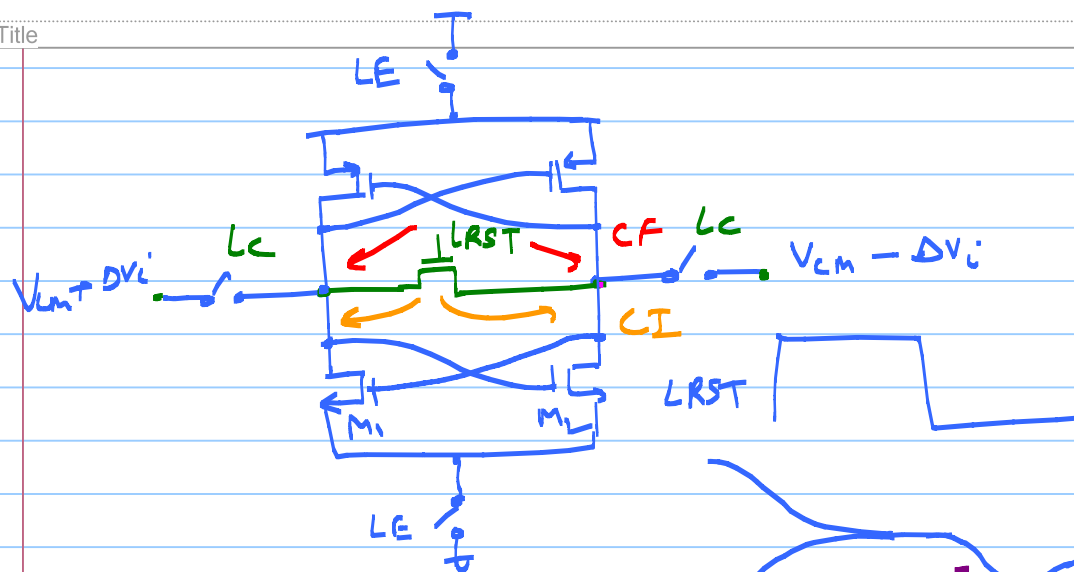


ECE 614 - Lecture 23.

Note Title

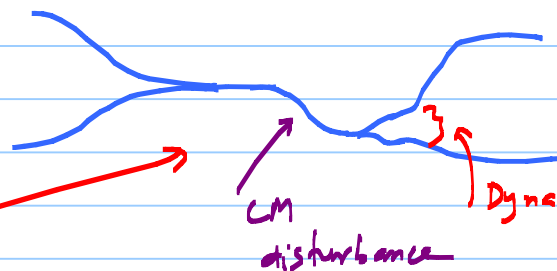
11/27/2012



$$\tau = C/g_m$$

① Static offset

② Dynamic offset



Dynamic offset

$\approx 50 \text{ mV}$

V_{os} due to M_1 & M_2

$$V_{os,1,2} = \Delta V_{THN,1,2} + \frac{1}{2} \frac{\Delta(W/L)}{(W/L)} (V_{GS,r2} - V_{THN})$$

$$\sigma_{V_{os,1,2}}^2 = \sigma_{\Delta V_{THN}}^2 + \frac{1}{4} \frac{\sigma_{\Delta W/L}^2}{(W/L)^2} V_{ov}^2$$

$$\approx 50 \text{ mV}$$

$$\sigma_{V_{os}} = 50 \sqrt{2} \text{ mV}_{rms}$$

0.5 μm CMOS

$$\sigma_{\Delta V_{THN}} = 5 \text{ mV}$$

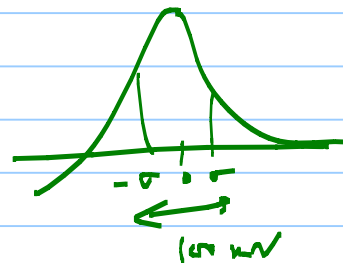
$$\sigma_{\frac{\Delta W/L}{W/L}} = 0.1$$

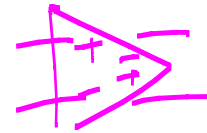
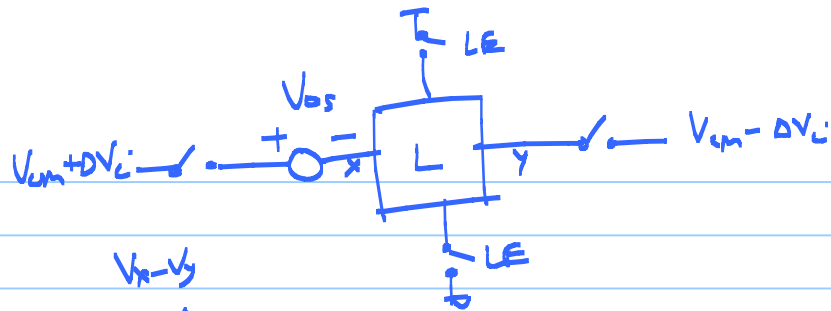
$$V_{ov} = 1 \text{ V}$$

A_v CMOS $\text{lat} \Rightarrow$

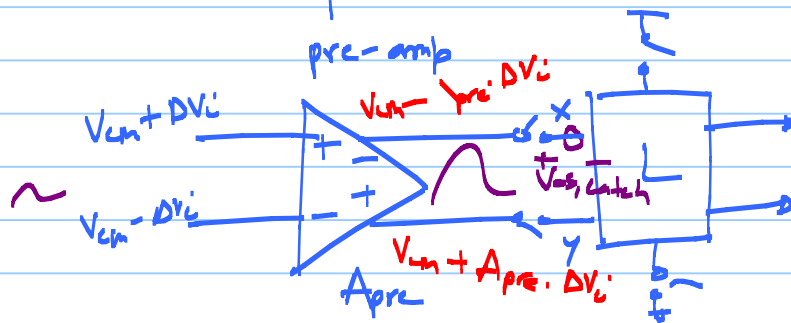
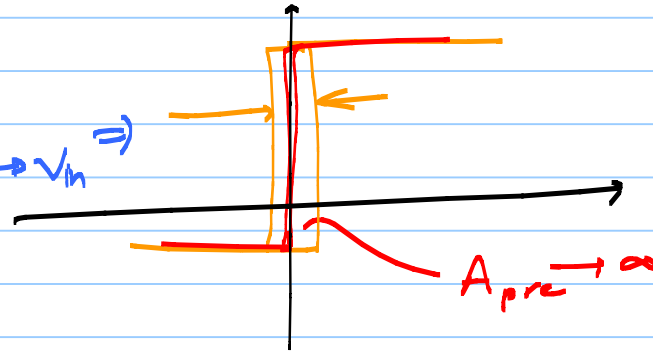
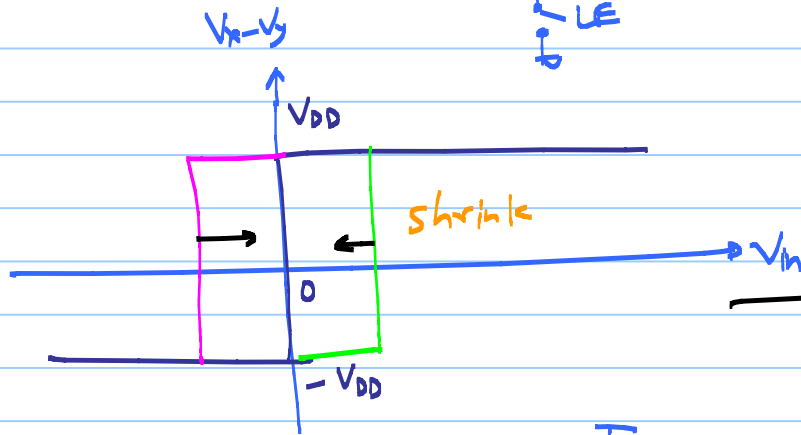
$$\sigma_{V_{os}} \Rightarrow 50 \text{ mV} \rightarrow 100 \text{ mV}$$

$$\mu_{V_{os}} = 0$$





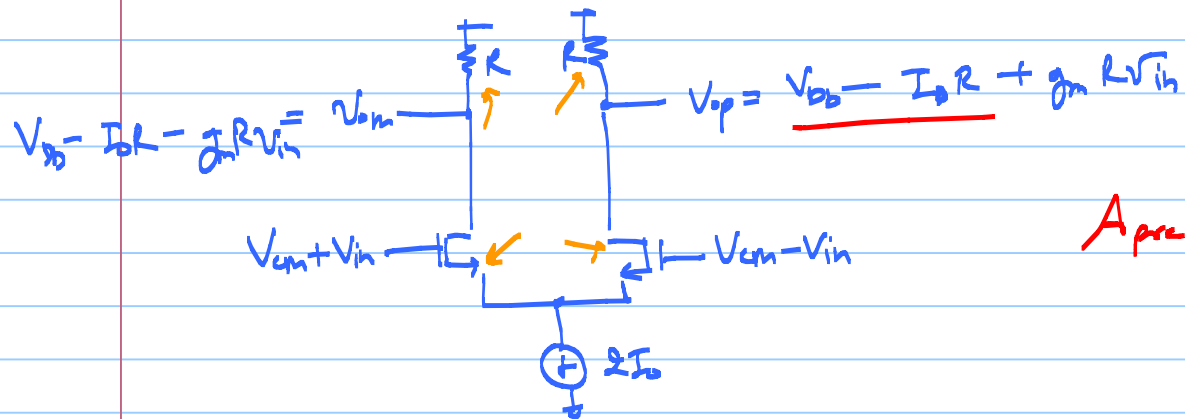
* Can't estimate this offset ↓



$$V_{os, in} = \frac{V_{os, latch}}{A_{pre}}$$

* Latch regenerates pre-amplified input

Example preamp :



$$A_{pre} = g_m R$$

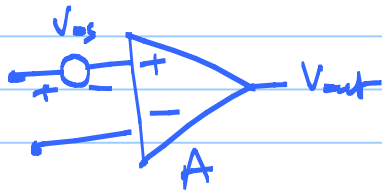
* If the pre-amp has offset

$$V_{os, in} = \underline{V_{os, pre} + \frac{V_{os, latch}}{A_{pre}}}$$

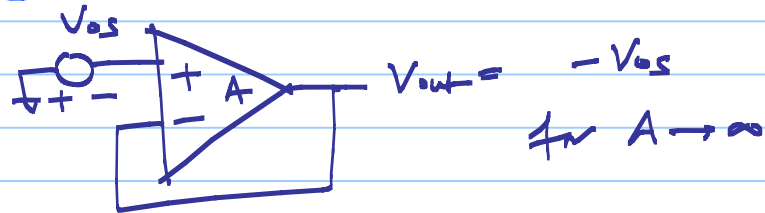
Not a perfect solution

Pre-amp offset Cancellation

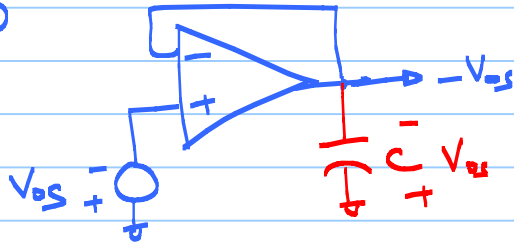
①



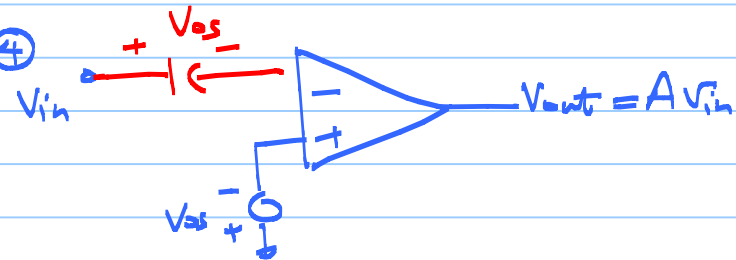
②



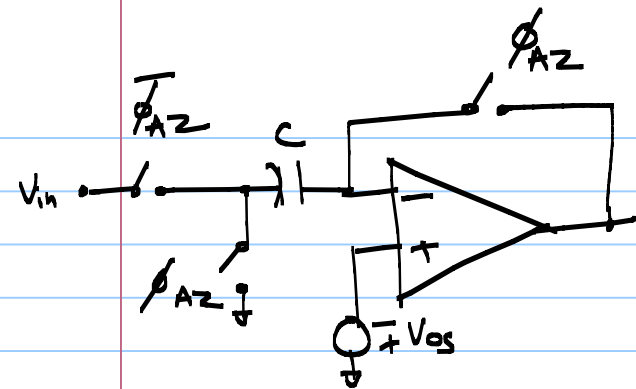
③



④



Input offset storage (I_{os})



* offset cancellation process
 $\rightarrow$ Autozeroing (AZ)

* finite pre-amp gain

$$V_{out} \approx -V_{os} \frac{A}{A+1}$$

$$\approx -V_{os} \left[1 - \frac{1}{A}\right]$$

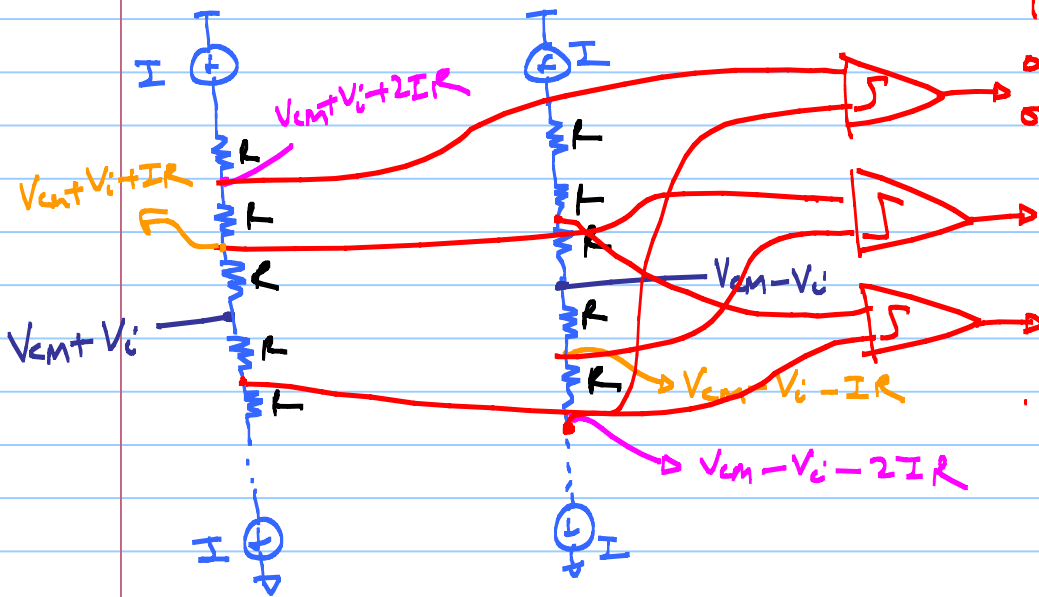
error of $\frac{V_{os}}{A}$

After Autozeroing

* Equivalent input offset = $\frac{V_{os,pre}}{A_{pre}}$

$$V_{os,in,comparator} = \frac{V_{os,pre}}{A_{pre}} + \frac{V_{os,Latch}}{A_{pre}} \rightarrow \text{Small for } A_{pre} \rightarrow \infty$$

Reference Subtraction



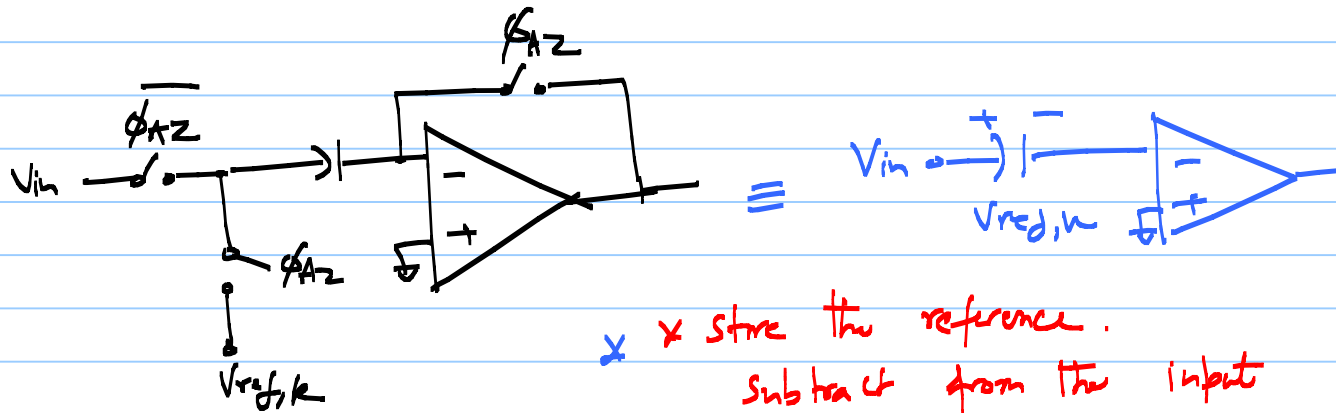
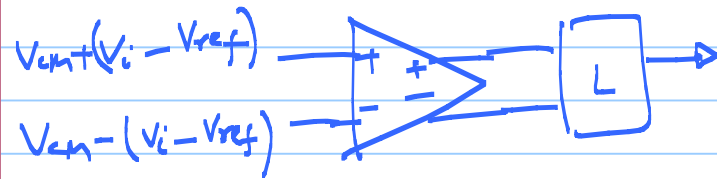
$$LSB \text{ size} = 2IR$$

$$(V_{cm} + V_i + 2IR) - (V_{cm} - V_i - 2IR)$$

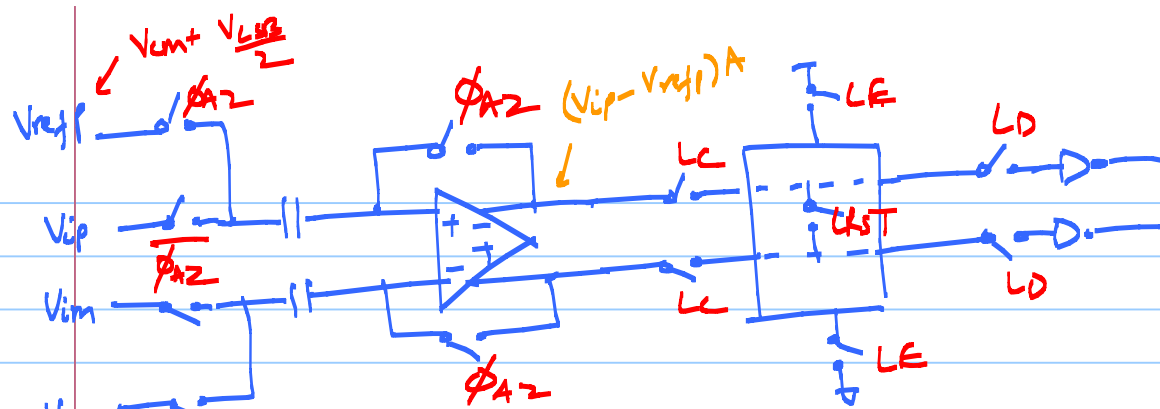
$$(V_{ip} - V_{refp}) - (V_{im} - V_{refm})$$

subtract the reference

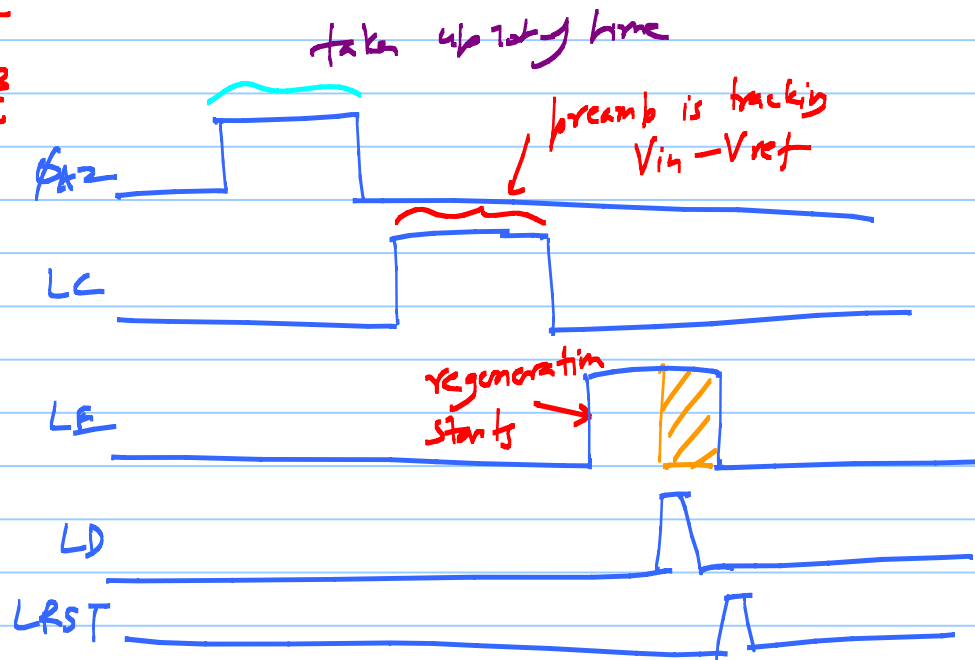
2. Flash ADC

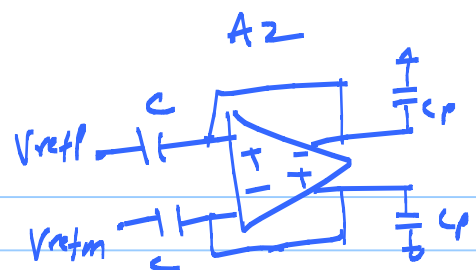


x x store the reference.
subtract from the input



$$V_{os,in} = \frac{V_{os,pre}}{A_{pre}} + \frac{V_{os,match}}{A_{pre}}$$





$$\tau_{A_2} \gg \tau_{L_c}$$

