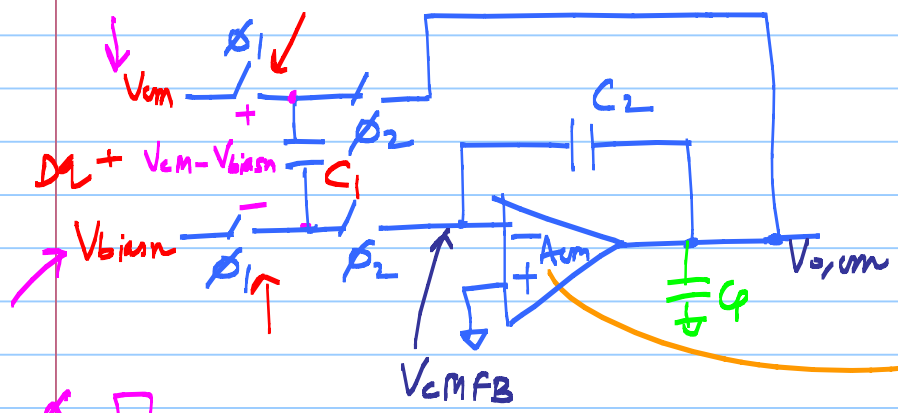
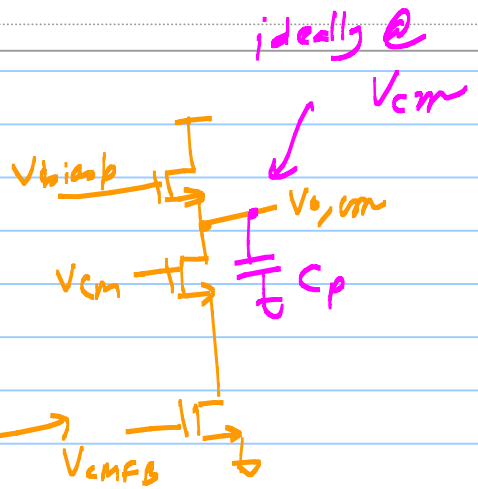
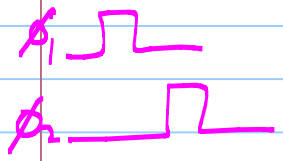
ECE 614 – Lecture 8

Note Title 9/20/2012

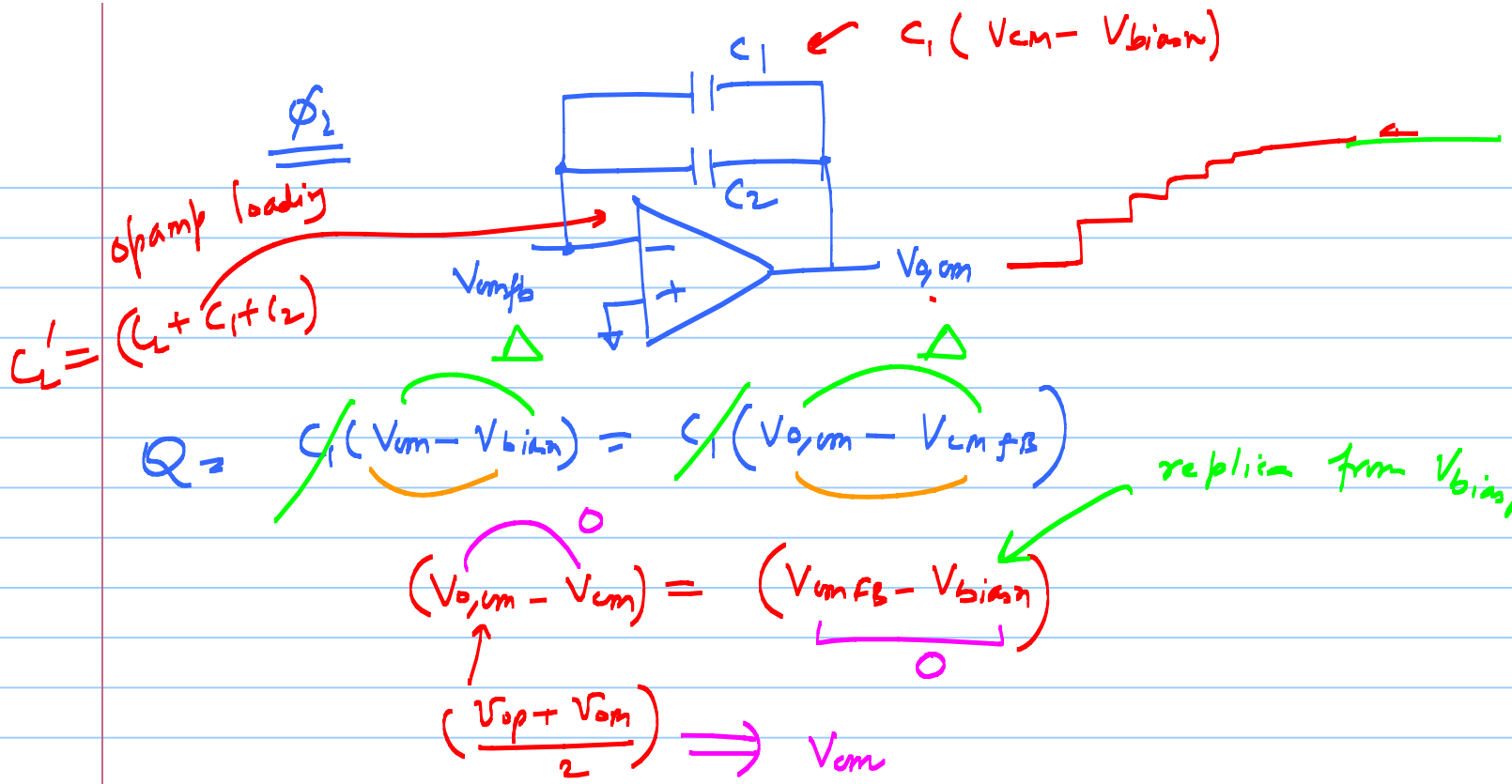
CM Equivalent Circuit







$Q = C_1(V_{cm}-V_{biasn})$



$$Q = C_1 (V_{cm} - V_{biasn}) = C_1 (V_{o,cm} - V_{cmfb})$$

replica from V_{biasp}

$$(V_{o,cm} - V_{cm}) = (V_{cmfb} - V_{biasn})$$

0 $\qquad$ 0

$$\left(\frac{V_{op} + V_{om}}{2}\right) \Longrightarrow V_{cm}$$

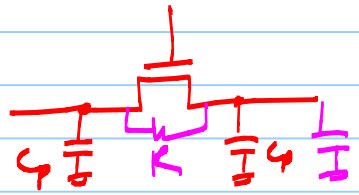
(+) o/p voltage swing is not limited by CM-detector

Caps don't load the o/p and kill the gain

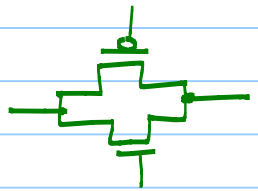
* $(C_1+C_2) < 10\%$ of C_2

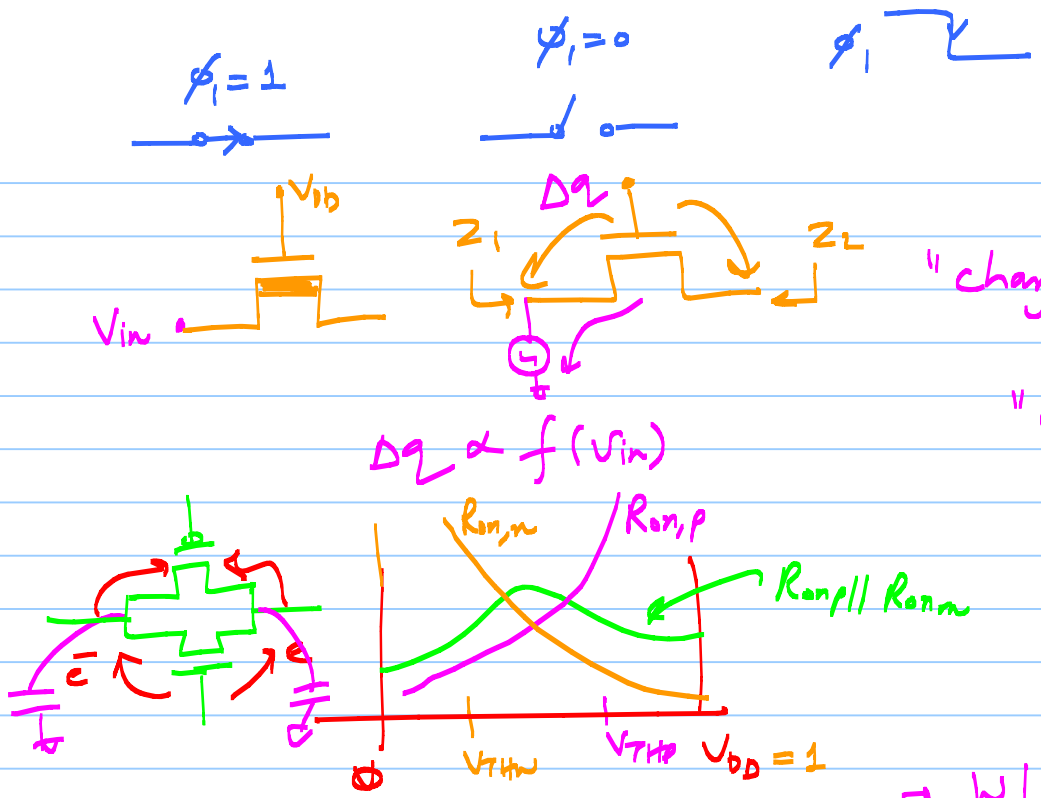
(+) looks like single-pole system

"DT"



$R_C << T_{\phi/2}$





"charge injection"

↓

"error"

↳ DC

↳ distortion

$\Delta q \propto f(V_{in})$

$\Rightarrow W_b \Rightarrow R_{on} \uparrow$

$\tau = R_{on} C_1$

$\Rightarrow W \uparrow \Rightarrow \Delta q \uparrow$

* make Δq independent of $V_{in} = V_{inp} - V_{inm}$

  * TG
  * fully-differential circuit

* MOS transistor switches inject charge into $C_1 \rightarrow \Delta q$

$$\Rightarrow C_1(V_{cm} - V_{biasn}) = C_1(V_{o,cm} - V_{cmFB}) + \Delta q$$

W ↓

$$\Rightarrow (V_{cm} - V_{o,cm}) = (V_{biasn} - V_{cmFB}) + \frac{\Delta q}{C_1}$$

offset in o/p cm-level

$V_{cm} = \frac{V_{op} + V_{om}}{2}$

$V_{biasn} - V_{cmFB} = 0$

increase C_1

$$V_{o,cm}[\infty] = \frac{V_{cm} + \left[\left(1 + \frac{C_{p1}}{C_1}\right)\left(V_{cmfb} - V_{bias}\right)\right] - \frac{\Delta q_1}{C_1} + \frac{(I_{j1} + 2I_{j2})T}{2C_1}}{1 + \left(\frac{1}{A_m}\right)\left(1 + \frac{C_{p1}}{C_1}\right)}$$

min, min, large

Dr $\Rightarrow$

$A_m \rightarrow$ large

No C_2 !

$$N_r = \simeq \left[1 - \frac{1}{A_m} \cdot \left(1 + \frac{C_{p1}}{C_1}\right)\right].$$

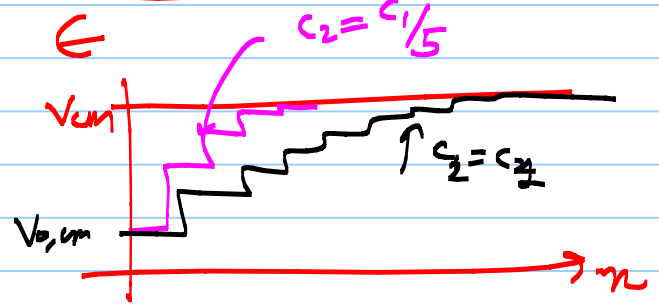
DT

Settling time $\Rightarrow t_s \propto \frac{C_1}{C_2}$

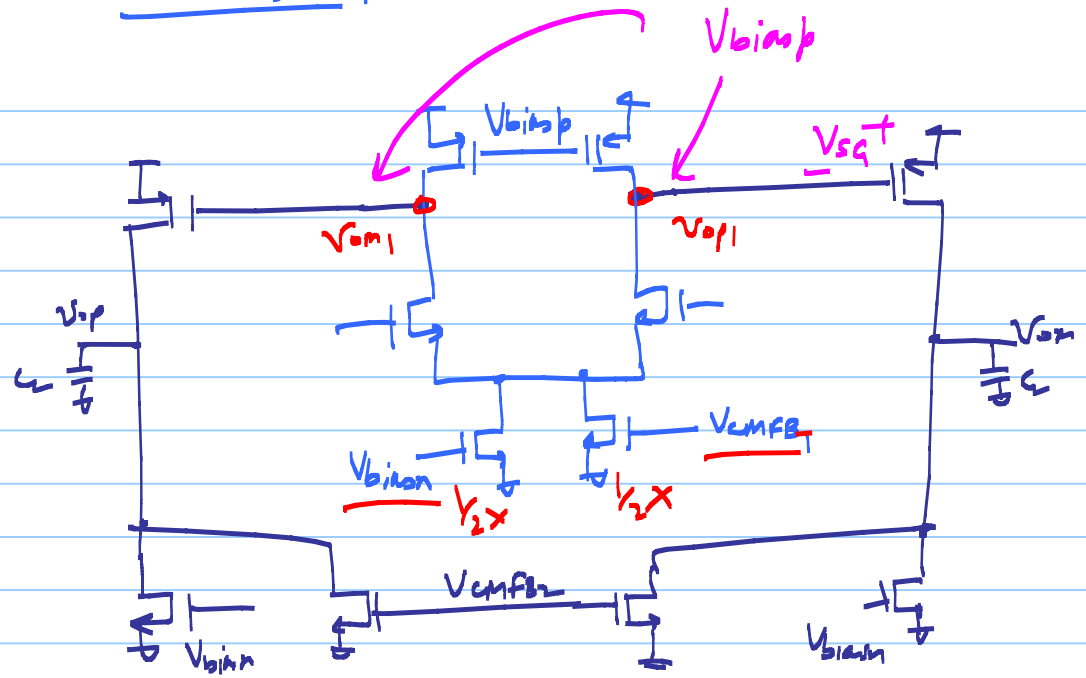
$C_1 = 5$ to $10\times$ of C_2

$C_2 = 10fF$

$C_1 = 50ff$

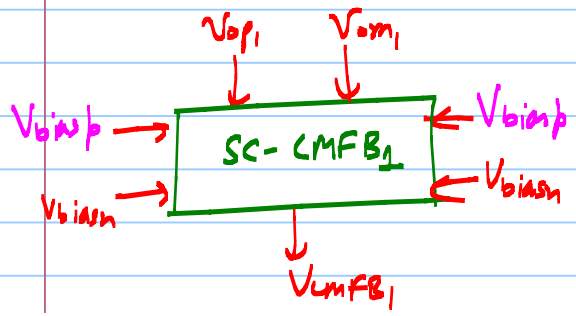


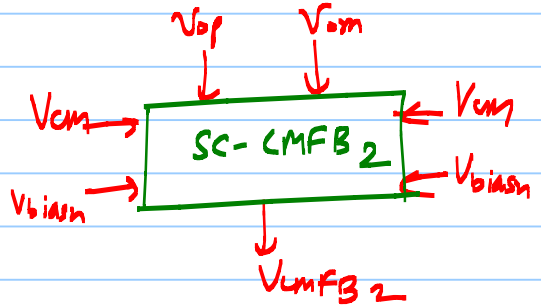
Two-Stage

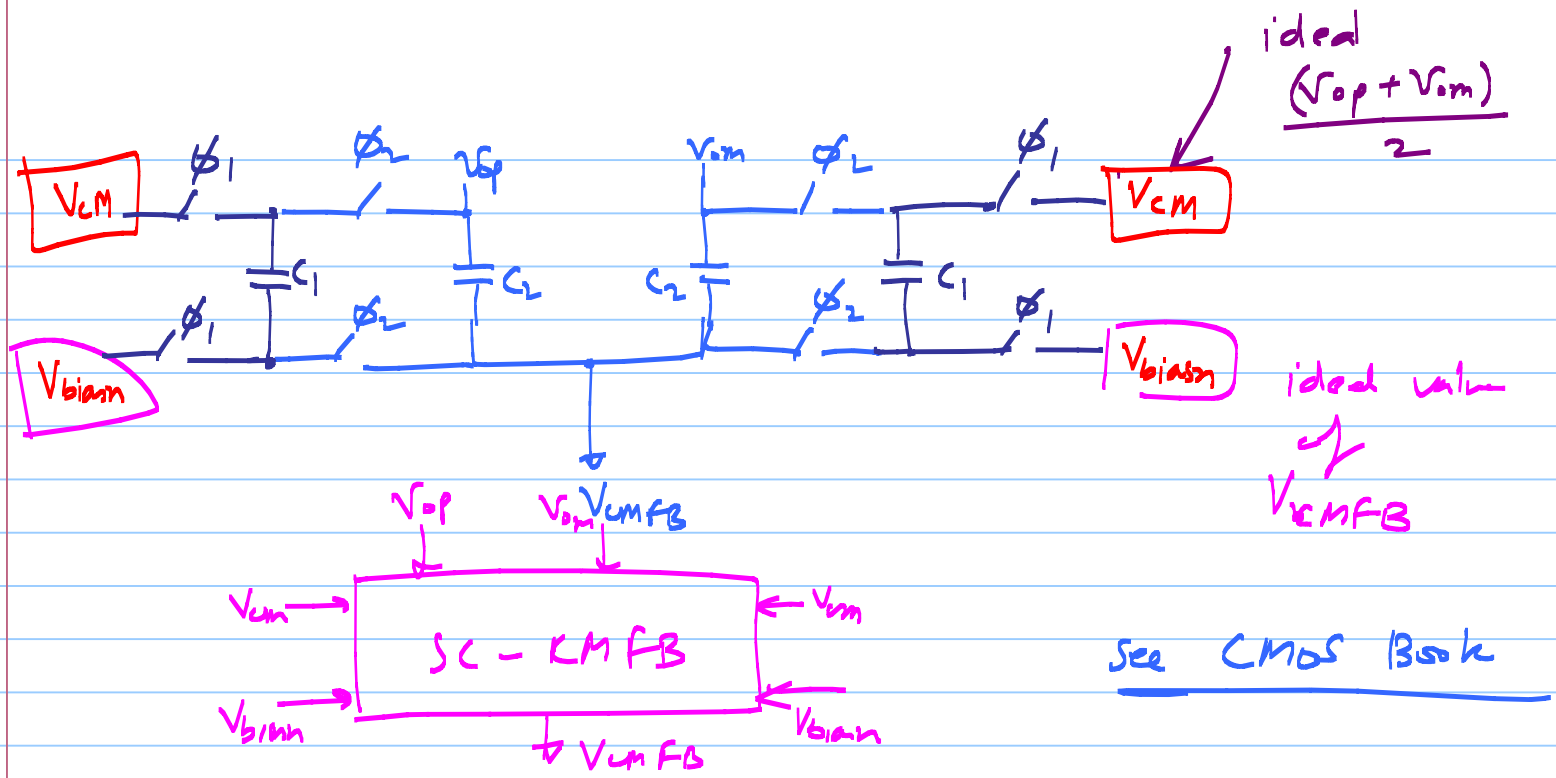


Run Sim

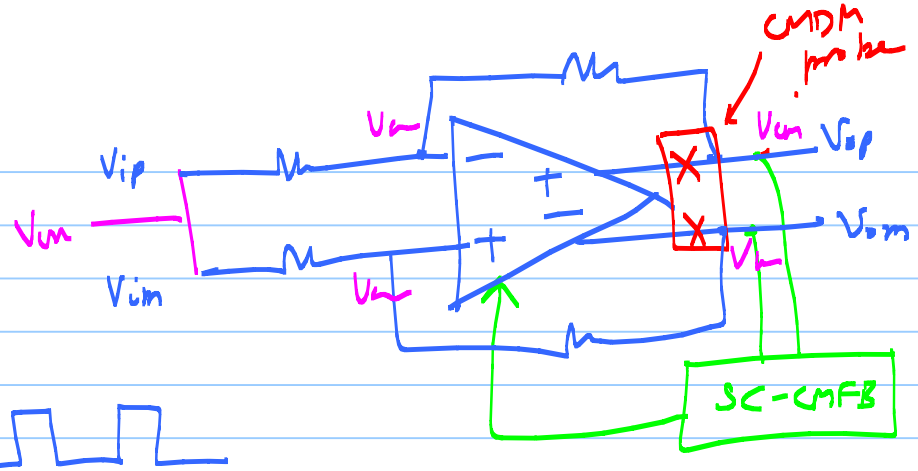
{ 26.55
  26.57







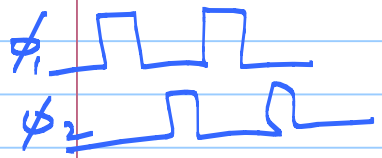
See CMOS Book



* Can I use SC-CMFB here ??

↳ need symmetric loading of opamp.

In both phases → $(C_1 + C_2)$



OL response ??

* NO DC operating point here!

↳ have a periodic steady state

SpectreRF → * PSS ← .op

PSTB ← STB

PAC, PXF, PNOISE, PDIST

Noise

Random process