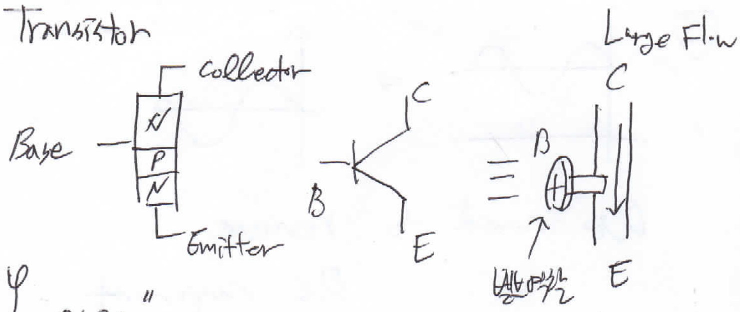
1

Transistor



"Laws"

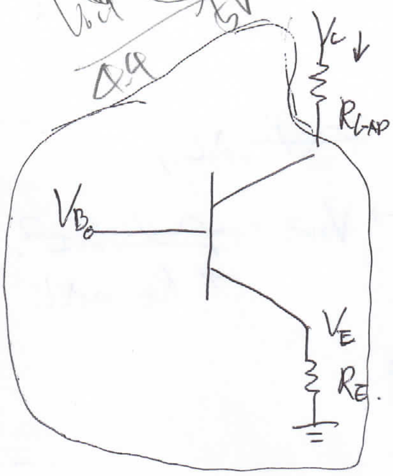
1. $V_C > V_E$ ($V_C - V_E \geqq 0.2V$) for current flow

2. $V_B - V_E = $ Const $= 0.6V$ when current flows.

3. $I_C \equiv \beta \cdot I_B$, $I_E \equiv I_C + I_B$
   (β ~ 100X)

$$= (\beta + 1) I_B$$

$$\approx \beta I_B \text{ (1\% error)}$$



$$I_{LOAD} = I_C \approx I_E = \frac{V_E}{R_E}$$

$$= \frac{V_B - 0.6V}{R_E}$$

$\neq f(R_{LOAD})$

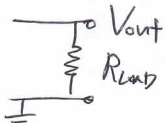
= Const = Current supply

Application

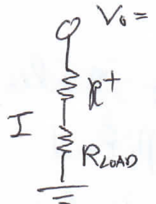
1) Current Source.

To generate constant current

※ Power supply



$$I_{LOAD} = \frac{V_0}{R_{LOAD}} \neq \text{Const} = f(R_{LOAD})$$

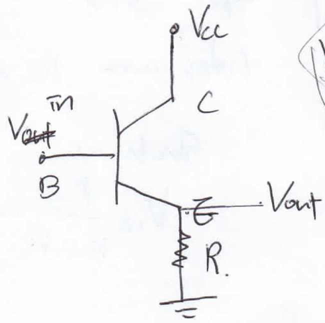


$$I_{LOAD} = \frac{V_0}{R^+ + R_{LOAD}}$$

$$= \frac{V_0}{R^+ (1 + \frac{R_{LOAD}}{R^+})}$$

$$\approx \frac{V_0}{R^+} \text{ (if } R^+ \gg R_{LOAD})$$

2) Emitter follower



$V_{out} = V_E = V_B - 0.6V$

$= V_{in} - 0.6V$

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

i) Gain $= \frac{\Delta V_{out}}{\Delta V_{in}} = 1$.

② $I_E \doteqdot I_C = \beta \cdot I_B$

$\therefore I_{out} = \beta \cdot I_{in}$.

11/1 (WED)

β times Current Amplification

Small current → Large current.

③ To drive R_{LOAD}

Z_{in} = Input Impedance to Emitter follower

$$Z_{in} = Z_B = \frac{\Delta V_B}{\Delta I_B} = \frac{\Delta V_E}{\frac{1}{\beta} \cdot \Delta I_E} = \beta \frac{\Delta V_E}{\Delta I_E}$$

$= \beta R$ ($\frac{\Delta V_E}{\Delta I_E} = R$)

or if

$\to \beta (R // R_{LOAD})$

$\approx R$ ($R_{LOAD} \gg R$)

→ "Very High Z_{in} is ideal" → for driving current (10X Rule)

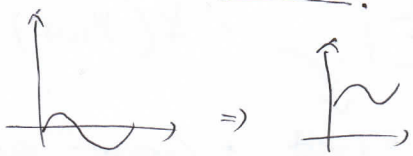
※ What happen?

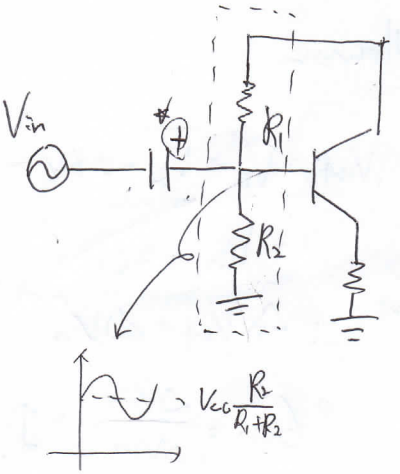
When V_{in} = ~, AC.,

→ V_{out} = ~, A.C?

⇒ No out!!

We need Biasing.

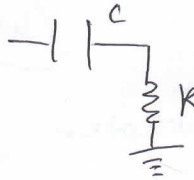




Input signal rides over DC capacitor

Such as $V_{cc}\frac{R_2}{R_1+R_2}$

Blocking Capacitor



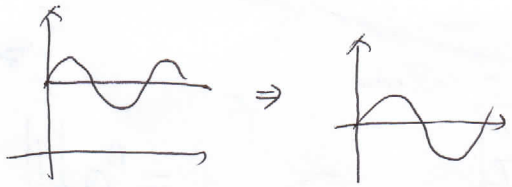
C serial

Smoothing Capacitor → parallel connection

⇒ a kind of HPF.

∴ Passing $\omega \gg \omega_{3dB} = \frac{1}{RC}$

Biasing : To pull TR's Quiescent Voltage $=0$ to mid point both V_{cc} and GND.

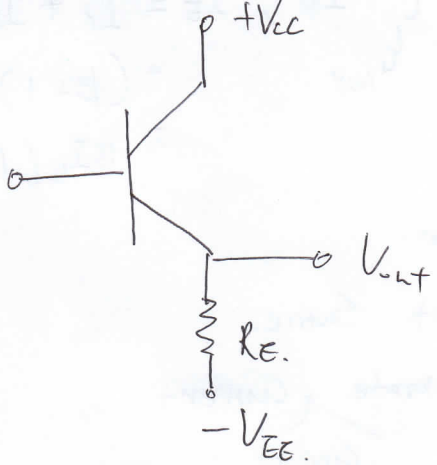
② 

We need to remove D.C component.

→ put blocking capacitor (C_2)

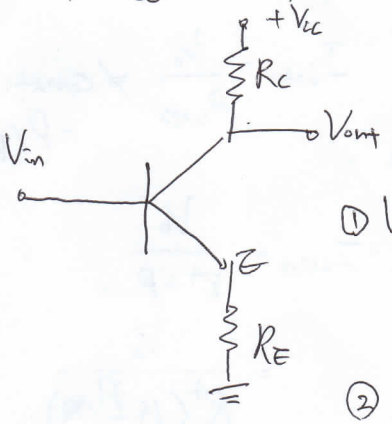
Passing $\omega \geq \omega_{3dB} = \frac{1}{RC_2}$

③ Emitter follower with split supply



$+V_{cc}$, $-V_{EE}$ → split supply.

3)



① Voltage is also amplified such $G = -\frac{R_C}{R_E}$

② $I_{out} = \beta I_{in}$

③ $Z_{in} = \frac{\Delta V_{in}}{\Delta I_{in}} = \frac{\Delta V_B}{\Delta I_B} = \beta R_E$

$V_{out} = V_{cc} - I_E R_C$

$I_E = \frac{V_E}{R_E} = \frac{V_{in} - 0.6V}{R_E}$

$\therefore V_{out} = V_{cc} - \frac{R_C}{R_E}(V_{in} - 0.6)$

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