

$$V_{ov9} = 0,5V$$

$$V_{ov3} = V_{ov1} = 0,2V$$

$$|V_{ov5}| = |V_{ov7}| = 0,3V$$

$$L = L_{min} = 0,5 \mu m$$

$$\left(\frac{W}{L}\right)_{1-4} = 1250$$

$$I_0 = \frac{1}{2} \mu C_{ox} \frac{W}{L} (V_{as} - V_T)^2$$

$$\left(\frac{W}{L}\right)_{5-8} = 1111$$

$$\left(\frac{W}{L}\right)_9 = 400$$

$$W_{tot} = \sum_i W$$

$$A_0 = g_m \left[(g_{m3} r_{o3} r_{o1}) \parallel (g_{m5} r_{o5} r_{o7}) \right] =$$

$$= 1416$$

$$r_o = \frac{1}{g_d}$$

$$g_m r_o = \sqrt{2 \mu C_{ox} \left(\frac{W}{L}\right) I_0} \cdot (\lambda I_0)^{-1} \quad (\lambda \sim 1/L) \rightarrow g_m r_o \uparrow \sim \sqrt{WL \uparrow / I_0}$$

$$I_0 = \sigma_{sat} \Rightarrow \frac{W}{L} = \sigma_{sat} \Rightarrow \text{όρα αν: } WL \uparrow \Rightarrow W \uparrow, L \uparrow$$

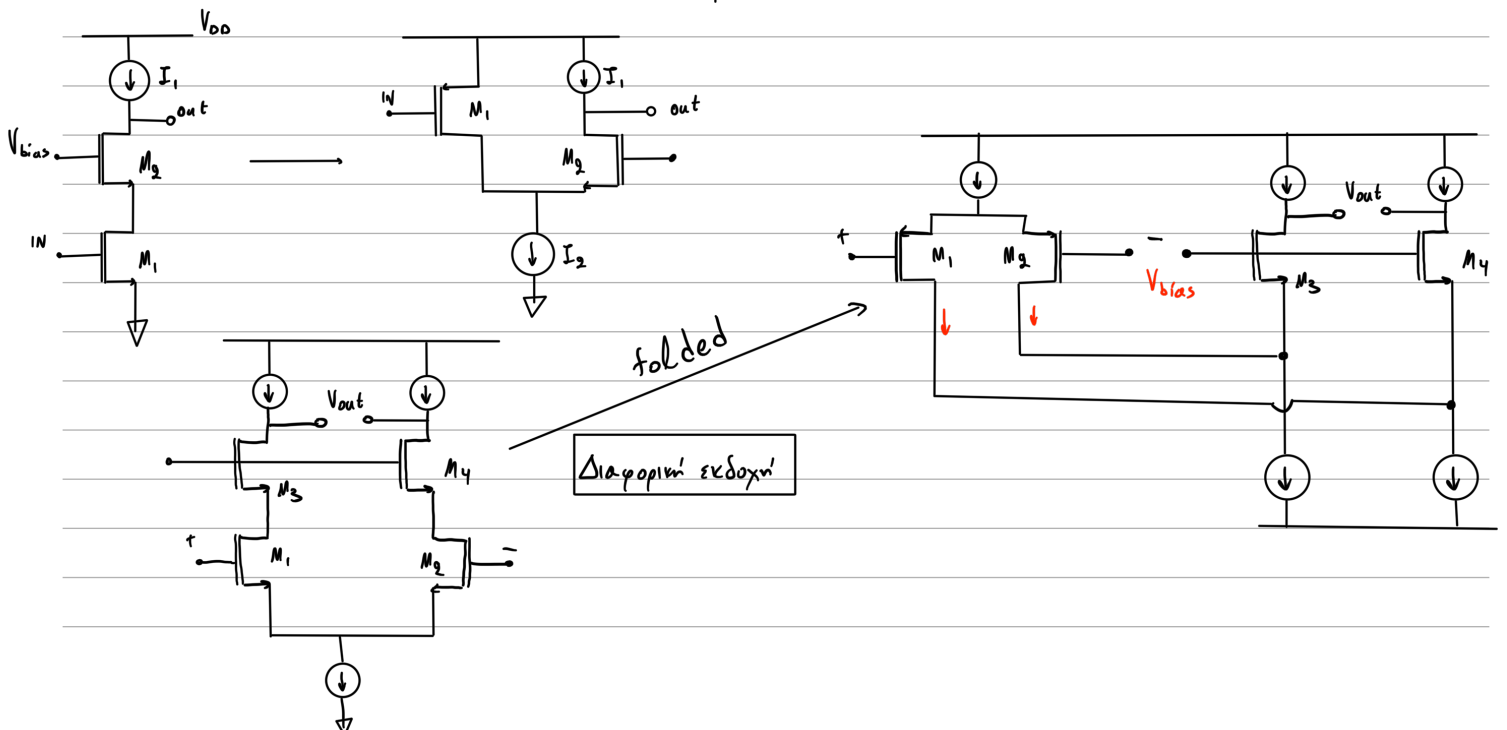
$$\Delta \pi \lambda \sigma \iota \acute{\alpha} \zeta \omega \ W, L \ M_5 - M_8 \ \sigma \tau \acute{o} \tau \epsilon \ A_0 = 4000$$

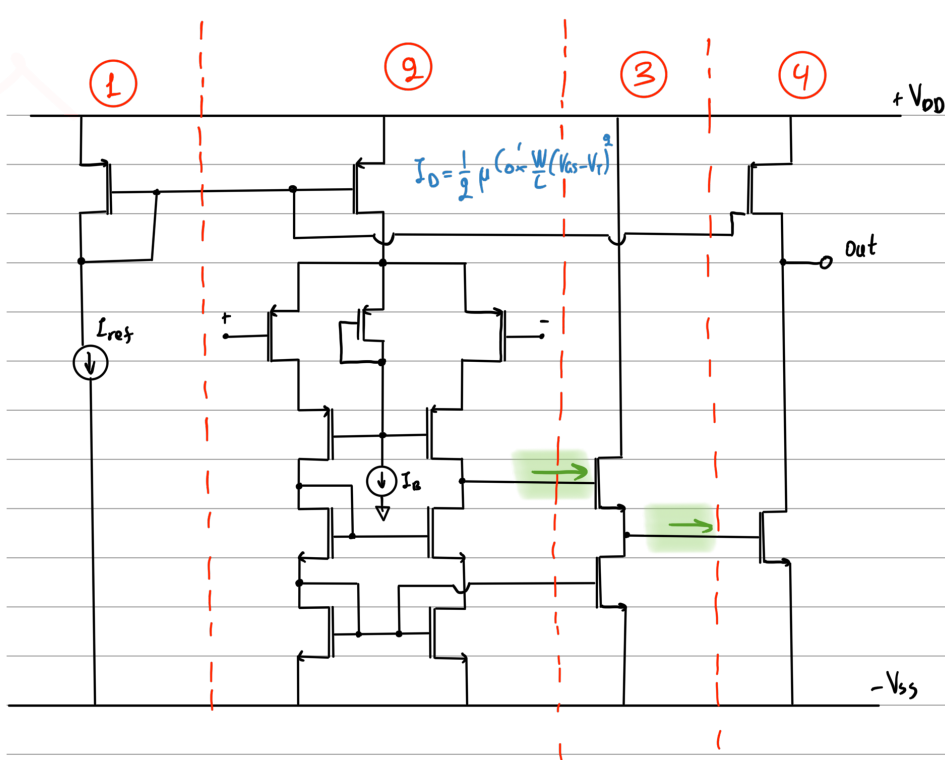
$$V_{b1}^{(min)} = V_{as3} + V_{ov1} + V_{ov9} \quad \underline{V_{as} = V_{ov} + V_T} \quad V_{ov3} + V_{Th} + V_{ov1} + V_{ov9} = 1,6V$$

$$V_{b2}^{(max)} = V_{DD} - (|V_{as5}| + |V_{ov7}|) = 1,7V$$

$$H_{min} \text{ (Μ διαφ. ζεύγους): } V_{as1} + V_{ov9} = 1,4V$$

Folded cascode amplifier



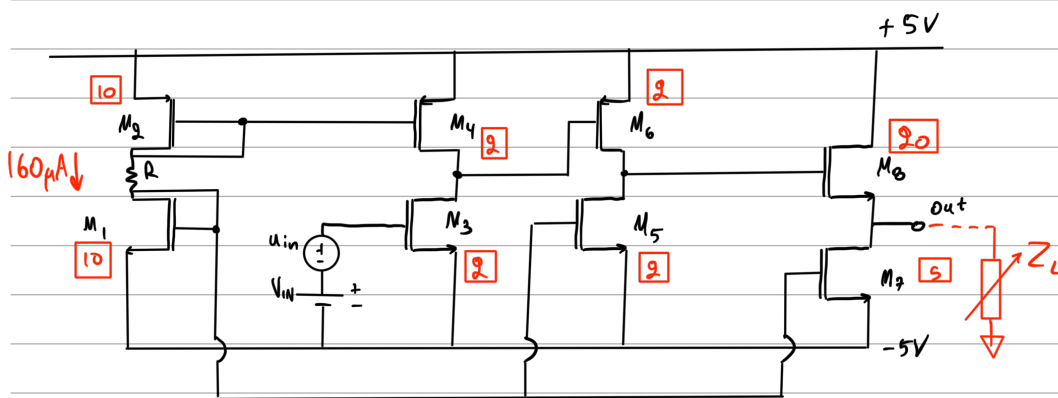
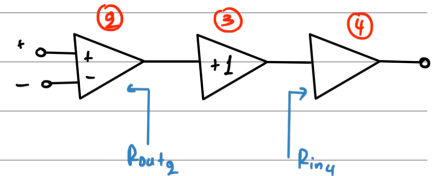


①: PMOS καθρέυσμα ρεύματος

②: Διαρ. cascode ενισχυτής με μετατροπή διαρ. σημ. σε απλό

③: ακόλουθος πηγής (buffer)

④: (CMOS) inverter



Δίνονται: $L_n = 6 \mu m$
 $L_p = 30 \mu m$, $V_{AN} = 90V$
 $|V_{Ap}| = 90V$, $k_n' = 34 \mu A/V^2$
 $k_p' = 11 \mu A/V^2$, $V_{out} = 0V$
 $V_{in}?$

$$I_{D1} = I_{D2} = 160 \mu A$$

$$I_{D3} = I_{D4} = 32 \mu A$$

$$I_{D5} = I_{D6} = 32 \mu A$$

$$I_{D7} = I_{D8} = 80 \mu A$$

Το V_{GS3} προκύπτει από το I_{D3} κ.ο.κ.