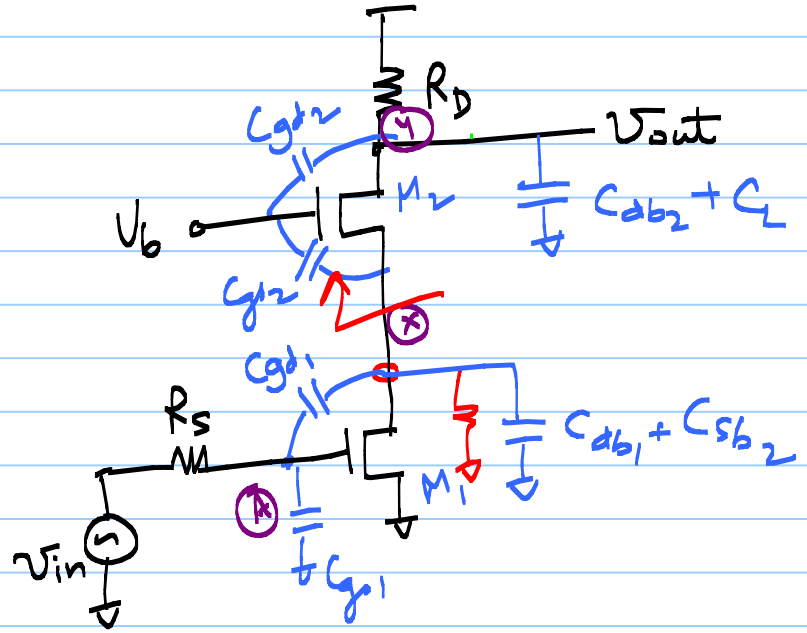
ECE 511 — Lecture 18

Note Title 4/4/2011



$$A_v = -g_{m_1}\left(R_D \| g_{m_1} r_{o_2}\right)$$

gain from (A) to (X)

↳ Assuming low value of R_D

$$-g_{m_1} \times \left(\frac{1}{g_{m_2} + g_{mb_2}} \| \cancel{r_{o_1}}\right)$$

$$\simeq -\frac{g_{m_1}}{g_{m_2}} \simeq -1$$

$\Rightarrow C_{gd_1}$ is only multiplied by 2x, instead of $|A_v|$

$\Rightarrow$ Miller effect is less significant in cascode amplifiers.

$$\omega_{pA} = \frac{1}{R_S\left[C_{gs_1} + \left(1 + \frac{g_{m_1}}{g_{m_2} + g_{mb_2}}\right) C_{gd_1}\right]} \longrightarrow (1)$$

$$\omega_{py} = \frac{1}{R_D\left[C_{db_2} + C_L + C_{gd_2}\right]}.$$

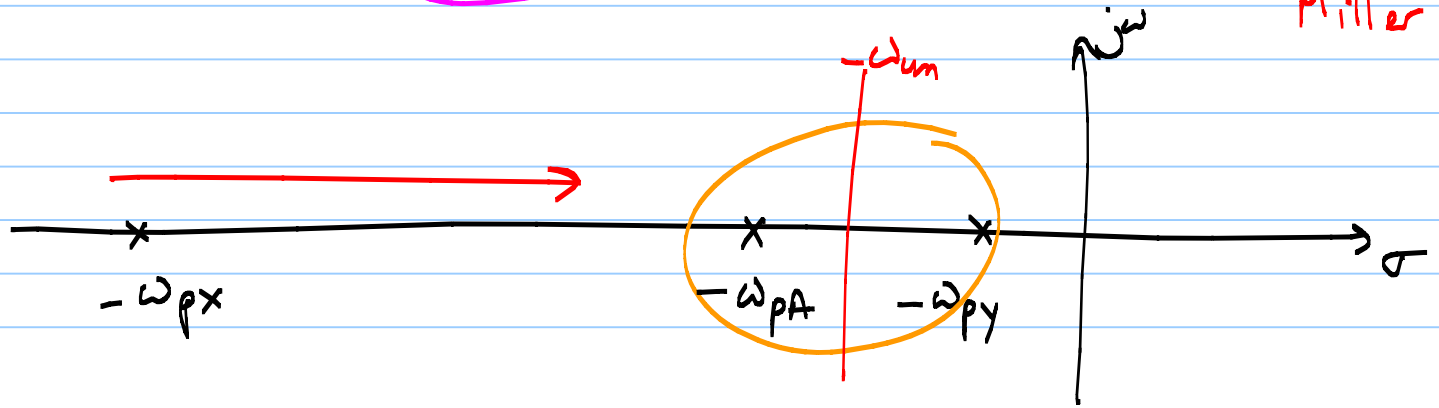
Δ pole @ node ⊗

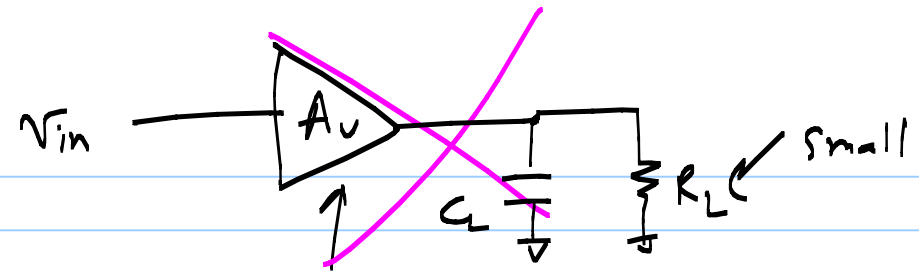
$$C_x = 2C_{gd_1} + C_{db_1} + C_{sb_2} + C_{gs_2}$$

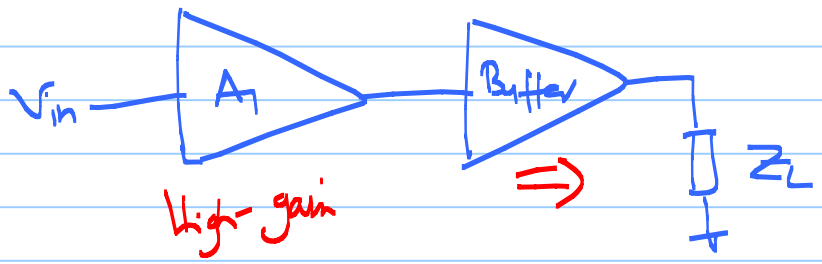
$$\omega_{px} = \frac{1}{\left(\frac{1}{g_{m_2} + g_{mb_2}}\right)\left[2C_{gd_1} + C_{db_1} + C_{sb_2} + C_{gs_2}\right]}$$

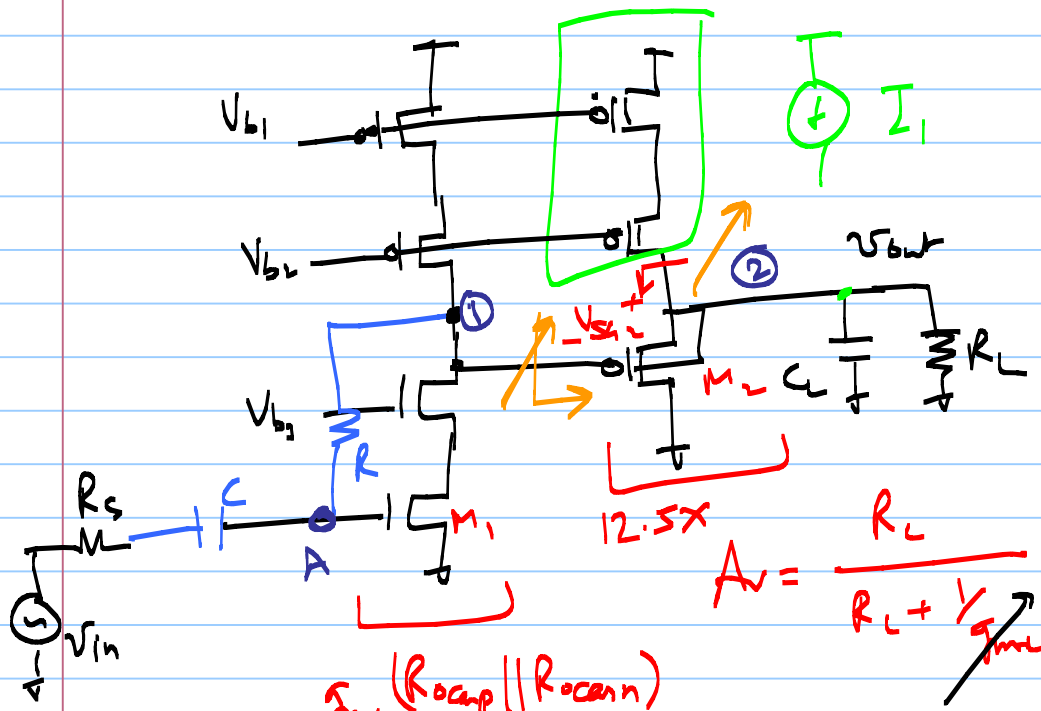
R_x

"Miller killer"




V_{in}
A_v
C_L
R_L
Small


V_{in}
A_1
Buffer
Z_L
High-gain



$\frac{I_1}{C_L}$

$C_{gs}(1 - A)$

Class - A

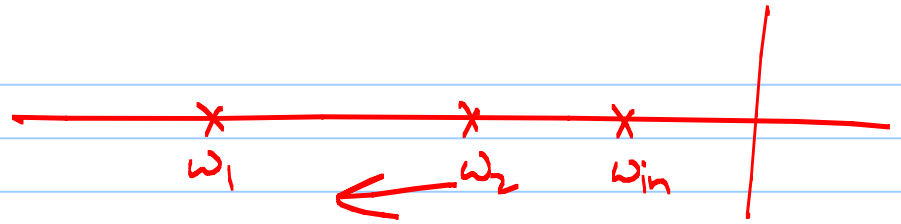
$R_L >> \frac{1}{g_{m2}}$

$\omega_{in} = \frac{1}{R_S C_{in}}$

$\omega_1 \Leftarrow \frac{1}{R_{ca} \cdot C_{small}}$

$\omega_2 \Leftarrow \frac{1}{R_{low} \cdot C_L}$

$\frac{1}{g_{m2}}$



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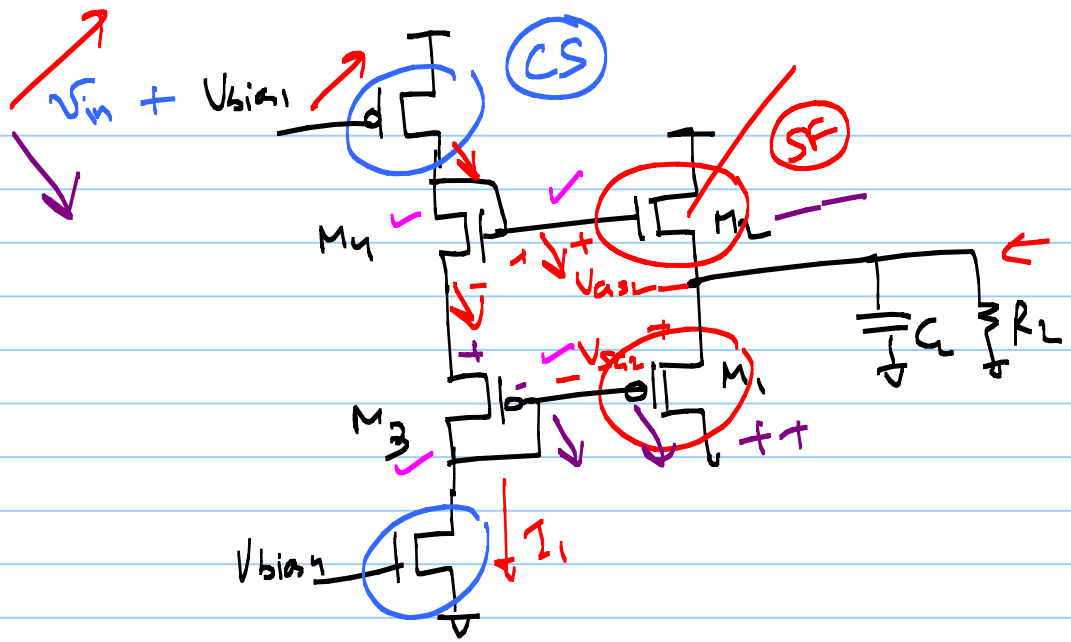
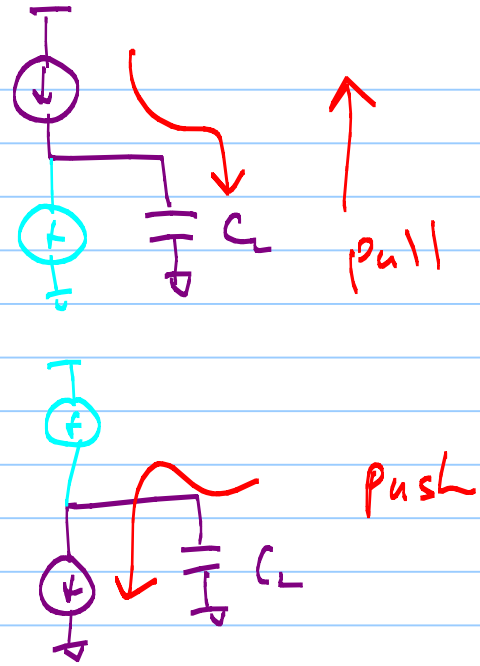
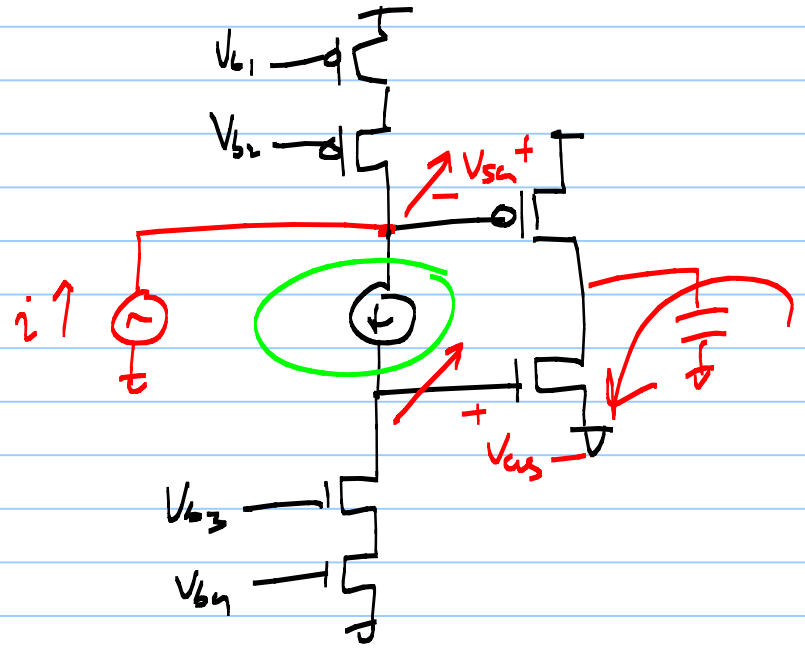
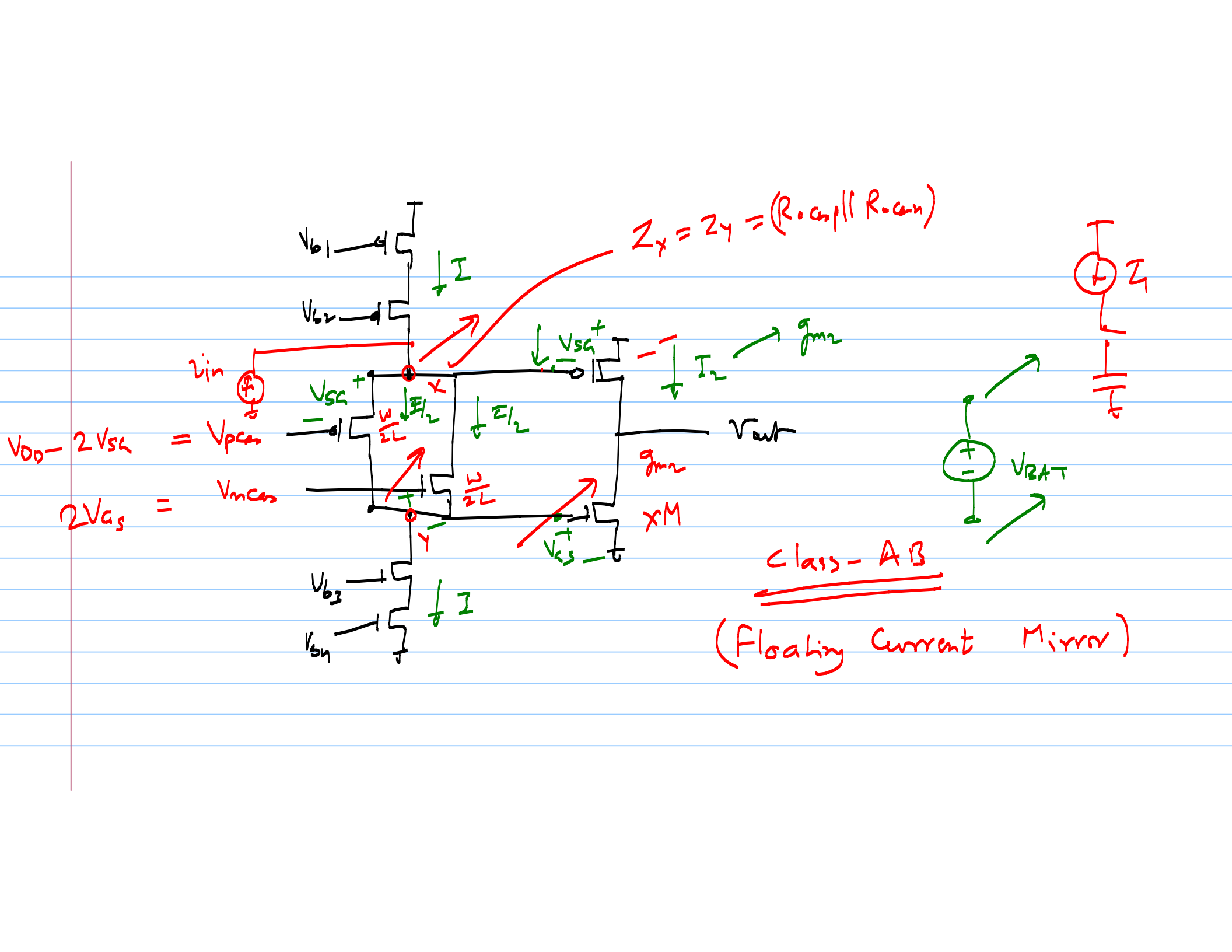

v_{in} + V_{bias1}
CS
SF
M_4
M_2
V_{GS2}
V_{SG2}
M_1
M_3
C_L
R_L
V_{bias2}
I_1


C_L
pull
push
C_L

Class- AB

Push-pull Amplifier




V_{b1}
V_{b2}
V_{b3}
V_{bn}
I
i_{in}
V_{SG}
V_{SG}
$I/2$
$I/2$
I_2
g_{m2}
g_{mn}
V_{out}
$\frac{W}{2L}$
$\frac{W}{2L}$
xM
X
Y
V_{GS}
$Z_x = Z_y = (R_{o,cap} \| R_{o,can})$
$V_{DD} - 2V_{SG} = V_{pcas}$
$2V_{GS} = V_{ncas}$
V_{BAT}
Z
Class - AB
(Floating Current Mirror)

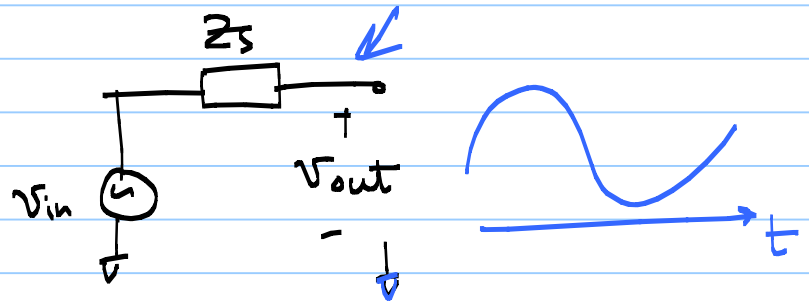
$$PCE = \frac{P_{load}}{P_{VDD}} \times 100\ \%$$

Class A $\rightarrow$ 12.5 %

Class AB $\longrightarrow$ 100 %

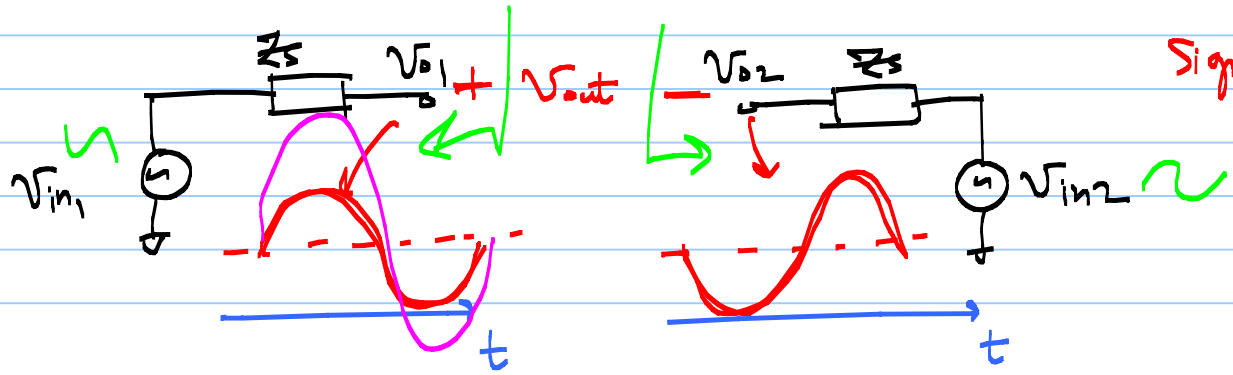
Class B $\longrightarrow$ "switchover distortion"

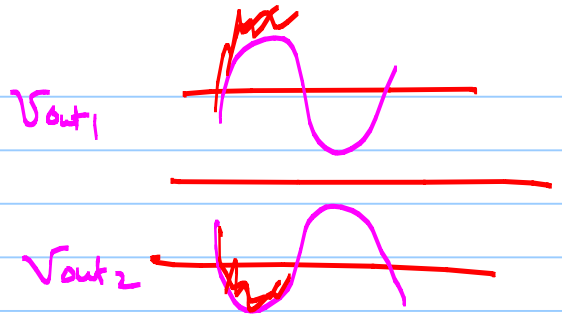
"Differential Amplifiers"



Single-ended is referenced to a fixed voltage → ground.

⇒ The center potential in differential Signaling is called "Common-mode" CM-level.

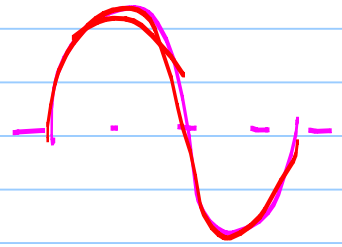


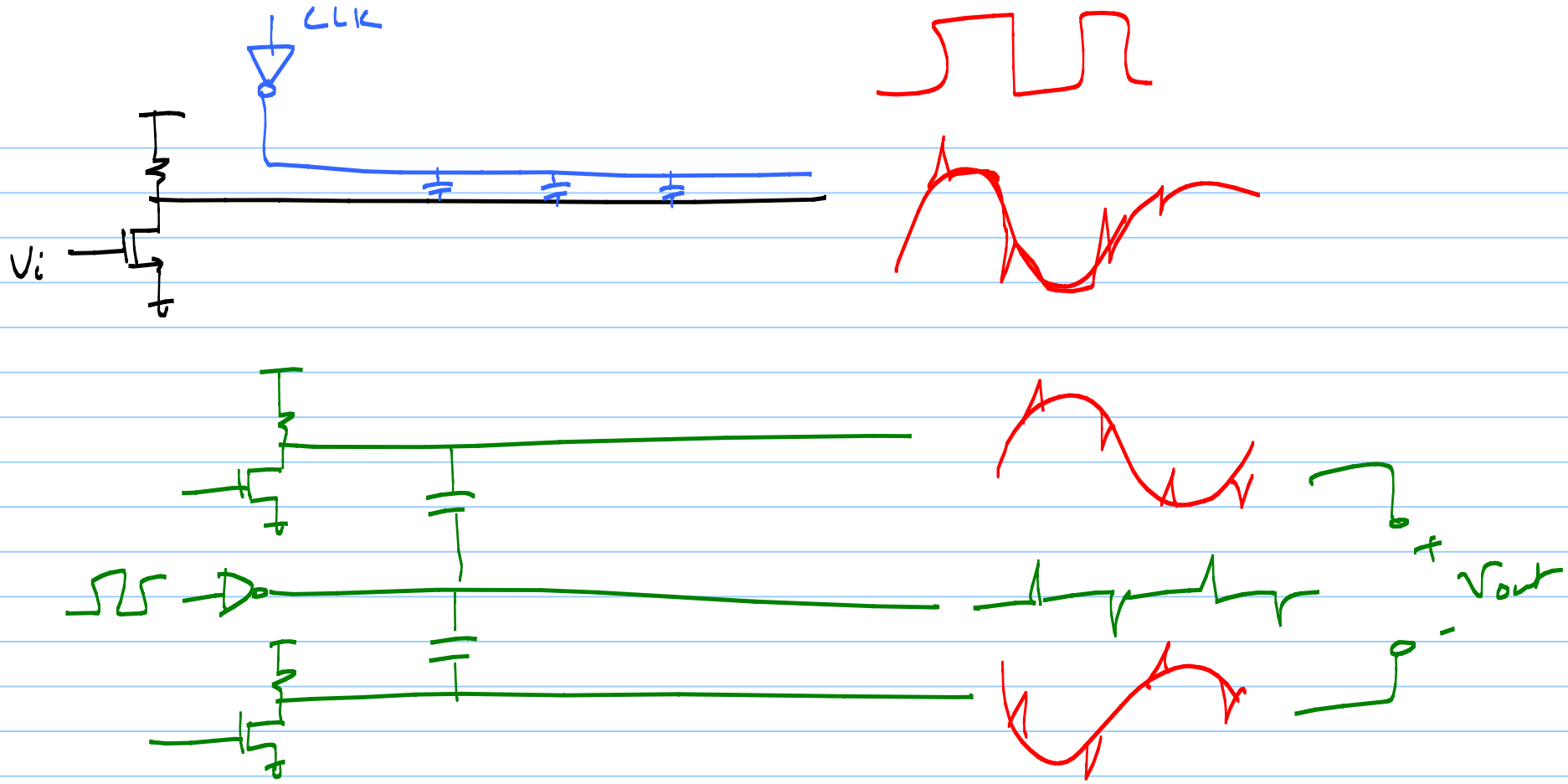


$$V_{CM} = \frac{V_{out_1} + V_{out_2}}{2}$$

$$V_d = V_{out} = (V_{out_1} - V_{out_2})$$

$$V_{out} = V_{out_1} - V_{out_2}$$




CLK
Vi
+
Vout
-

⇒ Common-mode disturbance rejection

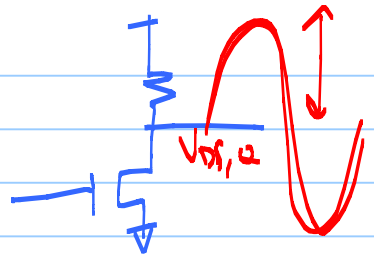
↳ differential output is still intact

→ CM-level is disturbed.

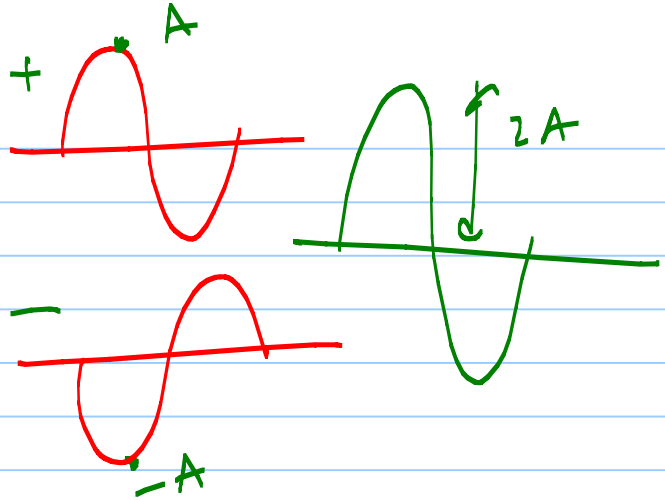
* Supply noise is rejected.

* Swing is effectively doubled!

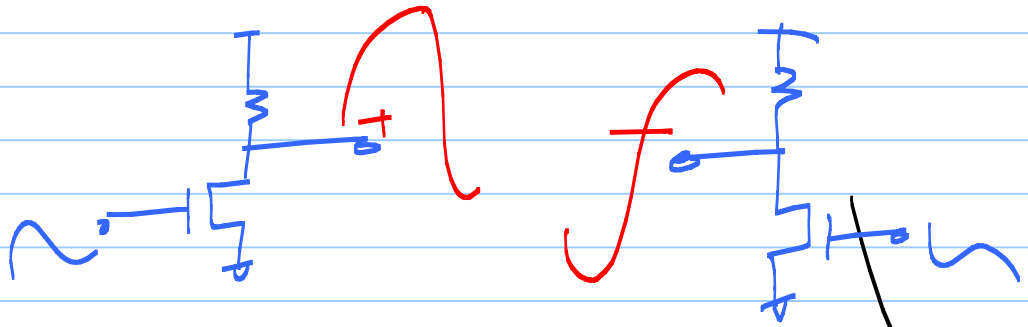
SE



$$\frac{(V_{DD} - V_{DS,sat})}{2} = A$$



$$(V_{DD} - V_{DS,sat})$$



* Biasing is simplified.