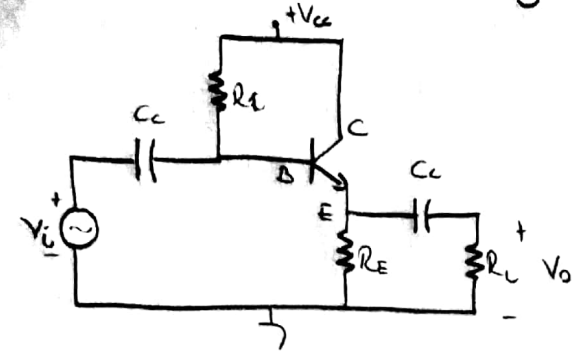
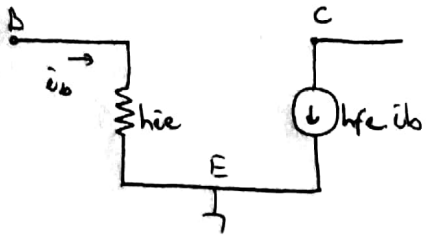
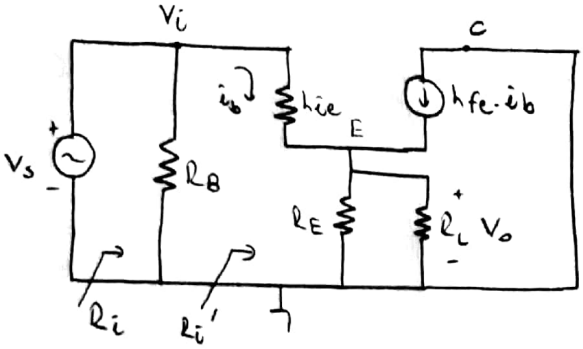
Ortak Kollektörlü Yükseltaç (iyi bir akım yükselticidir)





Yaklaşık h eşdeğer devresi

$(R_B = R_1 // R_2)$



$$A_V = \frac{V_o}{V_i} \qquad V_o = (i_b + i_b.h_{fe}).(R_E // R_L)$$

$$V_o = i_b(1+h_{fe}).(R_E // R_L)$$

$$V_i = i_b.h_{ie} + V_o$$

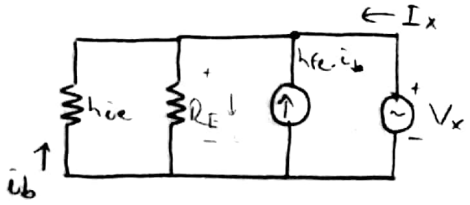
$$A_V = \frac{i_b(1+h_{fe}).(R_E // R_L)}{i_b.h_{ie} + i_b(1+h_{fe}).(R_E // R_L)}$$

$$A_V = \frac{i_b(1+h_{fe})(R_E // R_L)}{i_b(h_{ie} + [1+h_{fe}.(R_E // R_L)])}$$

$$R_i' = \frac{V_i}{i_b} = h_{ie} + (1+h_{fe})(R_E // R_L) \qquad R_i = R_i' // R_B$$

$$A_I = \frac{i_o}{i_i} = \frac{\frac{V_o}{R_L}}{\frac{V_i}{R_i}} = \frac{V_o}{R_L}.\frac{R_i}{V_i} = A_V.\frac{R_i}{R_L}$$

⇒ R_o' bulma



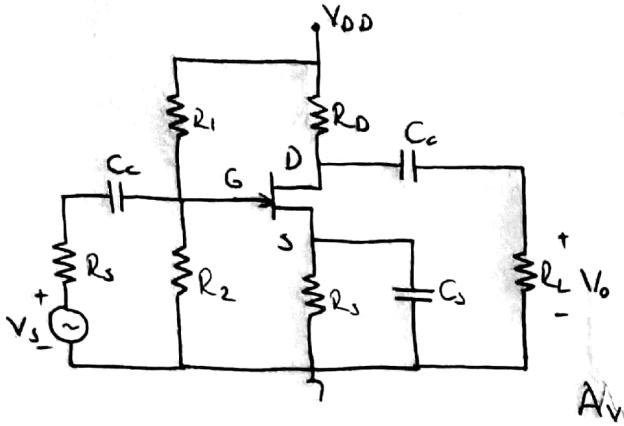
$$I_x + h_{fe}.i_b - \frac{V_x}{R_E} + i_b = 0 \qquad i_b = -\frac{V_x}{h_{ie}}$$

$$I_x = \frac{V_x}{R_E} + h_{fe}\frac{V_x}{h_{ie}} + \frac{V_x}{h_{ie}}$$

$$R_o = \frac{V_x}{I_x} = \frac{V_x}{V_x\left(\frac{1}{R_E} + \frac{h_{fe}}{h_{ie}} + \frac{1}{h_{ie}}\right)}$$

$$R_o = \left(\frac{1}{R_E} + \frac{h_{fe}}{h_{ie}} + \frac{1}{h_{ie}}\right)^{-1}$$

Ortak Source FET Yükselteç



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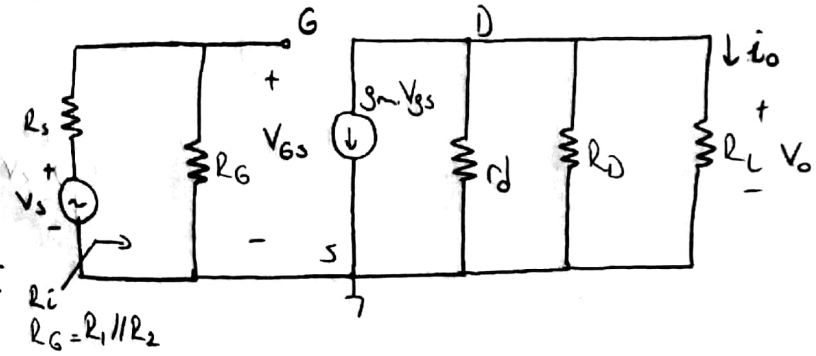
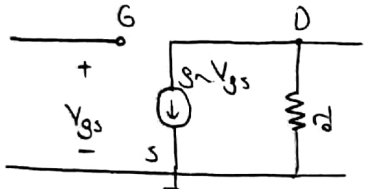




FET yaklaşık eşdeğer devresi

$A_V = \frac{V_o}{V_S}$ $\quad V_o = -g_m . V_{GS} . \underbrace{(r_d // R_D // R_L)}_{R_{es}}$ $\quad \frac{V_o}{V_{GS}} = -g_m . R_{es}$

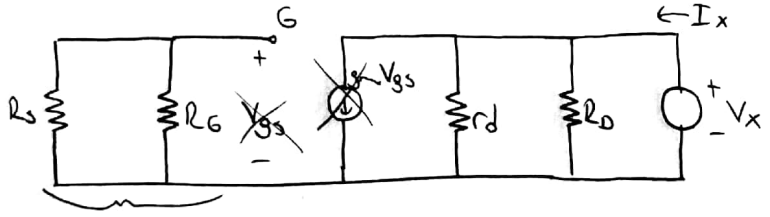
$A_V = \frac{V_o}{V_{GS}} . \frac{V_{GS}}{V_S}$ $\quad V_{GS} = \frac{V_S}{(R_S+R_G)} . R_G$ $\quad \frac{V_{GS}}{V_S} = \frac{R_G}{(R_S+R_G)}$

$A_V = \boxed{-g_m R_{es} . \frac{R_G}{R_S+R_G}}$ giriş ve çıkış gerilimleri arasında 180° faz farkı var.

$R_i = R_G$

$A_I = \frac{i_o}{i_i} = \frac{\frac{V_o}{R_L}}{\frac{V_S}{R_S+R_G}} = \frac{V_o}{V_S} . \frac{(R_S+R_G)}{R_L} = A_V . \frac{(R_S+R_G)}{R_L}$

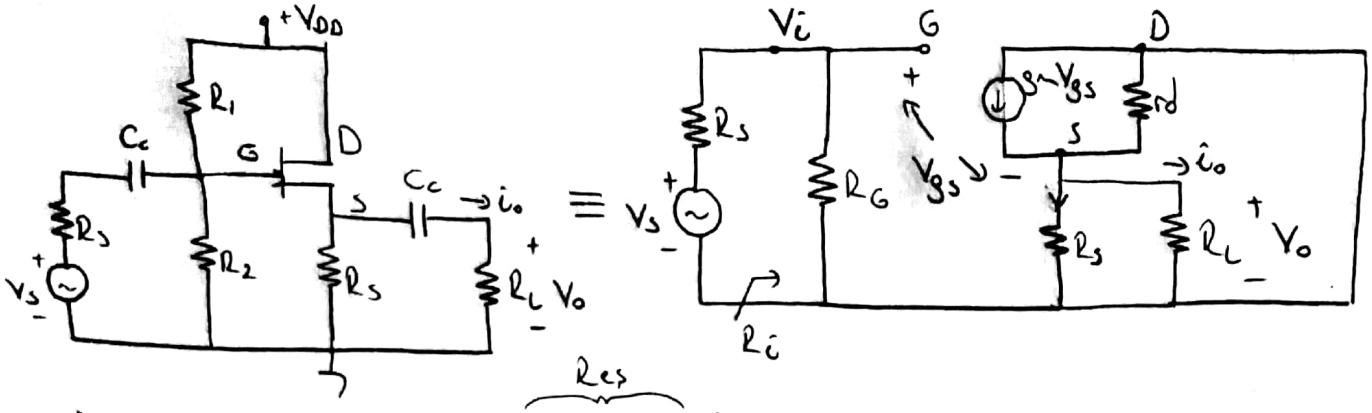
R_o'ı bulma



Giriste herhangi bir kaynak olmadığı için $V_{gs}=0$ olur; dolayısıyla $g_m . V_{gs}$ akım kaynağında 0 olur.

$R_o = r_d // R_d$ olur.

Ortak Drain (OD) Yükselteç



$A_v = \frac{V_o}{V_s}$ $\quad V_o = g_m V_{gs} \cdot (r_d // R_S // R_L)$ $\quad V_i = V_{gs} + V_o$ $\quad V_i = \frac{V_S}{(R_S+R_G)} \cdot R_G$

$A_v = \frac{V_o}{V_i} \cdot \frac{V_i}{V_s}$ $\quad \frac{V_i}{V_S} = \frac{R_G}{R_S+R_G}$ $\quad V_i = V_{gs} + g_m V_{gs} (r_d // R_S // R_L)$

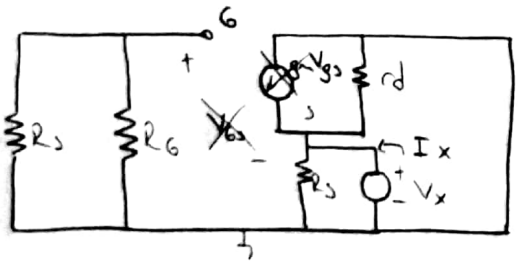
$V_i = V_{gs} (1 + g_m (r_d // R_S // R_L)$

$\frac{V_o}{V_i} = \frac{g_m R_{es}}{1+g_m R_{es}} \Rightarrow A_v = \frac{g_m R_{es}}{(1+g_m R_{es})} \cdot \frac{R_G}{(R_S+R_G)}$

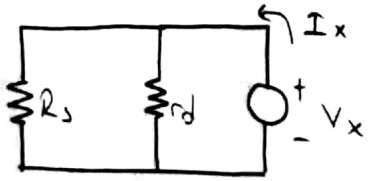
$R_i = R_G$

$A_I = \frac{i_o}{i_i}$ $\quad i_o = \frac{V_o}{R_L}$ $\quad i_i = \frac{V_S}{R_S+R_G}$ $\quad A_I = \frac{\frac{V_o}{R_L}}{\frac{V_S}{R_S+R_G}} = A_v \cdot \frac{R_S+R_G}{R_L}$

R_o'i bul

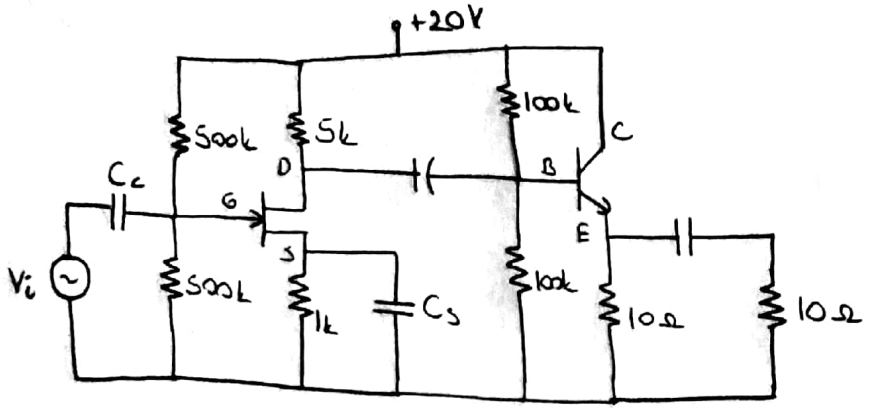


$V_{gs} = 0 \Rightarrow g_m V_{gs} = 0$ olur

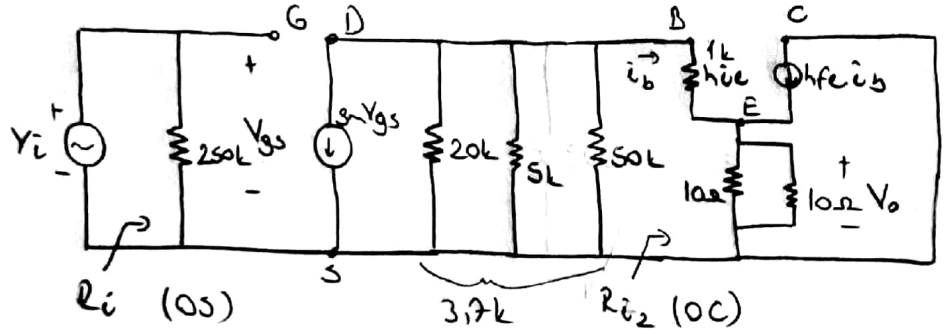


$R_o = R_S // r_d$

Lab örnek 1)



FET; $g_m = 1mS$, $r_d = 20k\Omega$
BJT; $h_{ie} = 1k$, $h_{fe} = 100$,

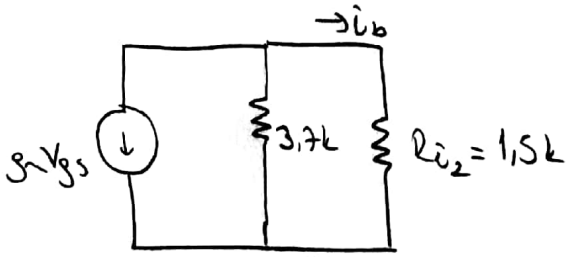


$A_V = \frac{V_o}{V_i} = \frac{V_o}{V_D} \cdot \frac{V_D}{V_i}$ $\quad V_o = i_b(1+h_{fe}) \cdot 0,005k\Omega = 101 i_b \cdot 0,005 = 0,505 i_b$

$V_D = i_b \cdot 1k + V_o = 1,505 i_b \quad V_i = V_{gs}$

$\frac{V_o}{V_D} = \frac{0,505 i_b}{1,505 i_b} = 0,335$

$R_{i_2} = \frac{V_D}{i_b} = \frac{i_b(1k \cdot 0,505)}{i_b} = 1,5k$



$i_b = -g_m V_{gs} \cdot \frac{3,7 \cdot 1,5}{3,7+1,5} \cdot \frac{1}{1,5} = -g_m V_{gs} \cdot 0,711$

$V_D = 1,505 i_b = -1,505 g_m V_{gs} \cdot 0,711$

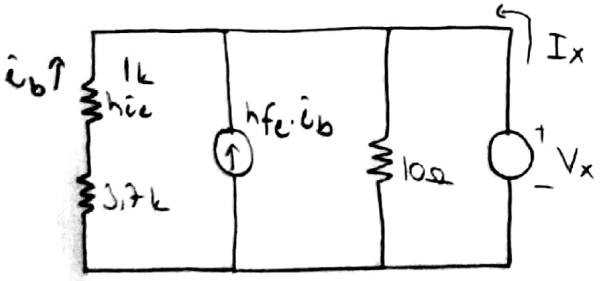
$\frac{V_D}{V_i} = \frac{-1,505 g_m V_{gs} \cdot 0,711}{V_{gs}} = -1,071 \cdot 1mS$

$A_V = 0,335 \cdot -1,071 \cdot 1mS = \underline{-0,359 \cdot 1mS}$

$R_i = 250k \quad A_I = \frac{i_o}{i_i} = \frac{\frac{V_o}{R_L}}{\frac{V_i}{R_i}} = \frac{V_o}{R_L} \cdot \frac{R_i}{V_i} = A_V \cdot \frac{R_i}{R_L} = A_V \cdot \frac{250k}{10}$

$V = IR \quad I = \frac{V}{R}$

R_o'i bul $V_i = 0$ olduğu için $V_{gs} = 0$ olur.



$R_o = \frac{V_x}{I_x} \quad I_x = \frac{V_x}{3,38k} \quad \boxed{R_o = 3,38k\Omega}$