

$$\bar{V}_{GS_1} = \bar{V}_{GS_2}$$

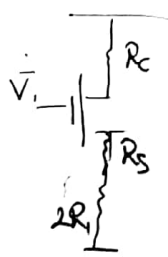
$$I_{O_2} = 5 I_{ref}$$

$$I_{D_4} = 10 I_{ref}$$

$$I_B = 3 I_{ref}$$

$$\rightarrow I_{copy} = (10 - 3) I_{ref} = 7 I_{ref}$$

نویسندگان



$$R_{S_1} = R_{S_2}$$

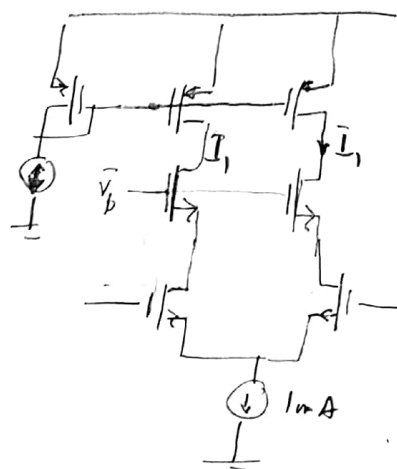
$$\rightarrow R_2 = R_S + 2R_1$$

$$\rightarrow R_2 = R_S + 2R_1$$

نویسندگان

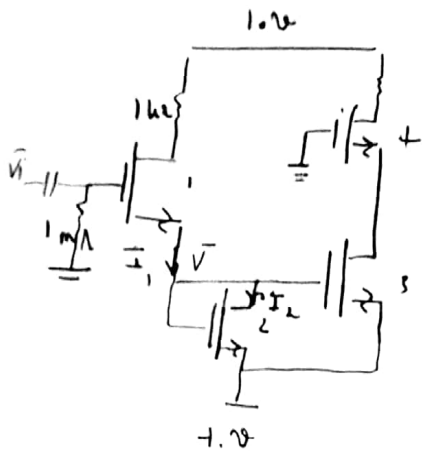
$$I_D = \frac{\mu_n C_{ox} (W/L)}{2} (\bar{V}_{GS} - \bar{V}_{th})^2$$

$$\bar{V}_{DS} = \bar{V}_{GS} - \bar{V}_{th}$$



$$I_1 = I_2 = 0.5 \text{ mA} \quad ??$$

نویسندگان



$V_{th} = 3V$

$$I_1 = \frac{1}{2} \times \frac{2mA}{V_{th}^2} \times (0 - V_{th} - 3)^2$$

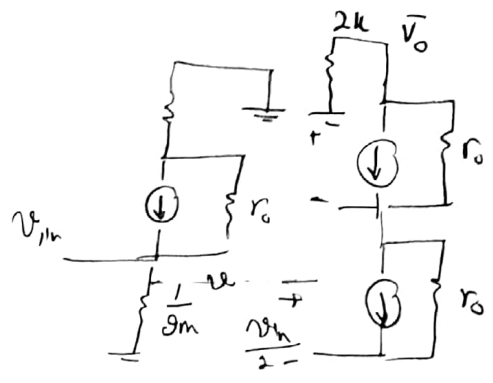
$$I_2 = \frac{1}{2} \times 2 \times (V_{th} + 10 - 3)^2$$

$$I_1 = I_2 = (V_{th} + 3)^2 = (V_{th} + 7)^2$$

$$6V + 9 = 8V + 49$$

$$\rightarrow V_{th} = 5V$$

$$g_m = \frac{2 \times 4}{V_{GS} - V_{th}} = 4mS$$



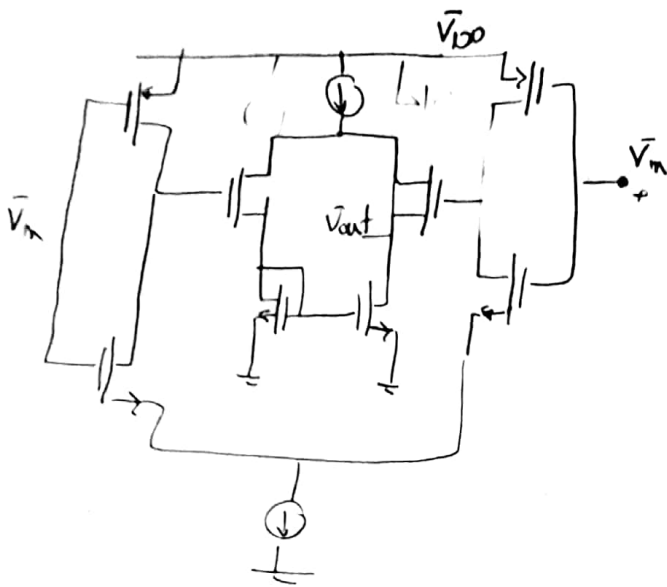
	1	2	3	4	5
I_D	4mA	4mA	4mA	4mA	
V_{DS}	11V	5V	5V	7V	

$$\frac{V_{in} g_m}{2} - \frac{V_{out} g_m}{2} = 0 \rightarrow V_{out} = \frac{V_{in}}{2}$$

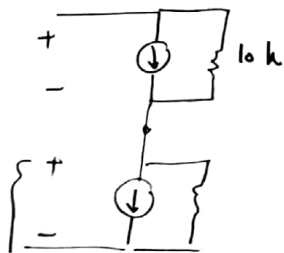
$$V_{out} - V'_{out} = \frac{V}{V_{th}} \times 2 =$$

$$\rightarrow V_{out} = 2k \times V_{out} = 2k \times \frac{V_{in}}{2} \times 4mS$$

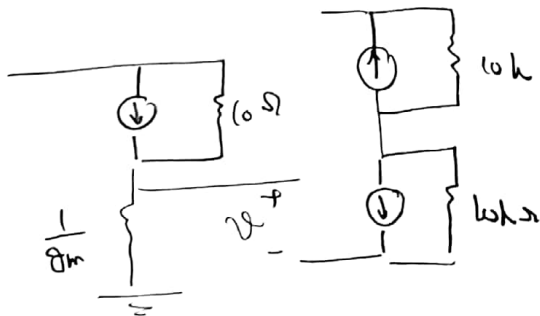
$$\rightarrow A_v = -4$$



تفاوت ولتاژ خروجی



$$v_o = -g_m r_o v_{in} \rightarrow A_v = -100$$



$$v_{z-100} v_{in} g_m \times \frac{10k}{10k + \frac{1}{g_m}} \times -\frac{1}{g_m}$$

$$v_z = 99 v_{in}$$

$$v_o = (10 v_{in} g_m + 99 v_{in} g_m) \times 5k$$

$$\frac{v_o}{v_{in}} = 9950$$

$$\rightarrow A_v = \frac{9950}{2} = 4975 \text{ بر دو تانگی}$$