

Lec 28

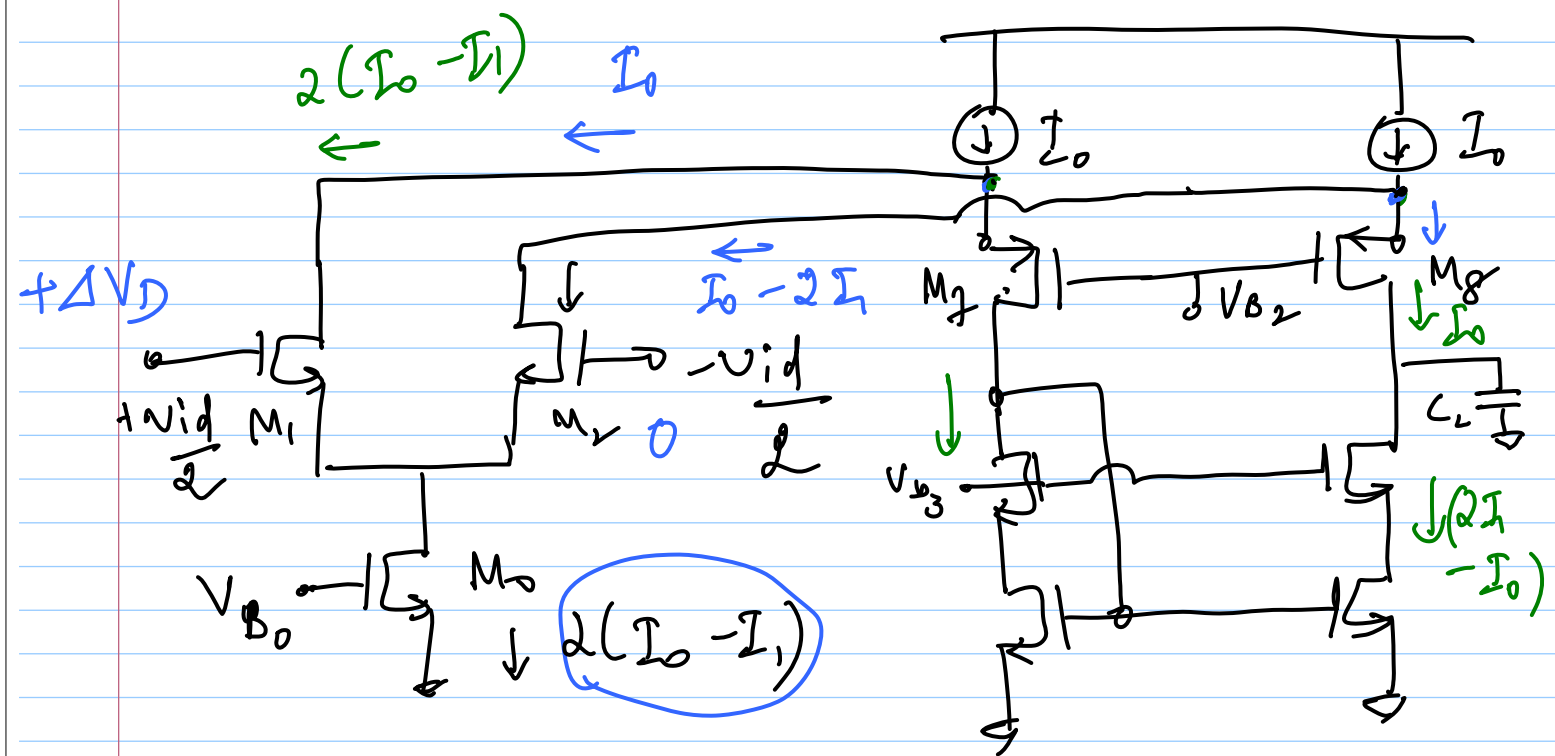


$$I_{\text{out}} = (2I_0 - 2I_1)$$

b) $2\mathbb{Z} < \mathbb{Z}$

$$I_0 = 4 \text{ mA} \quad , \quad I_1 = 1 \text{ mA}$$

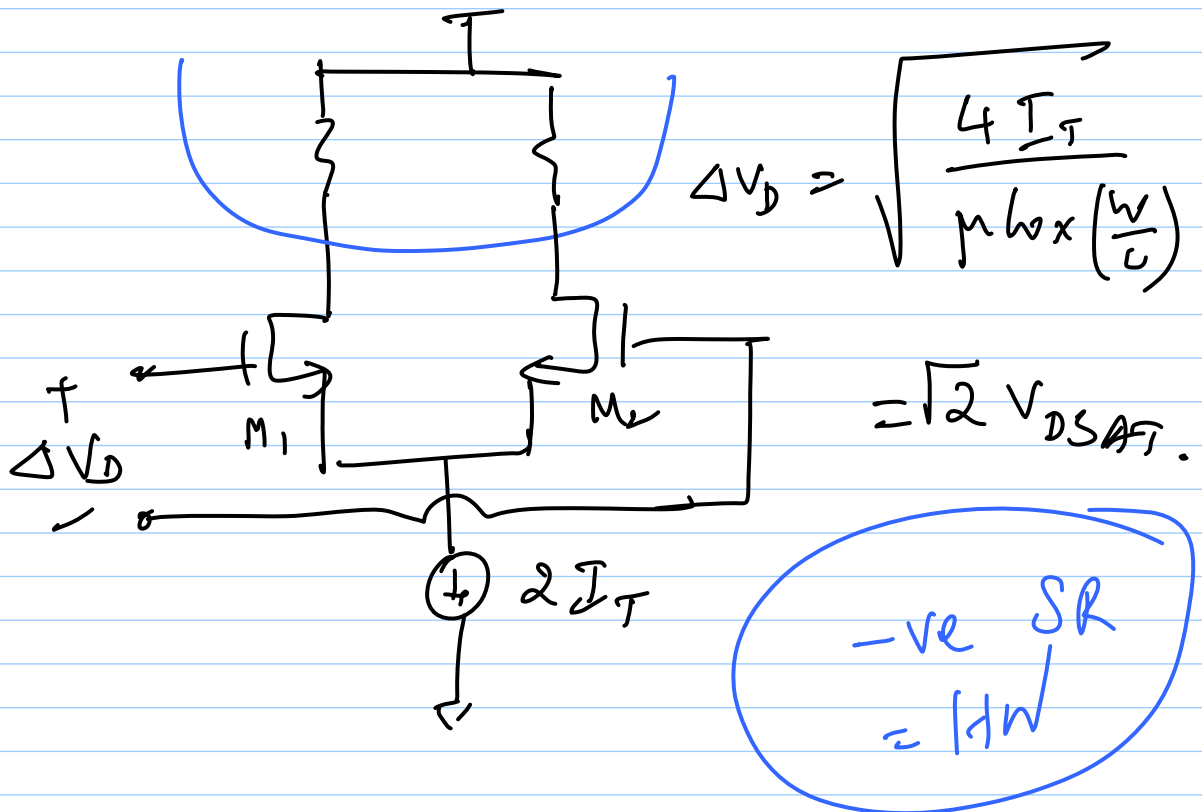
$$L_{\text{out}} = I_0 - I_2 = 2 I_1$$



$$I_1 = I_0 - I_{M1} = (2I_1 - I_0)$$

$$I_{out} = 2I_0 - 2I_1$$

$$I_{M8} = I_0 - I_{M2} = 2I_1$$



Novel

$$\overline{v}_{n, \text{in}}^2 = \frac{16kT}{3} \cdot \frac{1}{g_{m1}} + \frac{16kT}{3} \frac{g_{m3}}{g_{m1}^2}$$

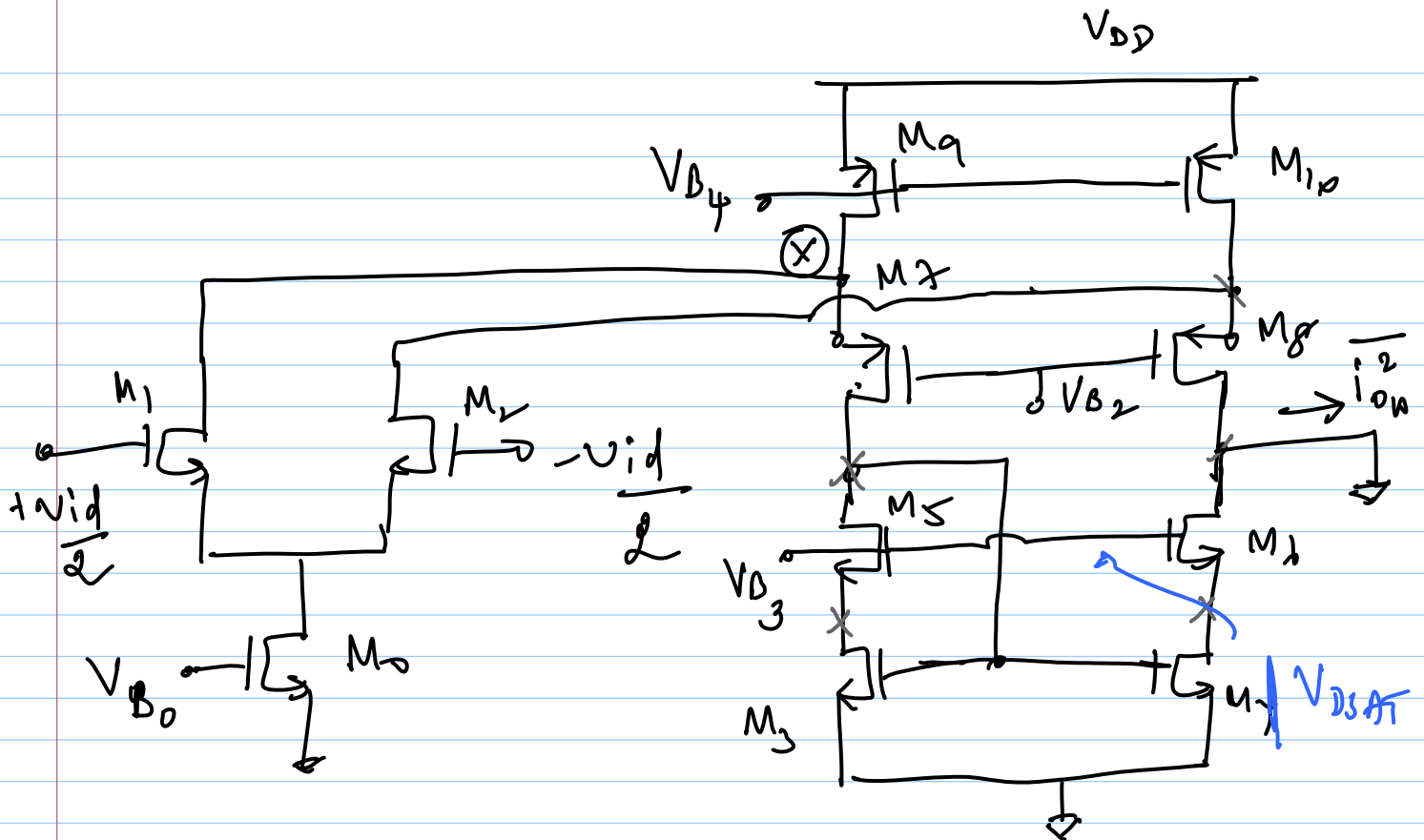
Noise is probably worse than that of Telesopic

a) $v_{n, M, 2}$

$$= \frac{16kT}{3} \cdot \frac{1}{g_{m,1}} \left[1 + \frac{g_{m,3}}{g_{m,1}} + \frac{g_{m,9}}{g_{m,1}} \right]$$

b) $\overline{v_n}, m_{3,4}, 9, 10$

c) No noise from M_{5-8} @ low freq.



6) Offset voltage

→ worse than telescopic

7) Output swing limits

$$(V_{DSAT3} + V_{DSAT5}) \leq V_{out} \leq (V_{DD} - V_{DSAT8} - V_{DSAT10})$$

better

8) Input CM range

$$V_{CM, in, (min)} = V_{DSAT2} + V_{A51}$$

$V_{CM, in}$ (max.)

$$V_{DD} - V_{DSAT9} + V_T \geq V_{DD}$$