

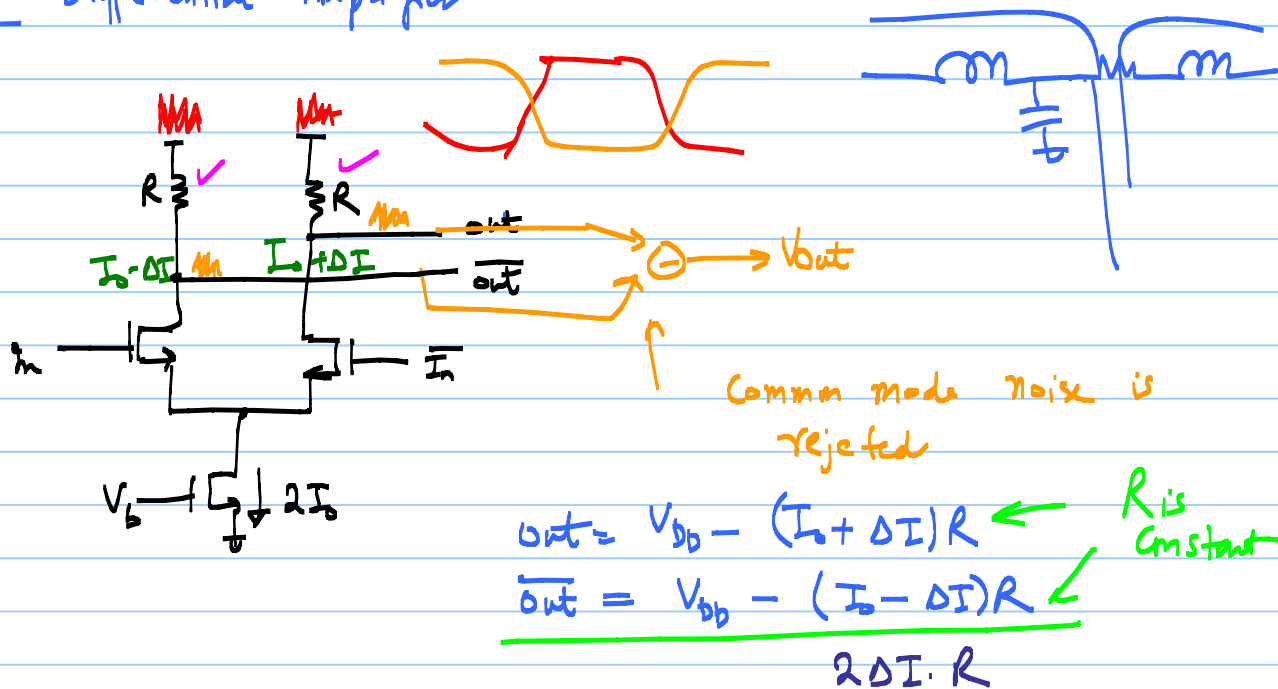
ECE 518- Lecture 20

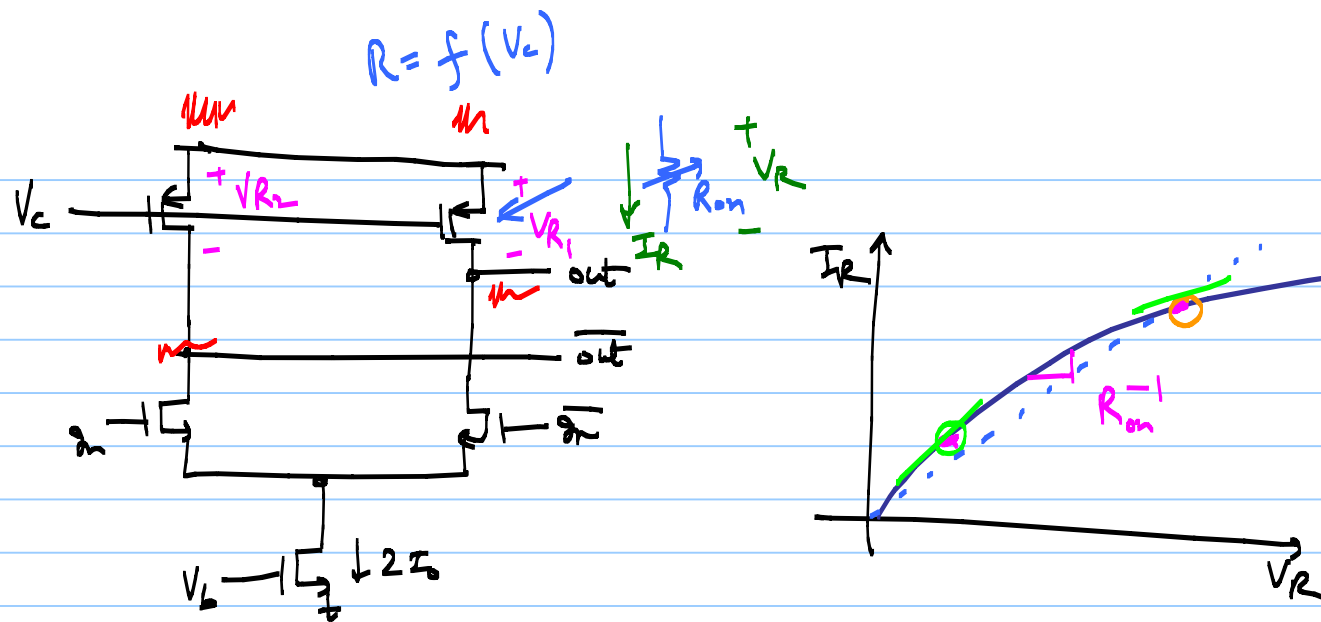
Note Title

4/4/2013

Power Supply Rejection :

Example: Differential Amplifier

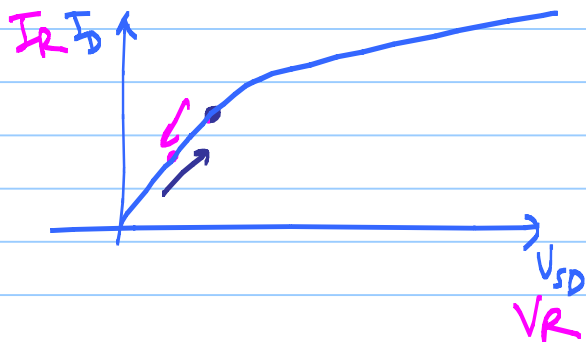
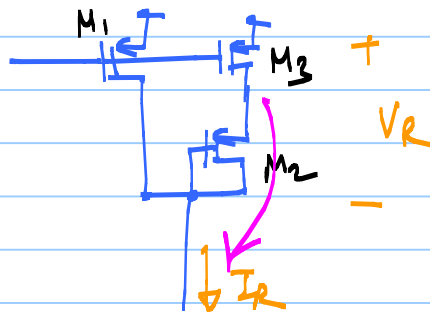
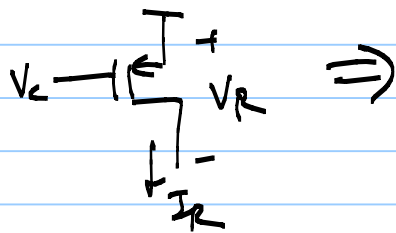




The non-linear resistors convert supply noise to differential output noise.

$$\rightarrow \text{for PSRR} = \frac{A_{diff} \frac{\partial V_{out}}{\partial V_{in}}}{\frac{\partial V_{out}}{\partial V_{DD}}} = A_{VDD}$$

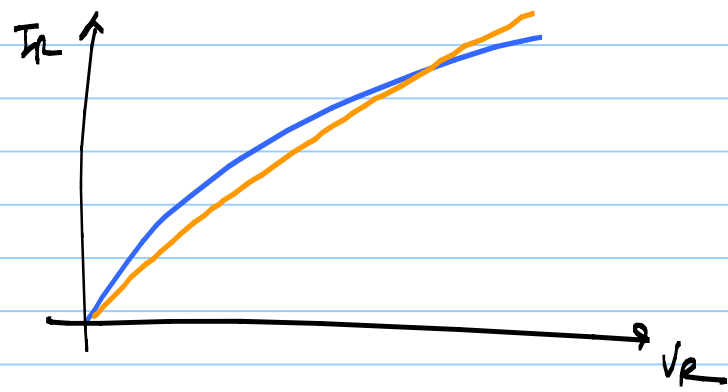
Improved V-I linearity loads



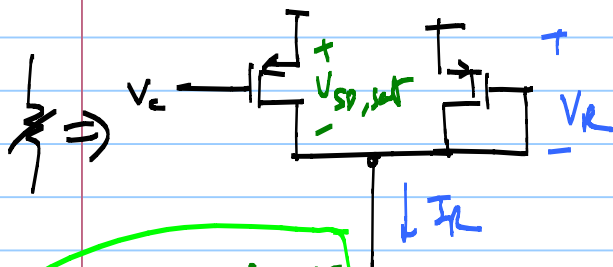
When M_1 starts saturating

↳ pull current through M_2

↳ extends the linear range of M_1



Symmetric loads $\rightarrow$ Mance's Cell.



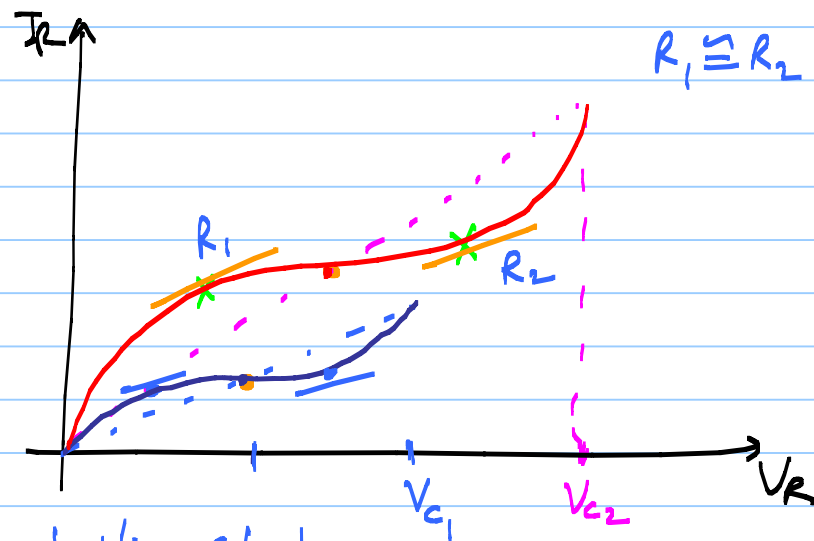
$$V_{SD} - V_{THP} < V_{SD,sat}$$

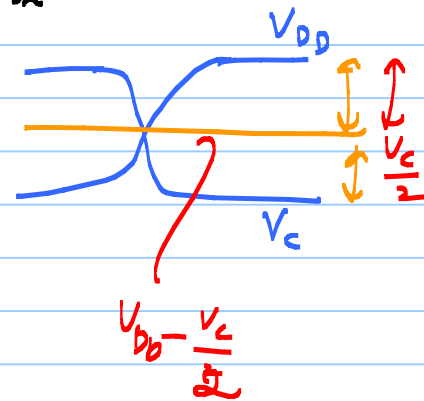
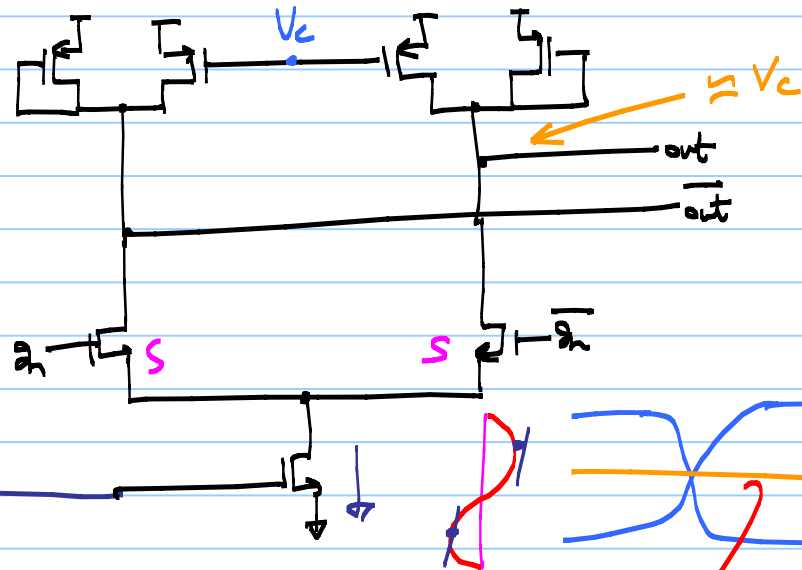
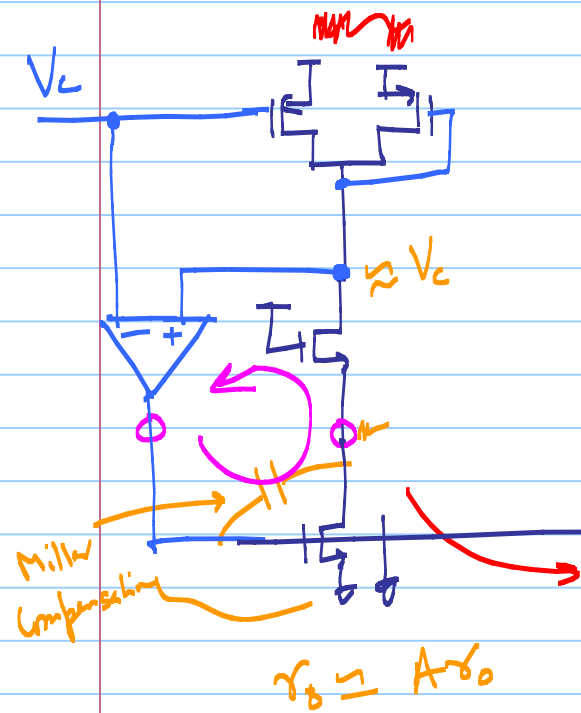
$$(V_{DD} - V_c) < V_{SD,sat} + V_{THP}$$

Symmetric I-V characteristics about the center of voltage swing

$\rightarrow$ nominally equal resistors in the delay cell
 $\rightarrow$ better PSRR

$\rightarrow$ Need to limit the output swing to V_c .

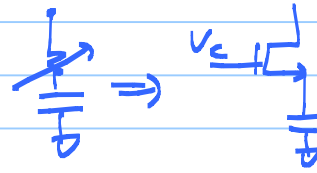
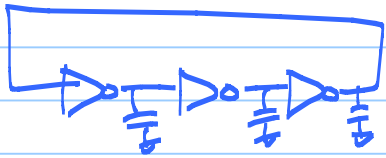




Disadvantages:

- (+) Excellent PSRR
 - (+) Wide tuning range
SX
- (-) Limited output swing
→ need a VCO buffer
 - (-) Power
 - (-) Noise → more devices are in saturation

Large-Swing Vcos

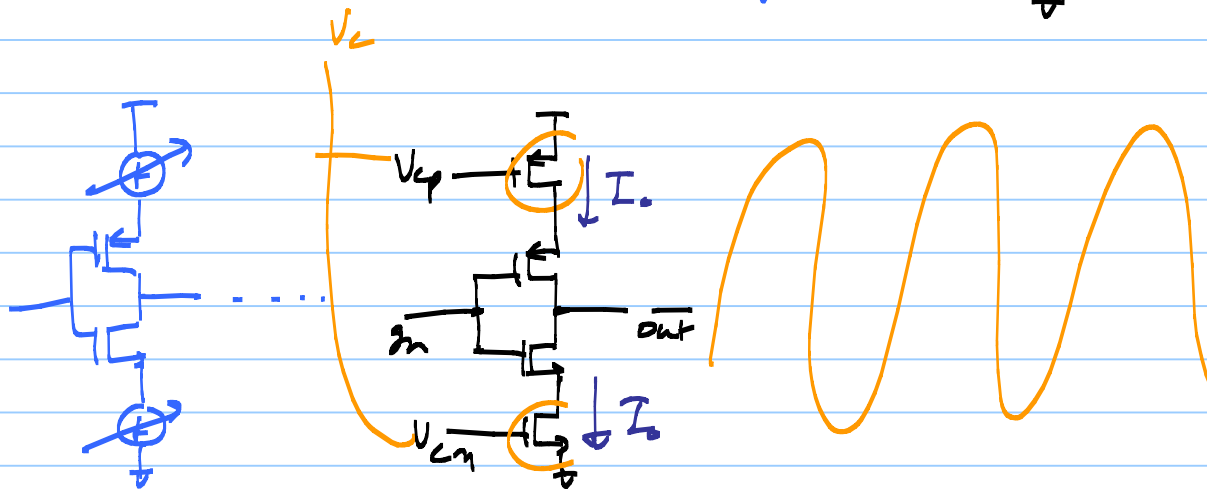
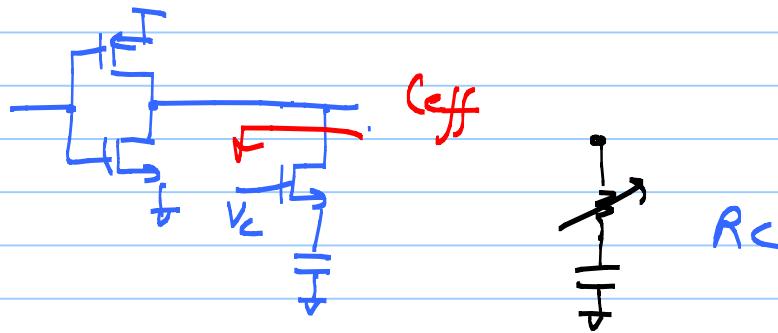


- * simple delay cells
- * Rail-to-rail output swing
- * Better phase noise performance

(-) Low PSRR

① Current starved VCO

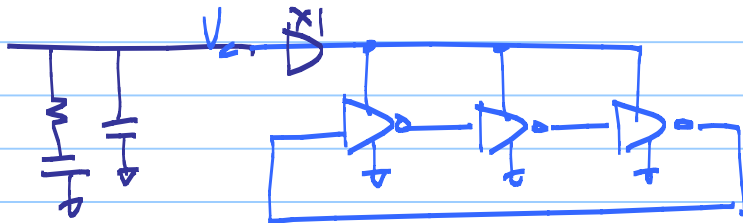
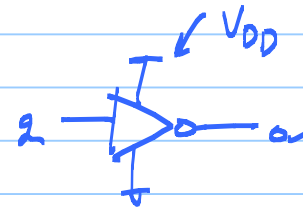
② Variable load cap



③ Tuning by supply voltage

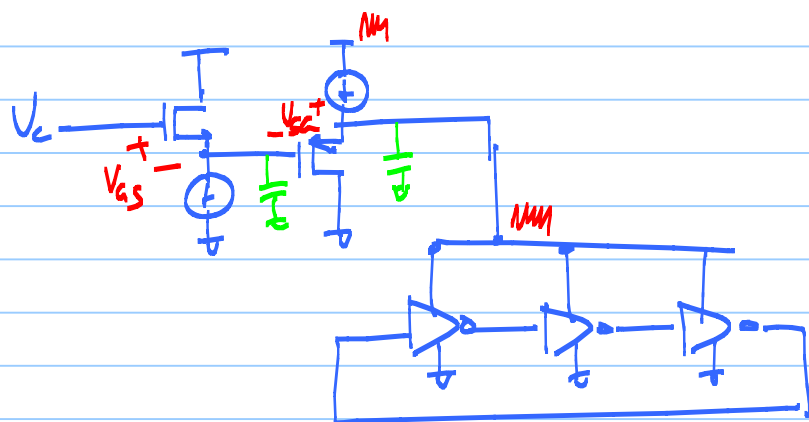
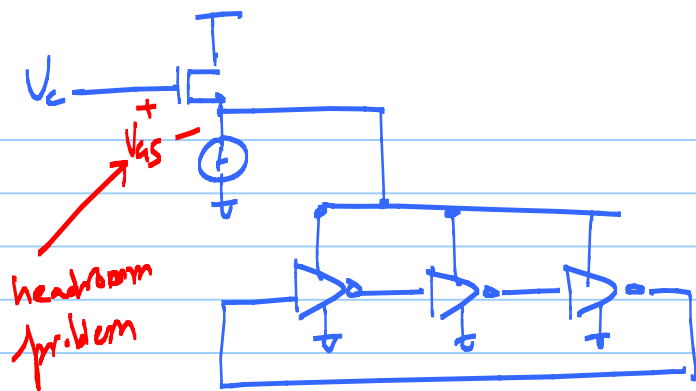
(*) Inverter delay is a strong function of V_{DD} .

- * Very wide tuning range
- * Automatic power scaling

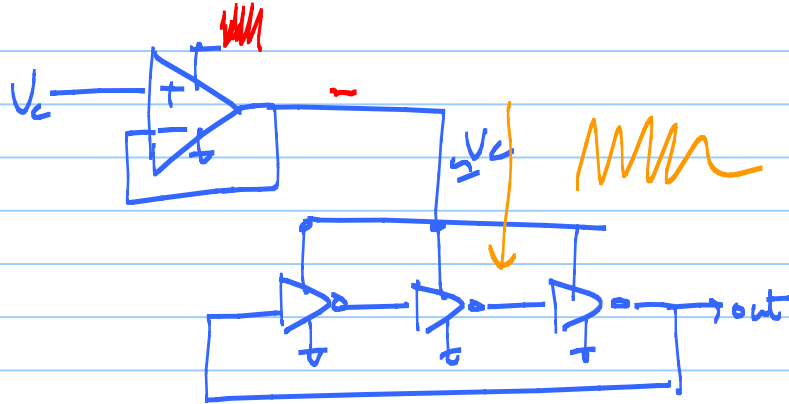


$$P = CV^2 f$$

(-) Need a buffer to drive V_c



Supply regulated VCO

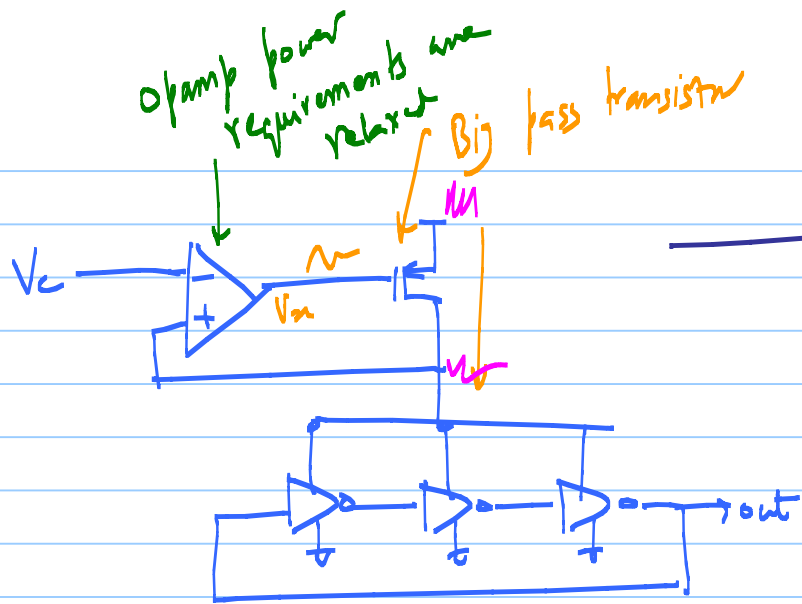


* Can design opamp with high PSRR

↳ overall VCO PSRR is Excellent

* opamp swing limits frequency range

* 5-10x power penalty



LDO
Voltage
regulator

* Degraded PSRR