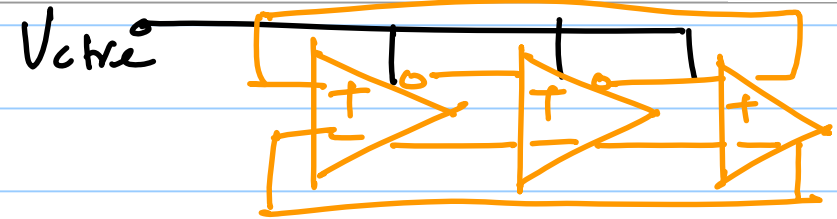
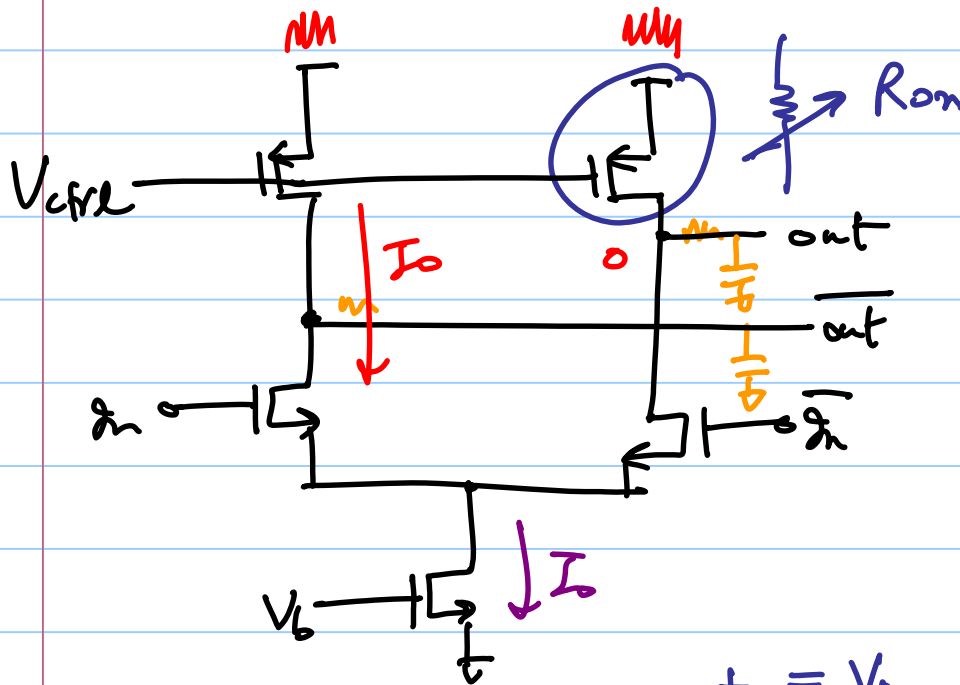


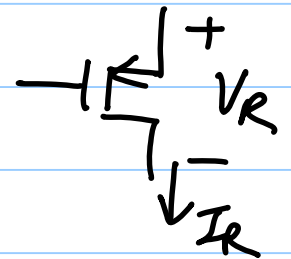
ECE 518- Lecture 17

Note Title

3/12/2015



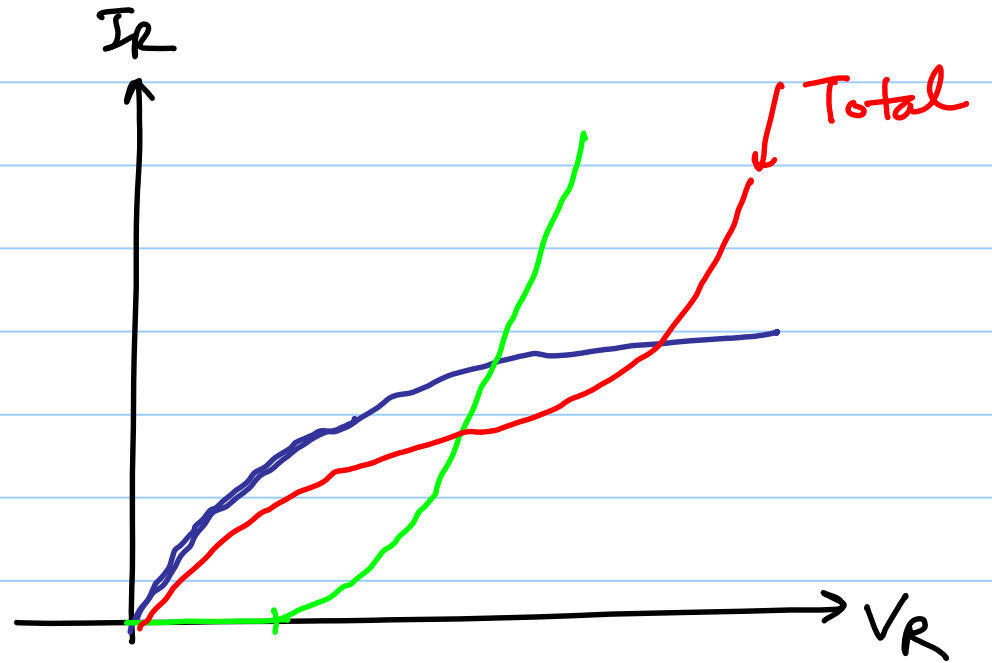
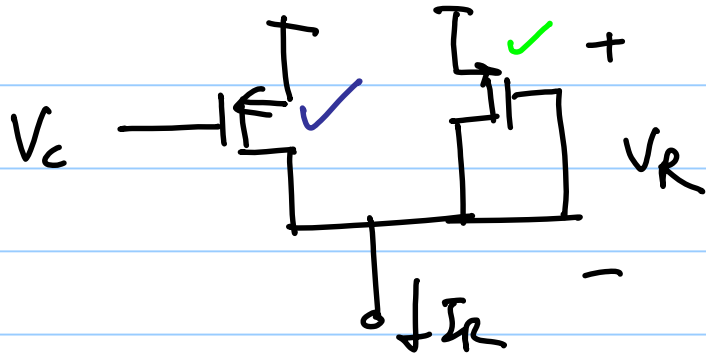
$$R_{on} = R(V_R, I_R)$$

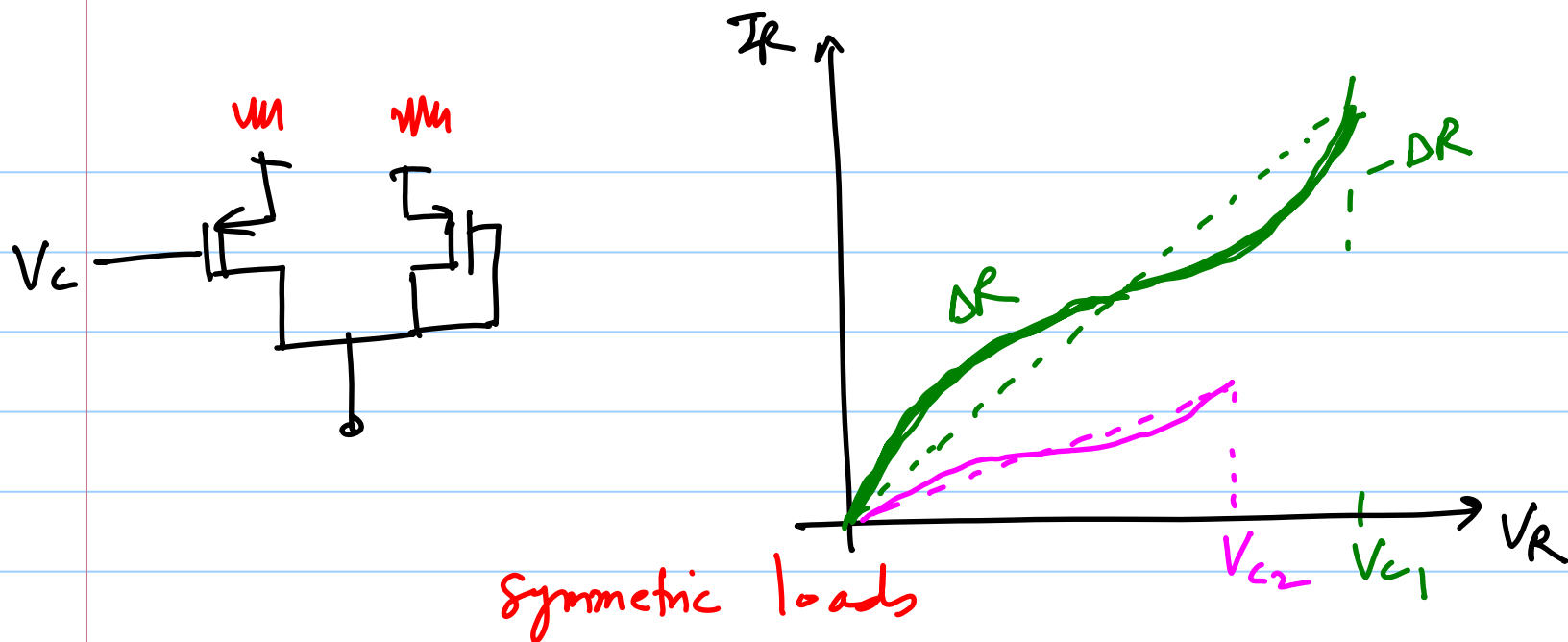


$$\begin{aligned} out &= V_{DD} - (I_0 + \Delta I) R_{on} \\ \overline{out} &= V_{DD} - (I_0 - \Delta I) R_{on} \end{aligned}$$

nonlinear resistor converts supply noise to differential output.

→ low PSRR

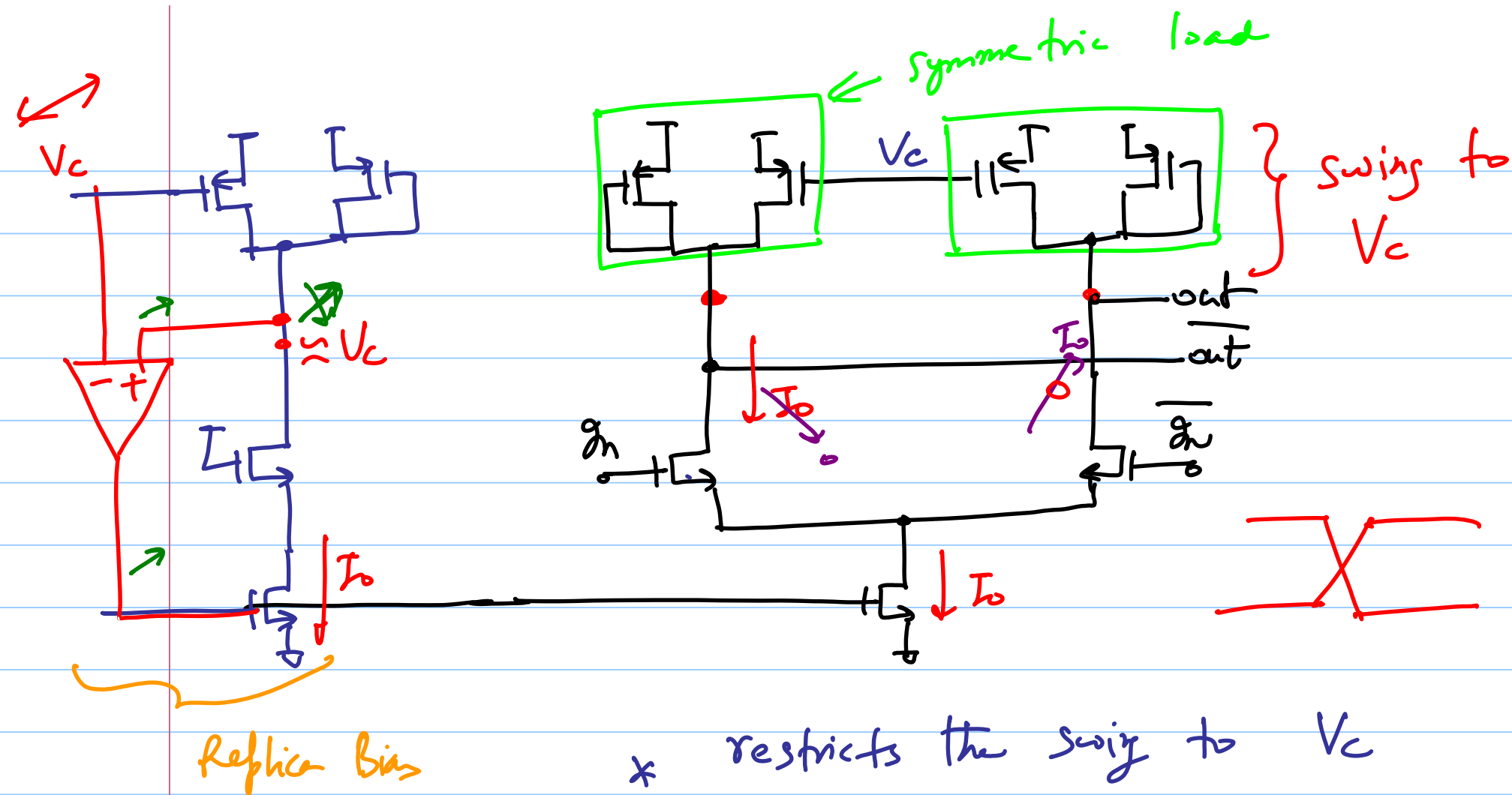




↳ Symmetric I-V characteristics about the center of the voltage swing.

↳ on average equal incremental resistance

↳ Better PSRR



* restricts the swing to V_c

$$* R_{on} = \frac{V_{DD} - V_c}{I_0}$$

⇒ low-swing V_{cos}

(+) PSSR

(-) swing = few 100's mV

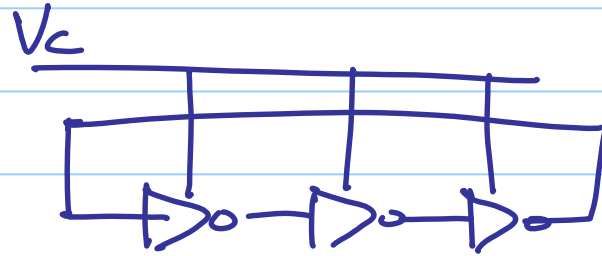
(-) More device Noise

(-) Higher power

↓
Poor phase noise performance

↳ transistors which contribute noise all the time

Large-swing oscillators.

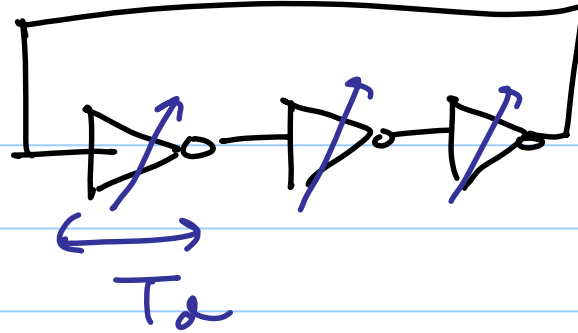


- * simple inverting cells

- * rail-to-rail output swing

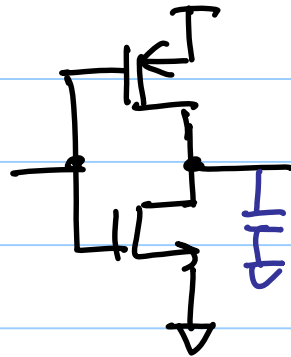
- (-) poor PSRR (power supply rejection ratio)

- ↳ better phase noise performance



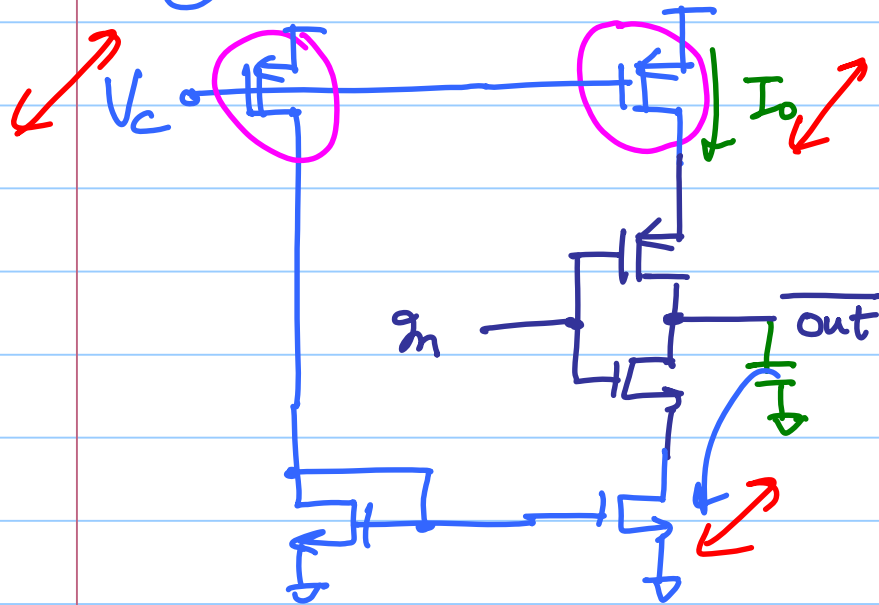
$$f_{osc} = \frac{1}{2 \cdot N \cdot T_d}$$

Variable delay Inverters?

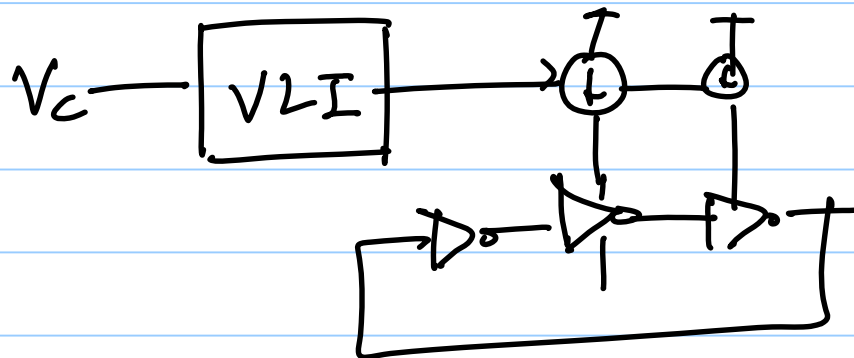
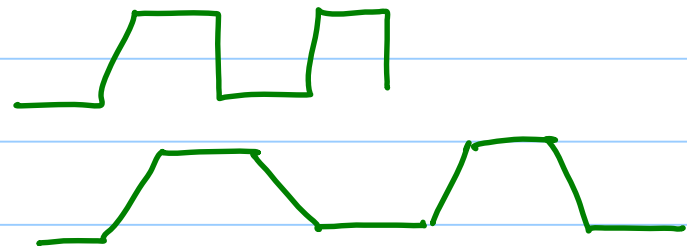


- * R_{on} ↑
- * C ↑
- * I_0 ↑
- * V_{DD} ↑

① Vary the charge/discharge current



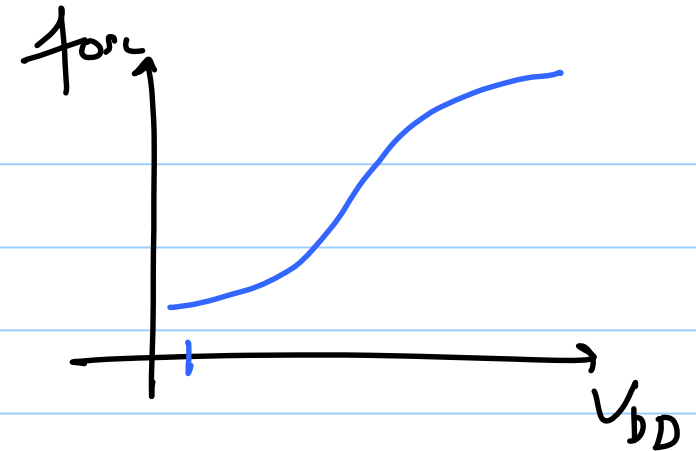
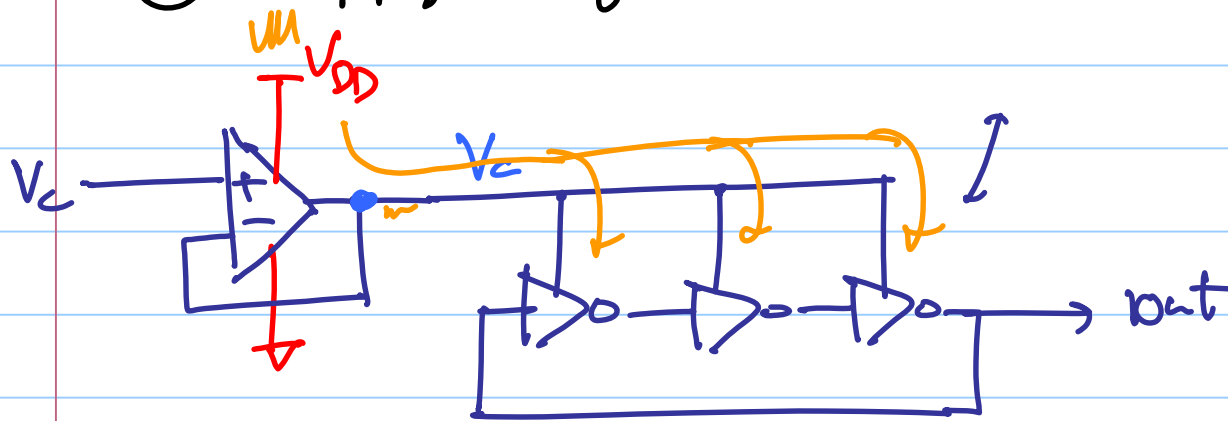
Current-starved VCO



CCO

Current controlled oscillator

② Supply regulated Vcos



(+) Excellent PSRR

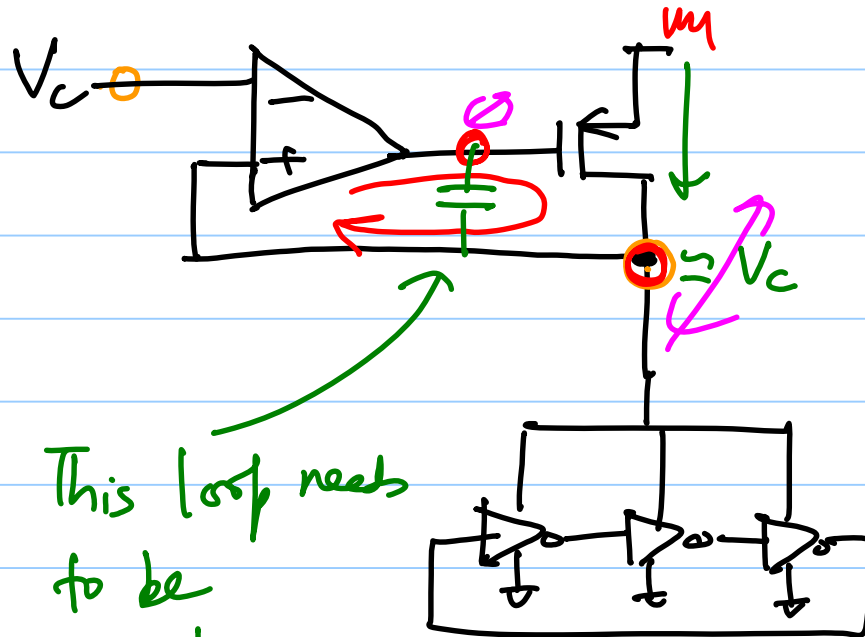
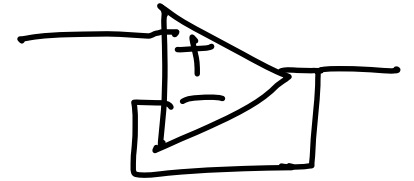
↳ only limited by the opamp PSRR

(-) power penalty

↳ opamp will need large bias currents

(±) opamp output swing limits frequency range

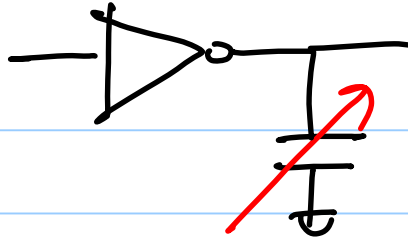
Lower power supply regulated VCO



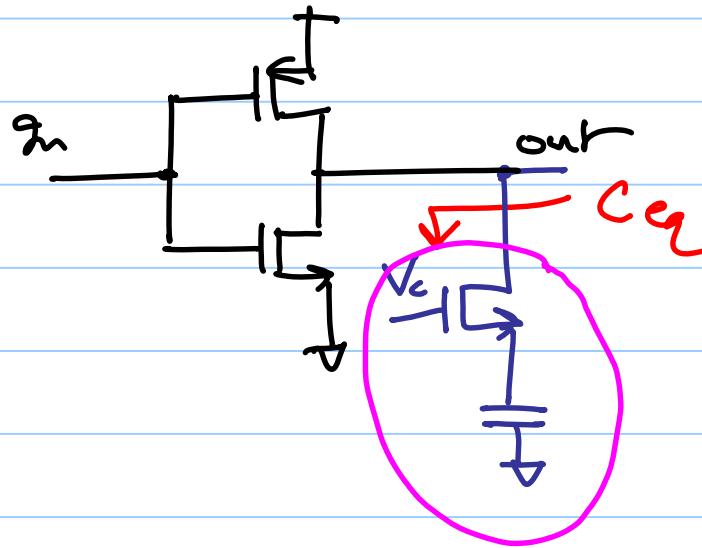
This loop needs
to be
compensated

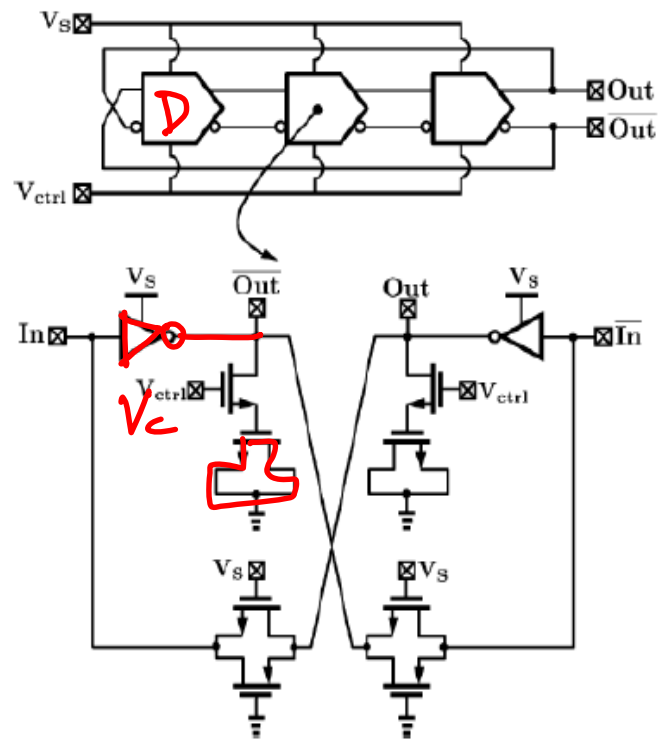
- * Pass device supplies the current
- * Pass device alleviates opamp output sizing requirements

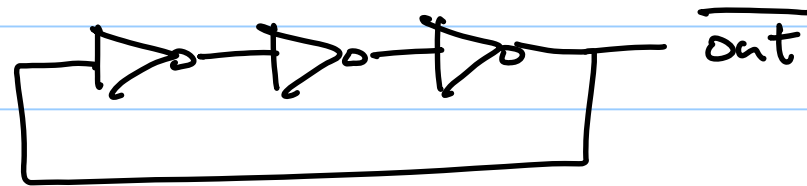
③



Variable load capacitance



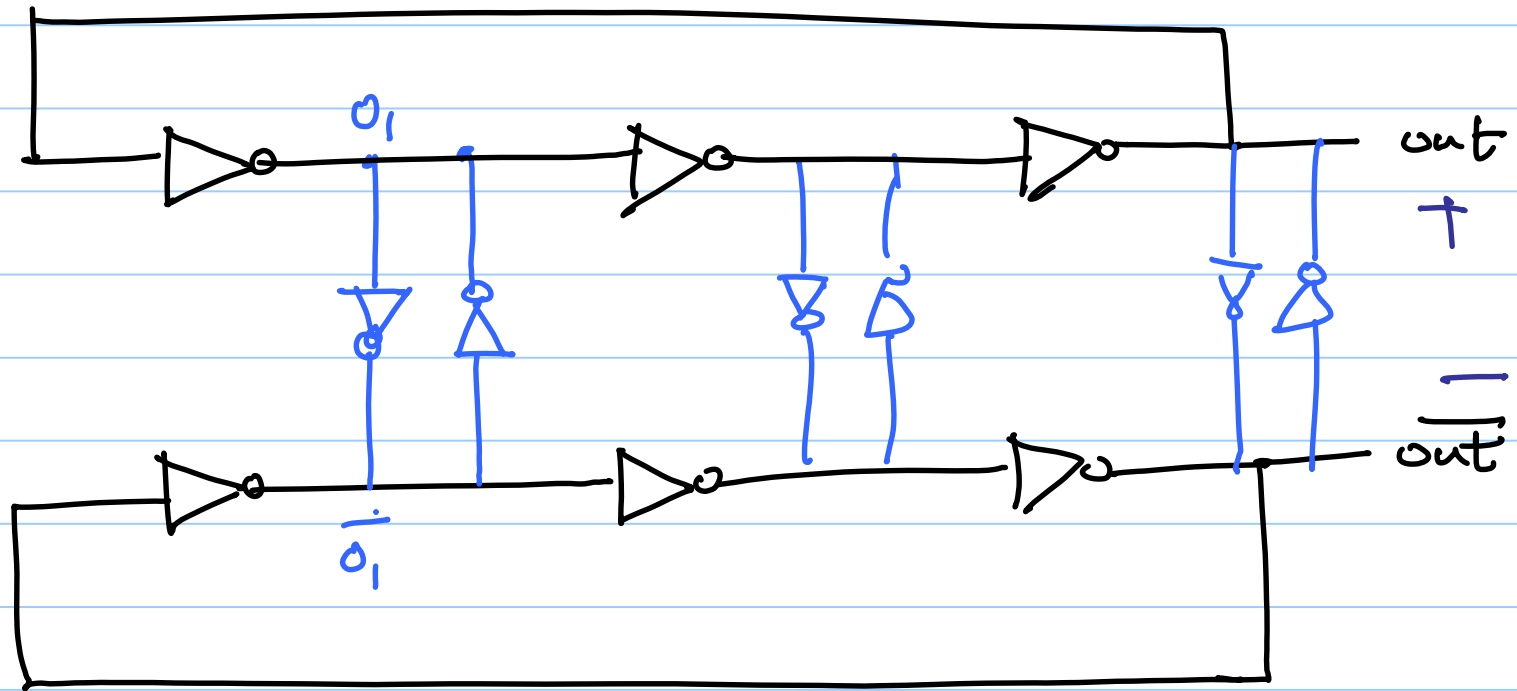




pseudo-differential

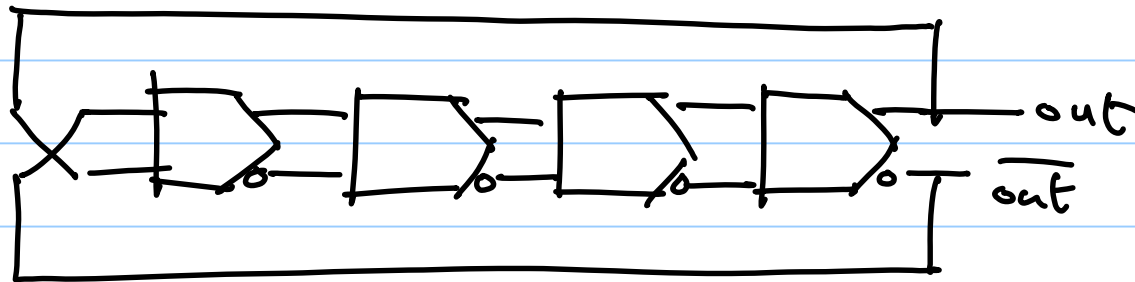
↳ No two oscillators are identical

Rail-to-Rail Differential Oscillators

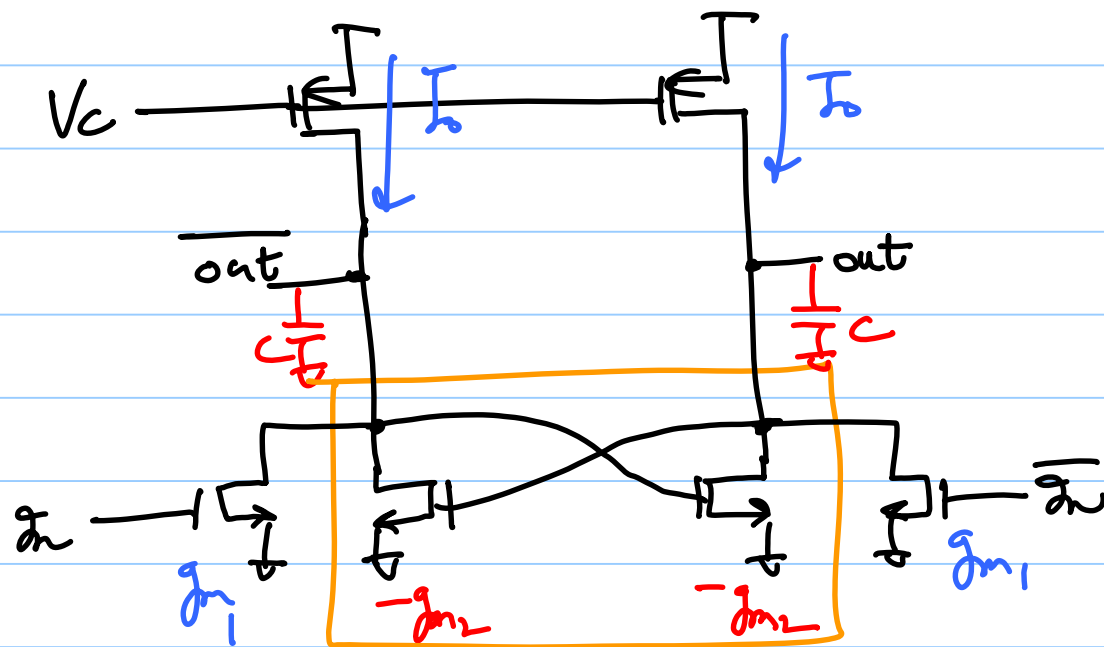


- ↳ small latches for differential operation
- ↳ slower oscillation frequency

Oscillators with even delay steps



More pseudo-differential Delay cells:

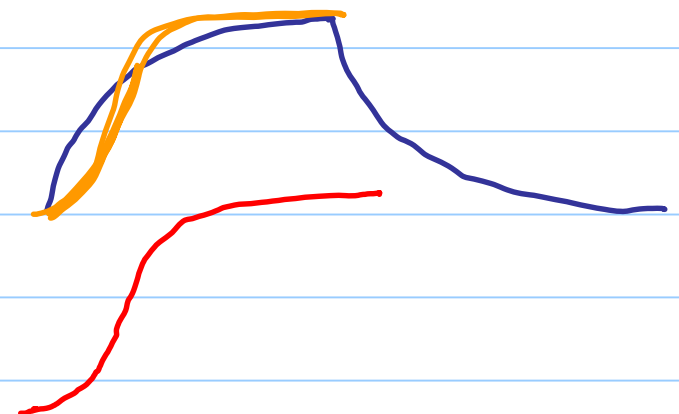


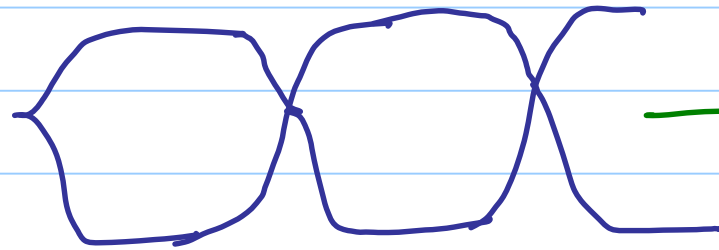
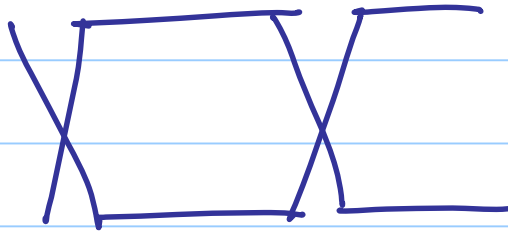
Small time constant

$$\frac{g_{m1} - g_{m2}}{C}$$

looks like Sense-amp

- * Wide tuning range
- * Asymmetric output waveforms





→ Duty cycle distortion

(-) Poor PSRR