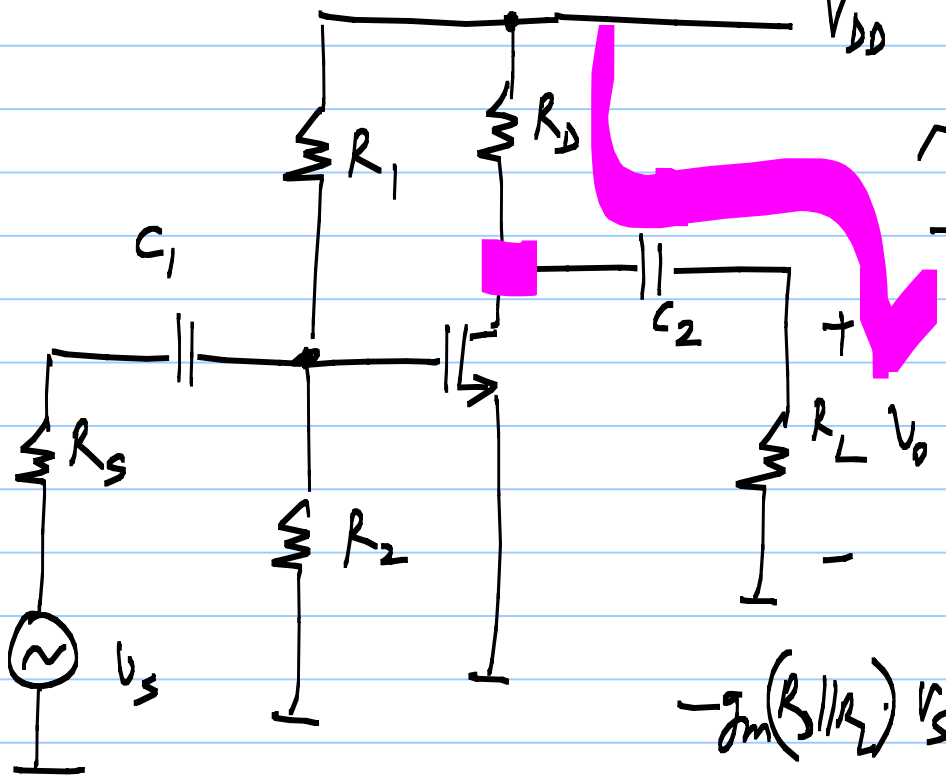
Lecture 17

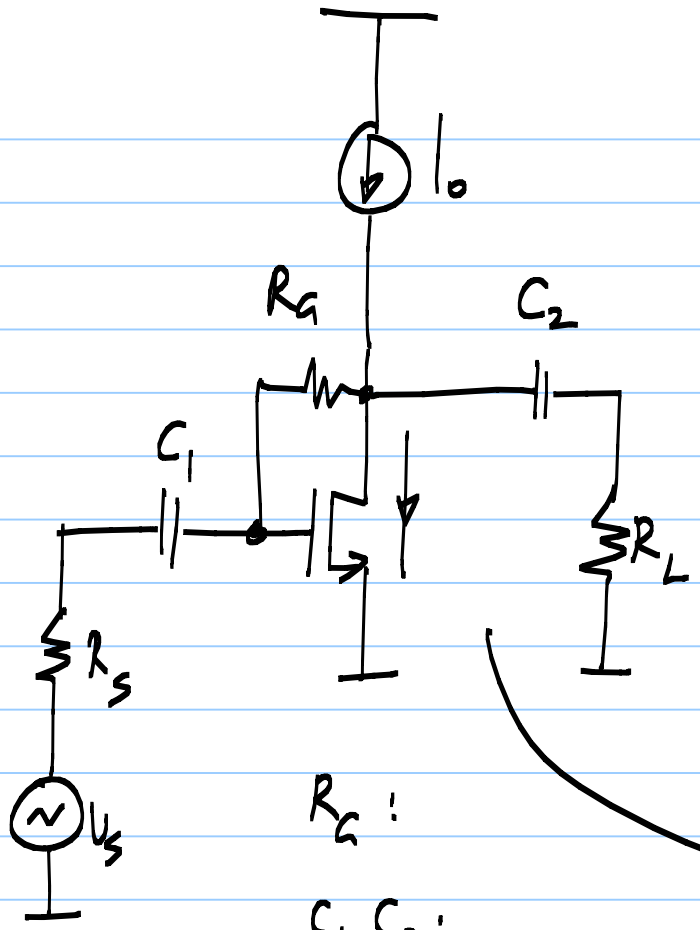


Input swing limits: $V_{s,max}$

$$\underbrace{-\frac{I_{D_0}}{g_m}}_{V_{s,min}} < v_s < \frac{V_{DD}\cdot\frac{R_1}{R_1+R_2} - I_D R_S + V_T}{1+g_m(R_D\|R_L)}$$

Output swing limits:

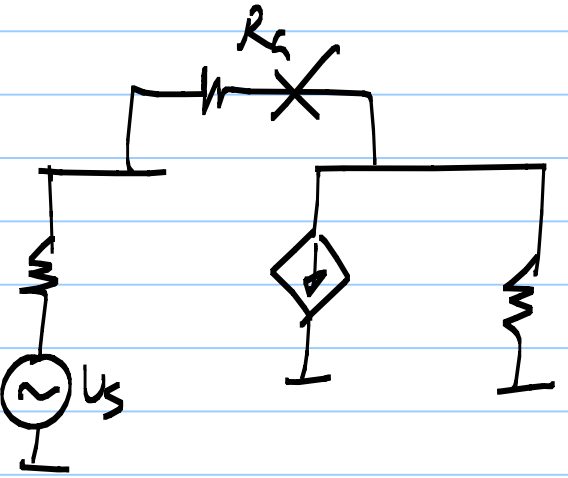
$$-g_m(R_S\|R_L)\,V_{s\,max} < v_o < -g_m(R_S\|R_L)\,V_{s\,min}$$



	op.point	increment
V_{GS}:	$V_T + \sqrt{\frac{2I_0}{k_n}}$	u_s
V_{DS}:	$V_T + \sqrt{\frac{2I_0}{k_n}}$	$-g_m R_L \cdot u_s$
I_D:	I_0	$g_m \cdot u_s$

R_G:

C_1, C_2:

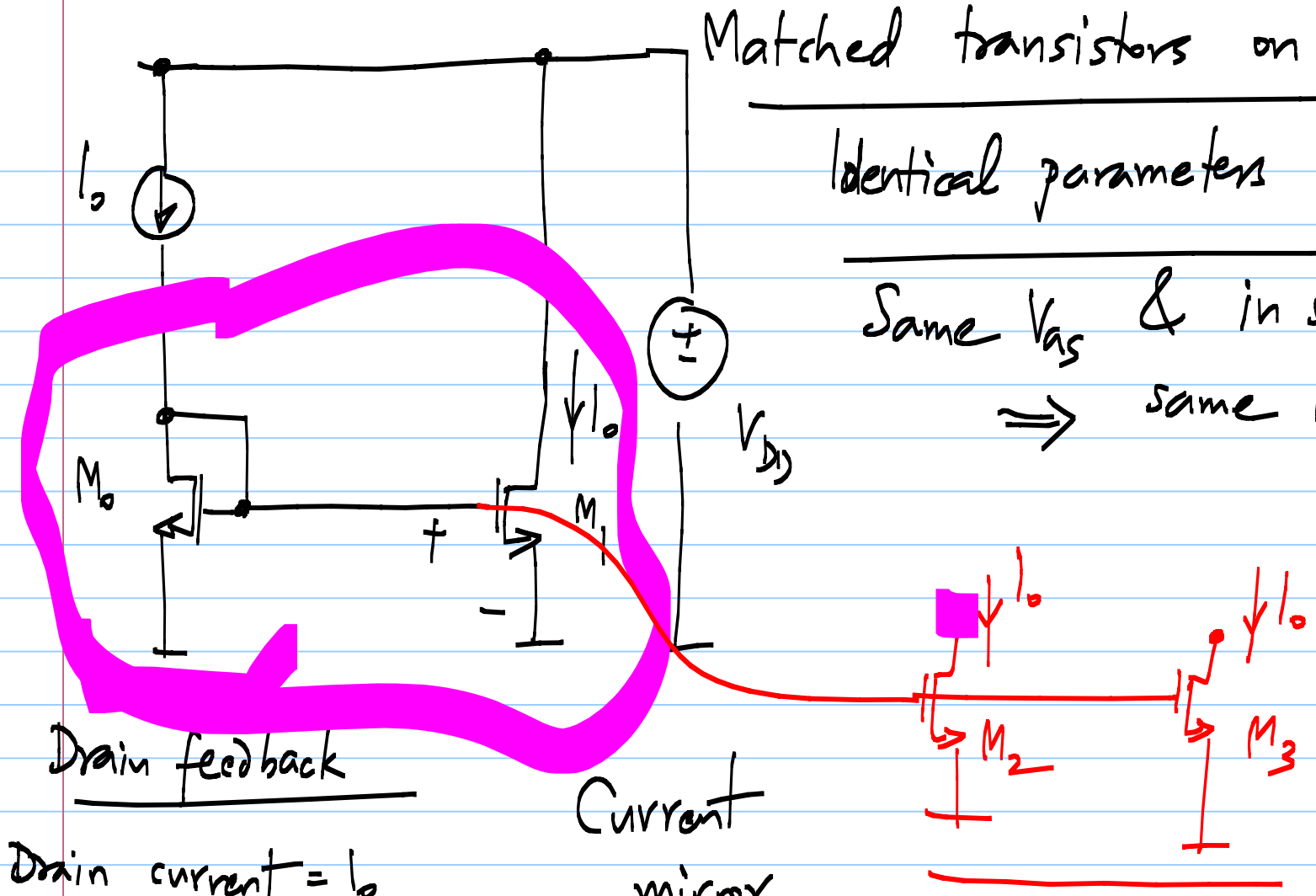


$$V_{DS,tot} \geq V_{GS,tot} - V_T$$

$$V_T + \sqrt{\frac{2I_D}{k_n}} - g_m R_L v_s \geq V_T + \sqrt{\frac{2I_D}{k_n}} + v_s - V_T$$

$$v_s \leq \frac{V_T}{1 + g_m R_L} \qquad \frac{V_{DD} \cdot \frac{R_1}{R_1 + R_2} - I_{D_0} R_D - V_T}{1 + g_m (R_D \| R_L)}$$

$$I_D + g_m v_s \geq 0 \qquad v_s \geq -\frac{I_D}{g_m}$$

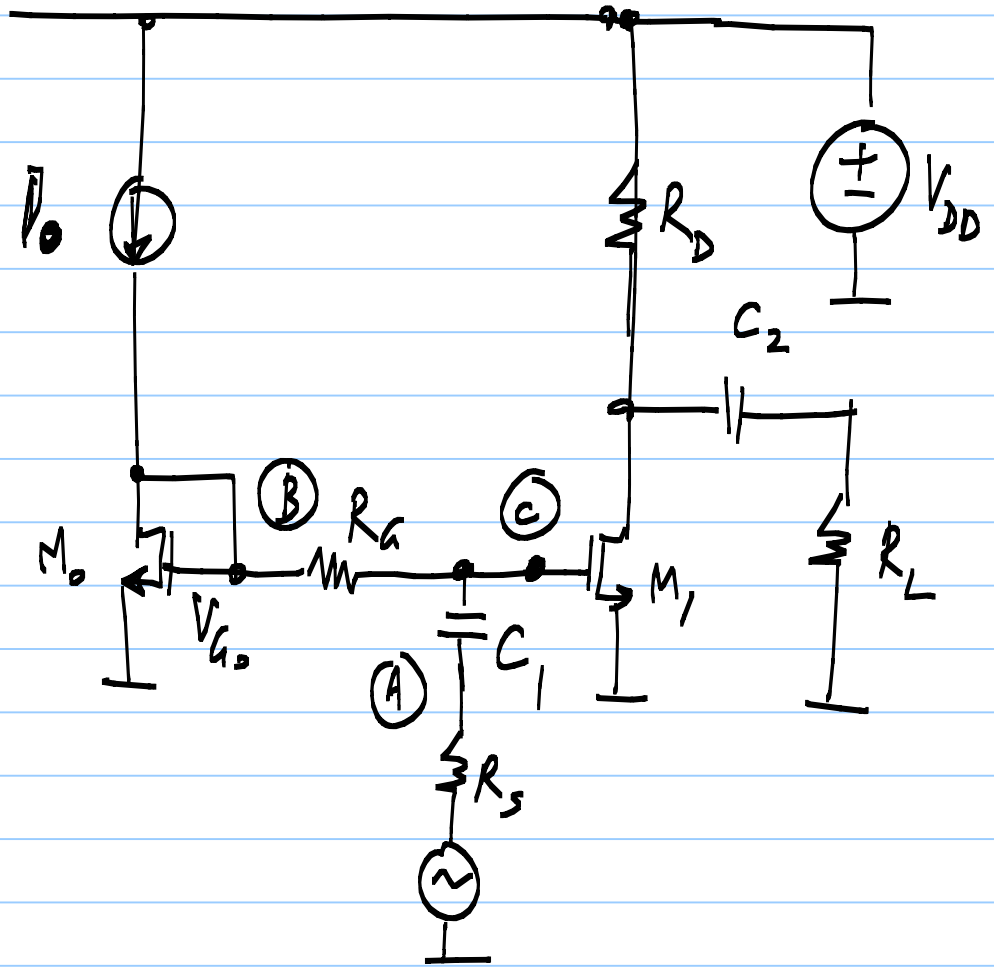


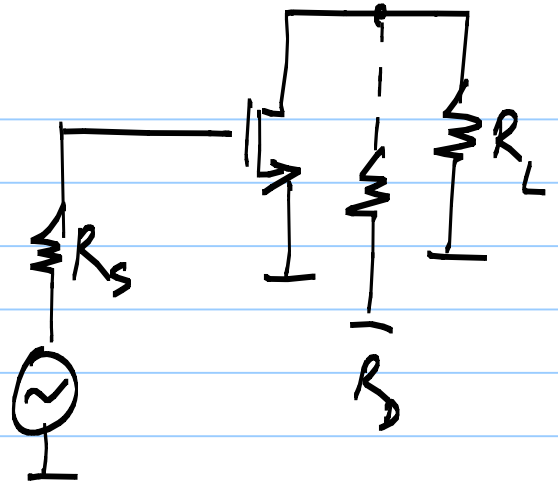
Matched transistors on an IC:

Identical parameters (K_n, V_T)

Same V_{GS} & in saturation

$\Rightarrow$ same I_D.





$-g_m (R_D \| R_L)$

$-g_m (R_D \| R_L \| r_{ds})$

Calculate:

* Incremental voltage @ gate of M_1
  (without neglecting R_a or M_0)
  Assume C_1 is a short

* Calculate constraints of C_1 & C_2
  for a given ω