0+g_m)}{y_\pi+g_0+g_m+G_L} = \frac{g_0(y_\pi+G_L)}{g_0+y_\pi+g_m+G_L}$$

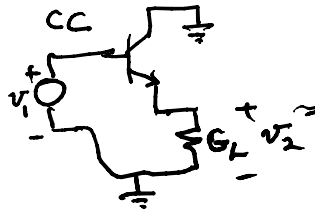
CE



$$\Rightarrow A_v = \frac{-g_m}{g_0+G_L}$$

$$y_{in} = y_\pi - 0\text{A}\ldots = y_{\pi\pi} = sC_\pi + g_\pi$$

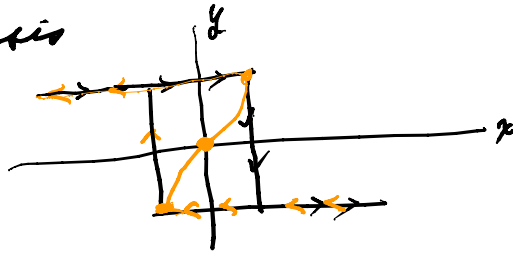
CC

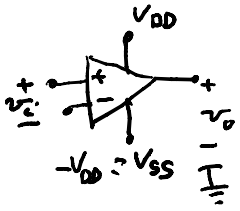


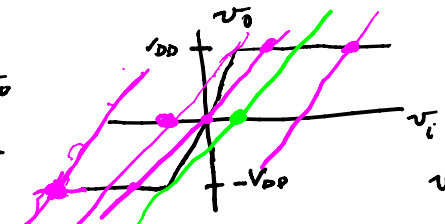
$$\Rightarrow A_v = \frac{g_m+y_\pi}{g_0+g_m+y_\pi+G_L} \approx \frac{1}{1+\frac{G_L}{y_{11}+g_m}} \approx 1$$

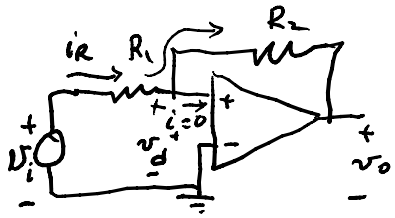
$$y_{in} = y_\pi - \frac{y_{\pi\pi}(g_m+y_\pi)}{g_0+g_m+y_\pi+G_L} = \frac{y_\pi(g_0+G_L)}{g_0+g_m+y_\pi+G_L}$$

p. 1187 = hysteresis



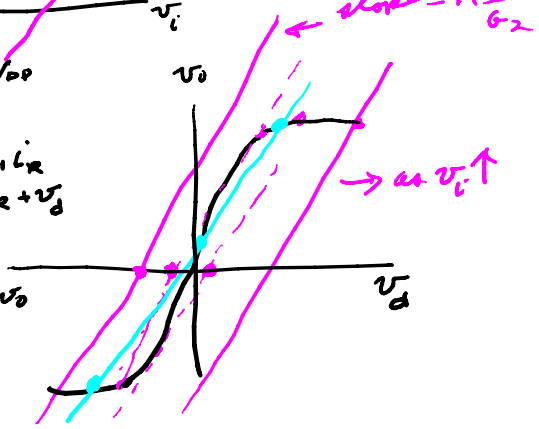






$$v_d = v_i - R_1 i_R$$
$$v_o = -R_2 i_R + v_d$$

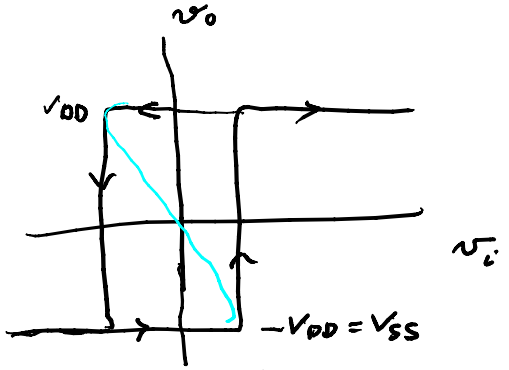
↑ solve for v_o w.r.t. v_d



$$i_R = G_1(v_i - v_d)$$
$$i_{R2} = G_2(v_d - v_o)$$

$$\frac{G_1}{G_2}(v_i - v_d) = v_d - v_o \Rightarrow v_o = \left(1+\frac{G_1}{G_2}\right)v_d - \frac{G_1}{G_2}v_i$$

$$v_d\Big|_{v_o=0} = \frac{1}{1+(G_2/G_1)}v_i$$



Schmitt trigger