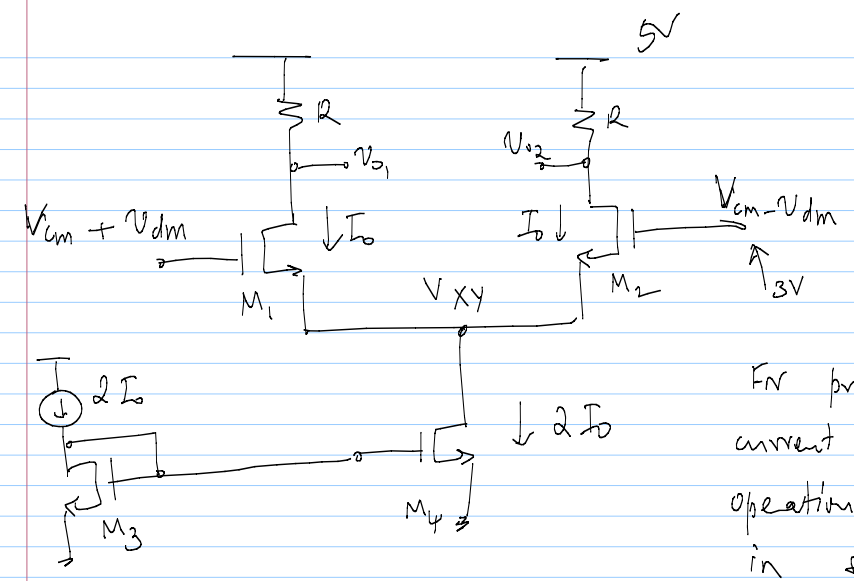
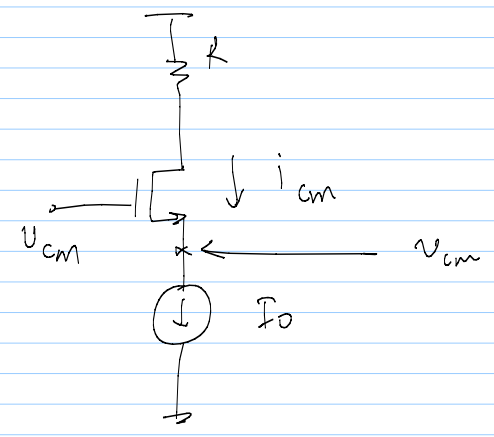


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For proper current source operation: M_4 is in sat.

$$V_{xy} \geq V_{sat4}$$

$$V_{cm} \geq \frac{V_{DSAT4}}{2I_0} + V_{AS,1,2} \Big|_{I_0}$$

$$V_{cm} \geq \frac{V_{DSAT4}}{2I_0} + V_{T,1,2} + \frac{V_{DSAT,1,2}}{I_0}$$

$$V_{D,cm} = V_{DD} - I_0 R$$

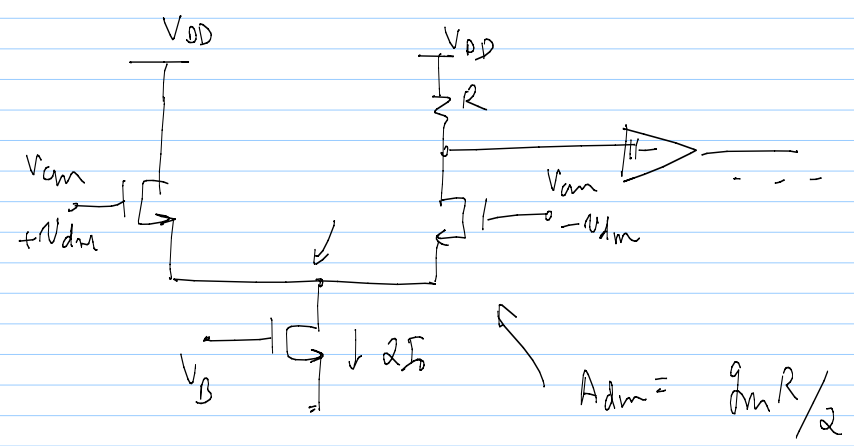
$$V_{cm} \leq V_{DD} - I_0 R + V_{T,1,2}$$

Input common-mode range:

$$\left\{ V_{AS,1,2} + V_{DSAT4}, V_{DD} - I_0 R + V_{T,1,2} \right\}$$

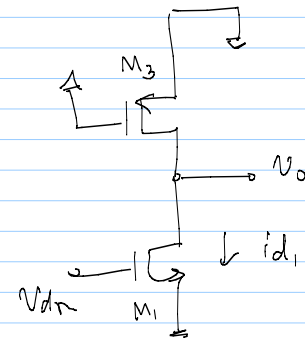
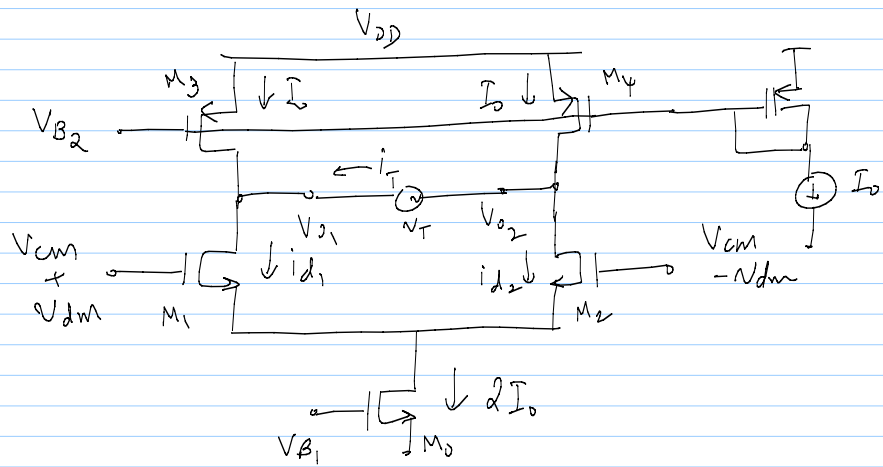
↑ gain ⇒ active load

single-ended o/p ⇒



$$A_{dm} = g_m R / 2$$

issues : lower DM gain , lower CMRR
 waiting help the DC power



$$i_{d1} = g_m v_{dm}$$

$$\frac{v_{o1}}{v_{dm}} = -g_m (r_{ds1} \parallel r_{ds3})$$