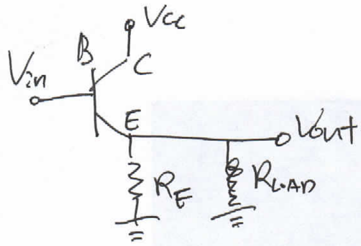
10/23 ①

Emitter follower



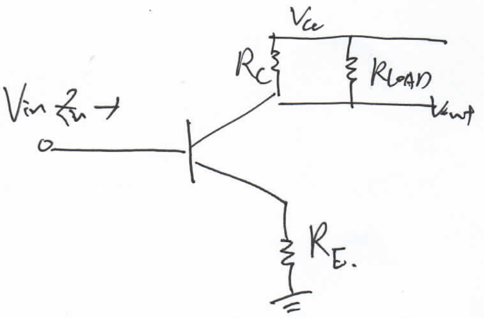
$\Delta V_{out} = \Delta V_{in}$

$I_{out} = \beta I_{in}$

$Z_{in} = \beta \cdot R_E$

$Z_{out} = R_E \, (/\!/ R_{LOAD})$

Common Emitter follower



$\Delta V_{out} = -\frac{R_C}{R_E} \Delta V_{out}$, $Z_{out} = R_C \, (/\!/ R_{LOAD})$

$I_{out} = \beta I_{in}$

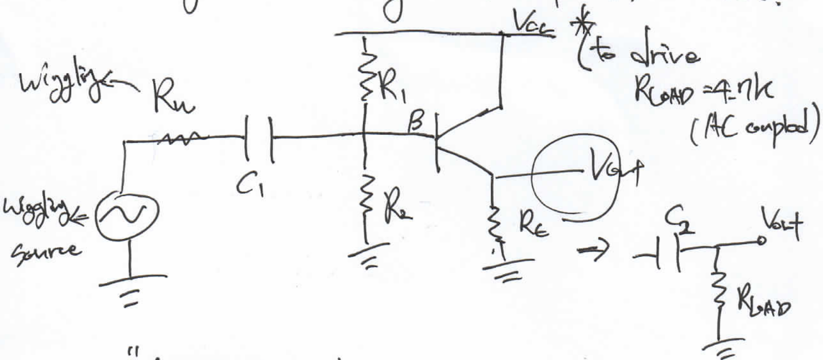
$Z_{in} = \beta \cdot R_E$.

$\omega_{3dB} = 100Hz\,(f)$

$I_{quiescent} = 0.5mA$ @ no signal input.

cf $V_{in} = \sim (A.C)$

Voltage Biasing Circuit is needed.



→ "AC - Coupled Emitter Follower"

1. Choose V_E to Centering to $V_{cc}/2$

$V_E = 7.5V$ to V_{out} maximum range.

$$R_E = \frac{V_E}{I_{quie}} = \frac{7.5V}{0.5mA} = 15kA.$$

2. Choose R_1, R_2

$$\frac{8.1}{15} = \frac{R_2}{R_1+R_2} \quad \cdots ①$$

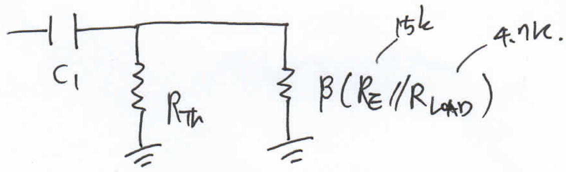
$R_{Th} = R_1 /\!/ R_2$

$R_{Th} = \frac{1}{10} Z_B$ (10X rule)

$$\frac{R_1R_2}{R_1+R_2} = \frac{1}{10}\beta \cdot R_E = 150k. \quad \cdots ②.$$

$\therefore R_1 = 277k$, $R_2 = 325k$.

3. Choose C_1



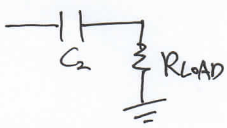
$\therefore R_{TOT} = R_{Th} /\!/ \beta(R_E /\!/ R_{LOAD})$

$= 105.7k\Omega. \approx 100k\Omega$

$\therefore \omega_{3dB} = 100Hz\,(2\pi) = \frac{1}{R_{TOT} \cdot C_1}$ *

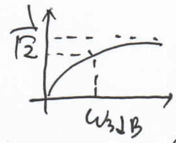
$C_1 = 1.5\times10^{-8}F = \approx 0.02\mu F$ (Commercially)

4. Choose C_2.



$\omega_{3dB} = 100Hz\,(2\pi) = \frac{1}{R_{LOAD} \cdot C_2}$ $\therefore C_2 = 0.3\mu F$.

For two cascaded HPF.

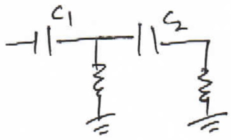


$C_2' = 3 \cdot C_2$ practice to prevent excessive attenuation @ 3dB

$C_{2\_new} \approx 1\mu F$

10/23 ②

Two Cascaded HPF ~~(LPF)~~



1) $C_1'|_{new} = C_1|_{old}$ $\quad C_2' = 3 \cdot C_2$

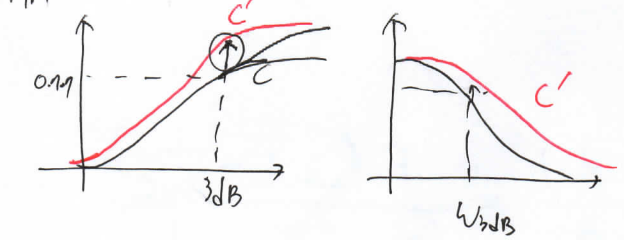
2) $C_1' = 2C_1$, $C_2' = 2C_2$

if LPF? $3 \to \frac{1}{3}$, $2 \to \frac{1}{2}$

1) $C_2' = \frac{1}{3} C_2$, "

2) $C_1' = \frac{1}{2} C_1$, $C_2' = \frac{1}{2} C_2$

HPF. LPF

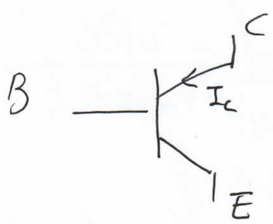


5.

R_W $\quad R_W \le \frac{1}{10} R_W = 10k.$

R_{TOT} $= 105k\Omega.$

Ebers-Moll Model for TR.



$\left[\begin{array}{l} V_{BE} = 0.6V = \text{Const} \\ I_B = \beta I_B,\ \beta = \text{Const.} \end{array}\right.$

$$I_c = I_s [\exp\left(\frac{V_{BE}}{V_T}\right) - 1]$$

$$\simeq I_s \cdot \exp\left(\frac{V_{BE}}{V_T}\right)$$

- E-M eqn

I_s = Saturation current = const

$V_{BE} = V_B - V_E$

$V_T = \cancel{kT}\, kT/q$ $\quad$ k: 볼츠만 상수 $\quad$ q: charge

T: Temp. (Kelvin)

$$V_{BE} = V_T \cdot \ln\left(\frac{I_c}{I_s}\right) = V_T(\ln I_c - \ln I_s)$$

$$, \frac{\partial V_{BE}}{\partial I_c} = V_T \frac{1}{I_c}$$

② $Z_{BE} \approx \frac{\partial V_{BE}}{\partial I_c} \left(= \frac{\Delta V_{BE}}{\Delta I_c}\right) = \frac{V_T}{I_c}$

def $\equiv r_e$ = Intrinsic resistance

B on E

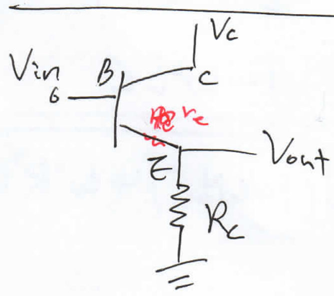
$\neq$ const $\quad r_e\left(\frac{V_T}{I_c}\right)$

③ $\frac{\Delta V_{BE}}{\Delta T} \approx \frac{-2.1mV}{K}$

④ $\Delta V_{BE} = -0.0001\, \Delta V_{CE}$

$= -0.01\%$ of ΔV_{CE}.

Revisit to previous model

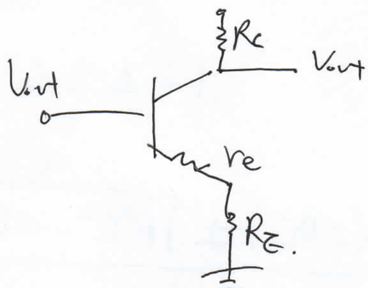


Emitter Follower

$$\Delta V_{out} = \frac{R_E}{R_E + R_B} \Delta V_{in}$$

$R_B \to r_e$

Common Emitter follower



$$\Delta V_{out} = -\frac{R_c}{R_E + R_c} \Delta V_{in}$$

r_e?

$r_e = \frac{25.3}{I_c}$