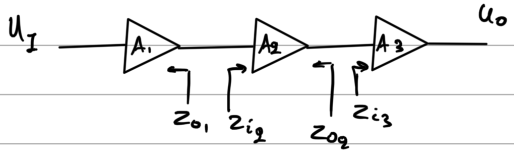
συνέχεια προηγούμενων παραδείγματος

$$g_m = 2\sqrt{k'\left(\frac{W}{L}\right) I_{DS}} \quad , \quad g_d = \frac{I_D}{V_A}$$

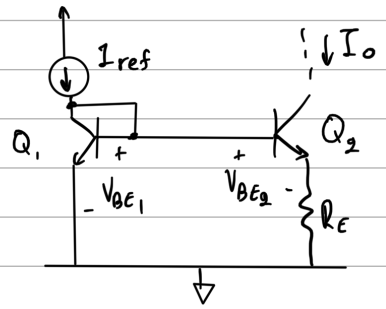
$g_{d3} = g_{d4} = g_{d5} = g_{d6} = 355,56 \ mA/V$
$g_{m3} = 39.87 \ \mu A/V$
$g_{m6} = 39.19 \ \mu A/V$
$g_{m8} = 2.993 \cdot 10^{-4} \ A/V$



$$A_o = A_1 \cdot A_2 \cdot A_3 = -\frac{g_{m3}}{g_{d3}+g_{d4}} \cdot \frac{-g_{m6}}{g_{d6}+g_{d5}} \cdot 1$$

(Αν BJT: $A = A(S)$)

Πηγή ρεύματος Wildar



$$V_{BE1} = V_T \ln\left(\frac{I_{ref}}{I_S}\right)$$

$$V_{BE2} = V_T \ln\left(\frac{I_o}{I_S}\right)$$

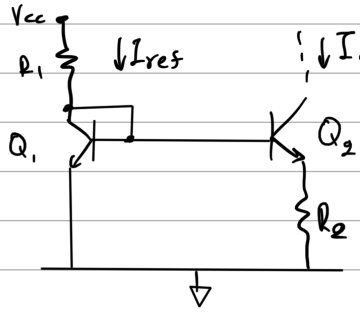
$$V_{BE1} = V_{BE2} = V_T \ln\left(\frac{I_{ref}}{I_o}\right)$$

$$V_{BE1} = V_{BE2} + I_o R_E$$

$$I_o R_E = V_T \ln\left(\frac{I_{ref}}{I_o}\right)$$

Παράδειγμα

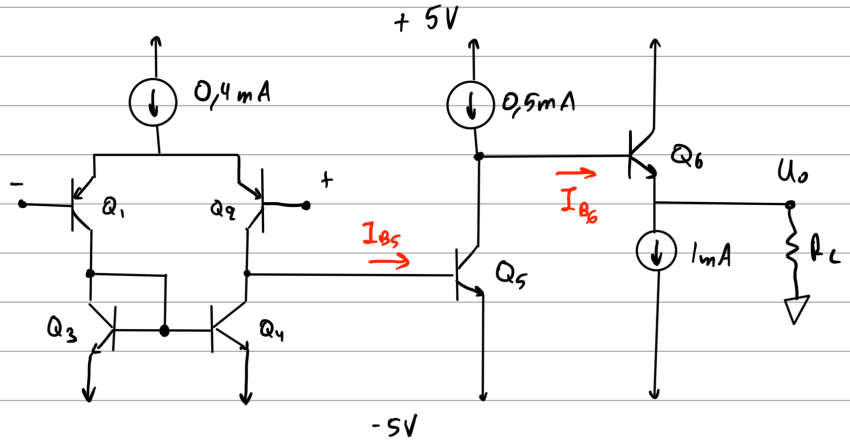
$V_{CC} = 5V$, $R_1 = 4,3k\Omega$, $I_o = 5\mu A$, R_2 ?



$$I_{ref} = \frac{5-0,7}{4,3k} = 1mA$$

$$V_T \ln\frac{I_{ref}}{I_o} = 26mV \cdot \ln\left(\frac{1mA}{5\mu A}\right) = 137mV$$

$$I_o R_2 = 137mV \rightarrow \boxed{R_2 = 27,4k\Omega}$$



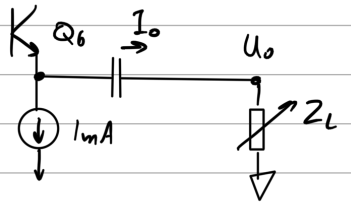
Δίνονται: $|V_{BE}| = 0,7V$
$\beta = 100$
$r_o \rightarrow \infty$

α) Να υπολογιστούν τα I_E για μηδ. σήμα εισόδου και για μηδ. σήμα εξόδου

β) Το κέρδος A_o για $R_L = 1k\Omega$

α) $I_{E_1} = I_{E_2} = 0{,}2\,mA$ $\quad I_{E_3} = I_{E_3} = 0{,}2\,mA$ $\quad I_{E_5} = 0{,}5\,mA$

$I_{E_6} = 1\,mA$

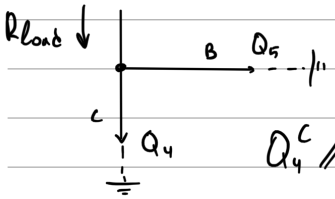


$U_o = 0 \Rightarrow I_o = 0$

$I_{E6} = 1\,mA$

β) **1° στάδιο:**

$$A_1 = \frac{U_{b5}}{U_{id}} = -G_m \cdot R_{load}, \quad G_m = g_{m1} = g_{m2} = \frac{I_{c_1}}{V_T} = 8\,mA/V$$



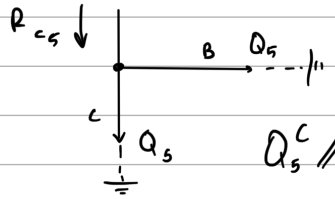
$Q_4^C \,//\, Q_5^B$

$$R_{load} \simeq r_{\pi 5} \,//\, \cancel{r_{O4}}^{\infty} = \frac{\beta}{g_{m5}} = 5\,k\Omega$$

$$\boxed{A_1 = -40\,V/V}$$

2° στάδιο:

$$A_2 = \frac{U_{c5}}{U_{b5}} = -g_{m5} \cdot R_{c5}$$



$Q_5^C \,//\, Q_5^B$

$$R_{c5} = \cancel{r_{O5}}^{\infty} \,//\, R_{in}^{(3)} = (\beta+1)(r_{e5} + R_L) = 103{,}5\,k\Omega$$

$$\boxed{A_2 = -2.070\ V/V}$$

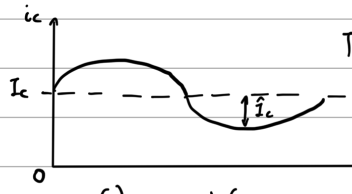
3° στάδιο:

$$A_3 = \frac{U_o}{U_{c5}} = \frac{R_L}{R_L + r_{e6}} = 0{,}976\ V/V$$

$$\boxed{A_o = A_1 \cdot A_2 \cdot A_3 \simeq 80.700\ V/V}$$

$A = A(s) =$ → $|A(s)|$, → $\angle A(s)$

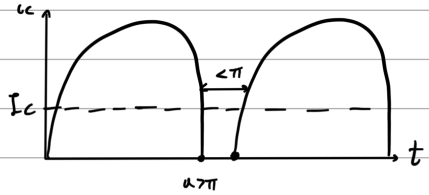
Ενισχυτές Ισχύος



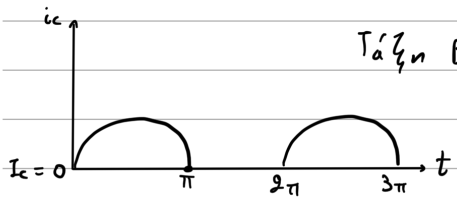
Τάξη A (Class A)

(+) ο πλέον γραμμικός ενισχυτής

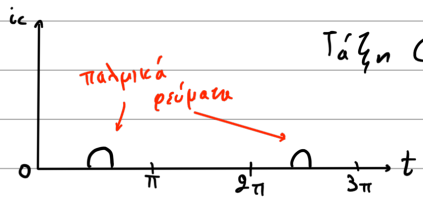
(−) υψηλότερη κατανάλωση



Τάξη AB (Class AB)



Τάξη B (Class B)



Τάξη C (Class C)