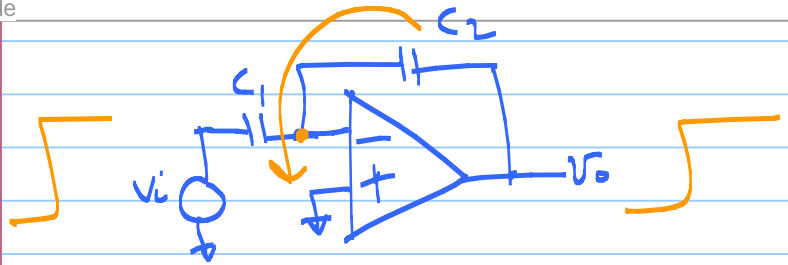
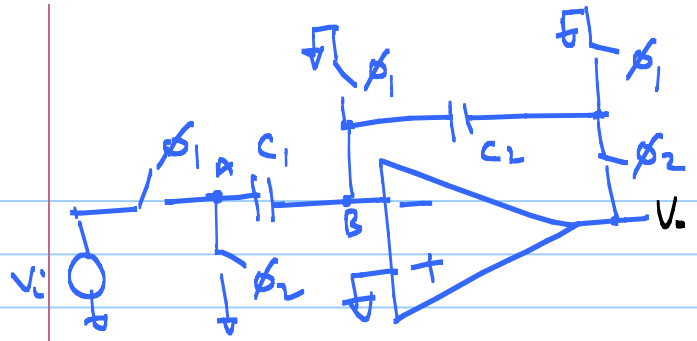
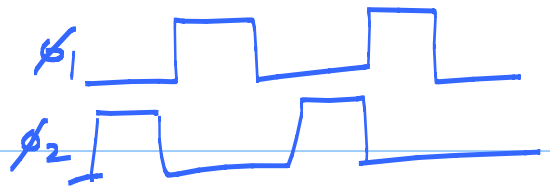
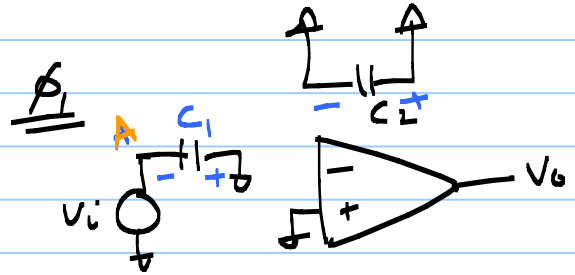
ECE 614 – Lecture 7

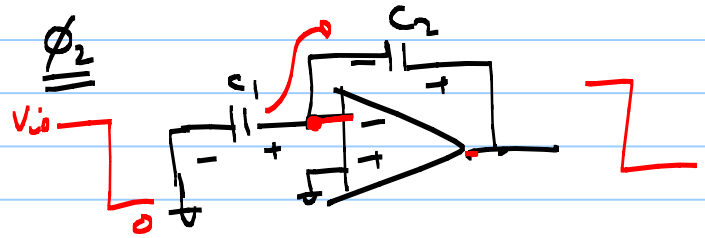
Note Title 9/18/2012

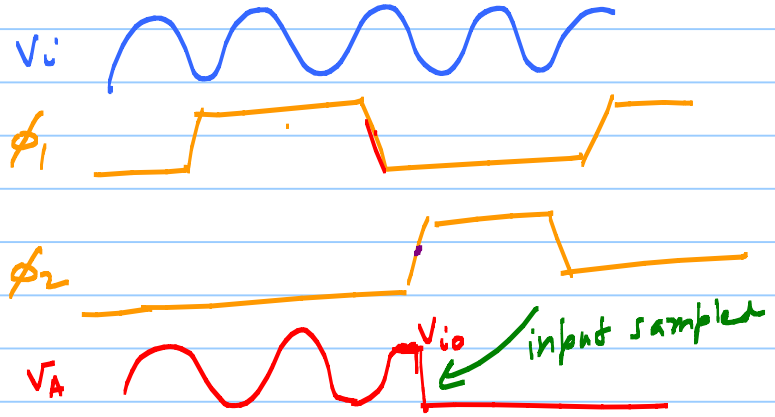






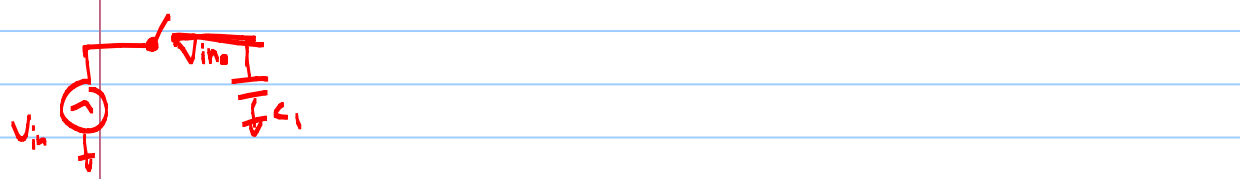


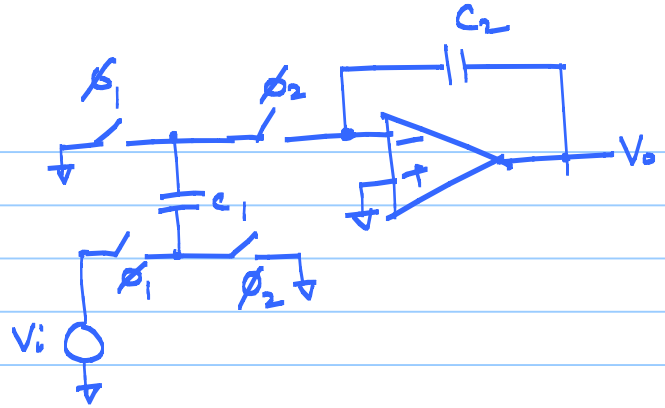


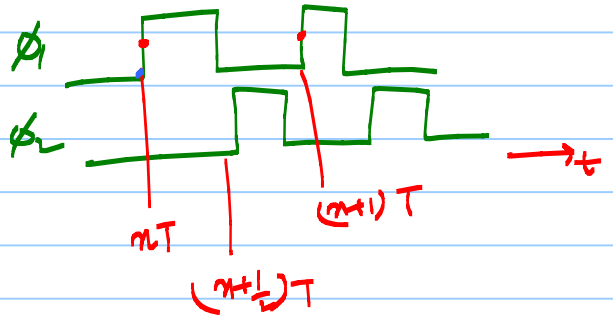


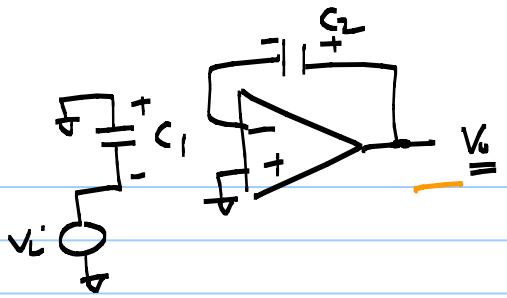
$Q_i = Q_f$

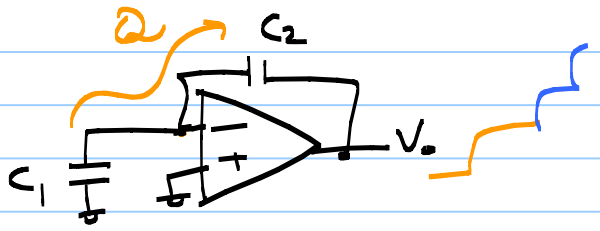
$V_o = \frac{C_1}{C_2} V_{in}$


V_o
$\frac{C_1}{C_2} \cdot V_i$
V_{in}
V_{in}
C_1









@ $t = nT \Rightarrow \phi_1$ = high

sampling $\quad Q[n] = -V_{in}[n]C_1 + (0 - V_o[n])C_2$

@ $t=(n+\frac{1}{2})T$

charge Transfer

$$Q[n+\tfrac{1}{2}] = 0 \cdot C_1 + \left(0 - V_o[n+\tfrac{1}{2}]\right) C_2$$

$$\Rightarrow \underline{Q[n] = Q[n+\tfrac{1}{2}]}$$

$$\rightarrow \quad V_o[n+\tfrac{1}{2}] = V_o[n] + \left(\frac{C_1}{C_2}\right) V_i[n]$$

$$V_o[n+1] = V_o[n+\tfrac{1}{2}]$$

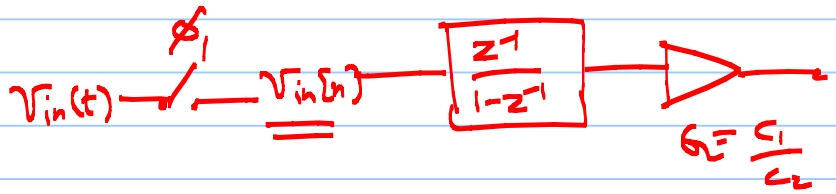
$$\rightarrow \quad V_o[n+1] = V_o[n] + \left(\frac{C_1}{C_2}\right) V_{in}[n]$$

DT non-inverting Integrator Delayit

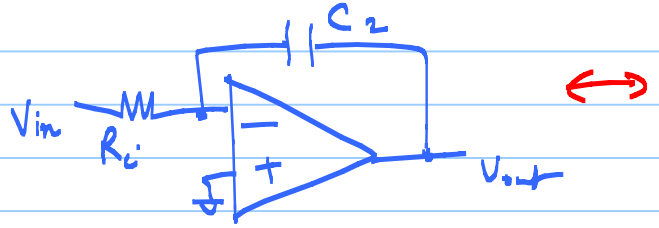
$$\therefore V_o(z) = V_o(z) + \left(\frac{C_1}{C_2}\right) V_{in}(z)$$

$$V_o(z) = z^{-1} V_o(z) + \left(\frac{C_1}{C_2}\right) z^{-1} V_{in}(z)$$

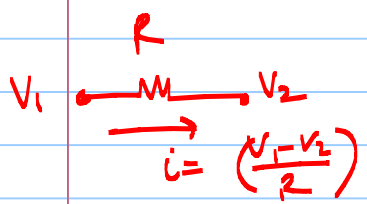
$$V_o(z) = \left(\frac{C_1}{C_2}\right)\frac{z^{-1}}{1-z^{-1}} \cdot V_{in}(z)$$



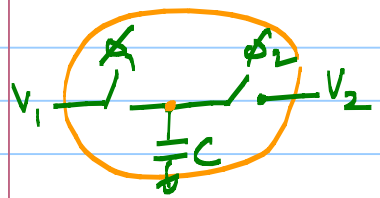
$\equiv$



$\leftrightarrow$



$$i = \frac{V_1 - V_2}{R}$$

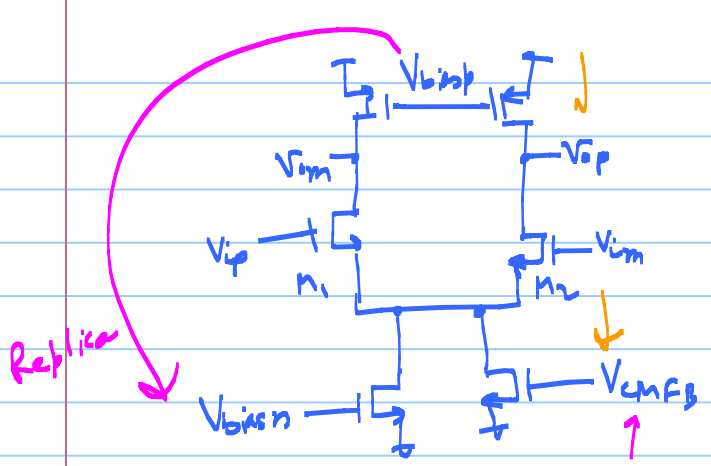


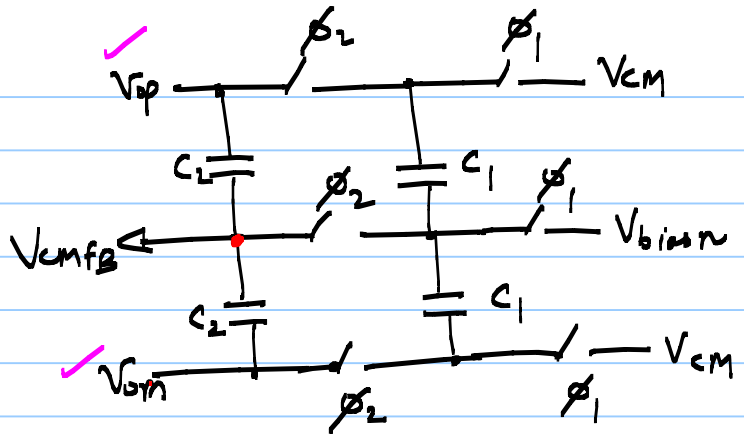
$$R_i = \frac{1}{f_s C_1}$$

$$R = \frac{1}{f_s C}$$

$$q = C(V_1 - V_2) \Rightarrow i_{av} = \frac{q}{T} = \frac{C}{T}(V_1 - V_2) = \frac{(V_1 - V_2)}{1/f_s C}$$

SC - CMFB

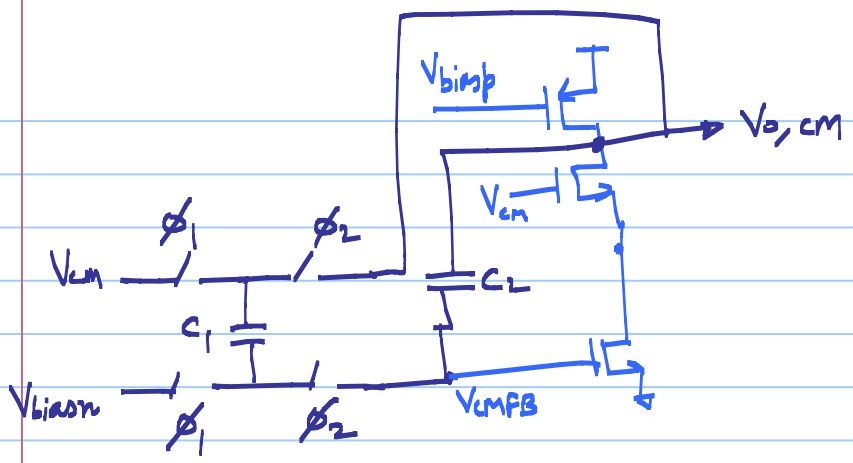


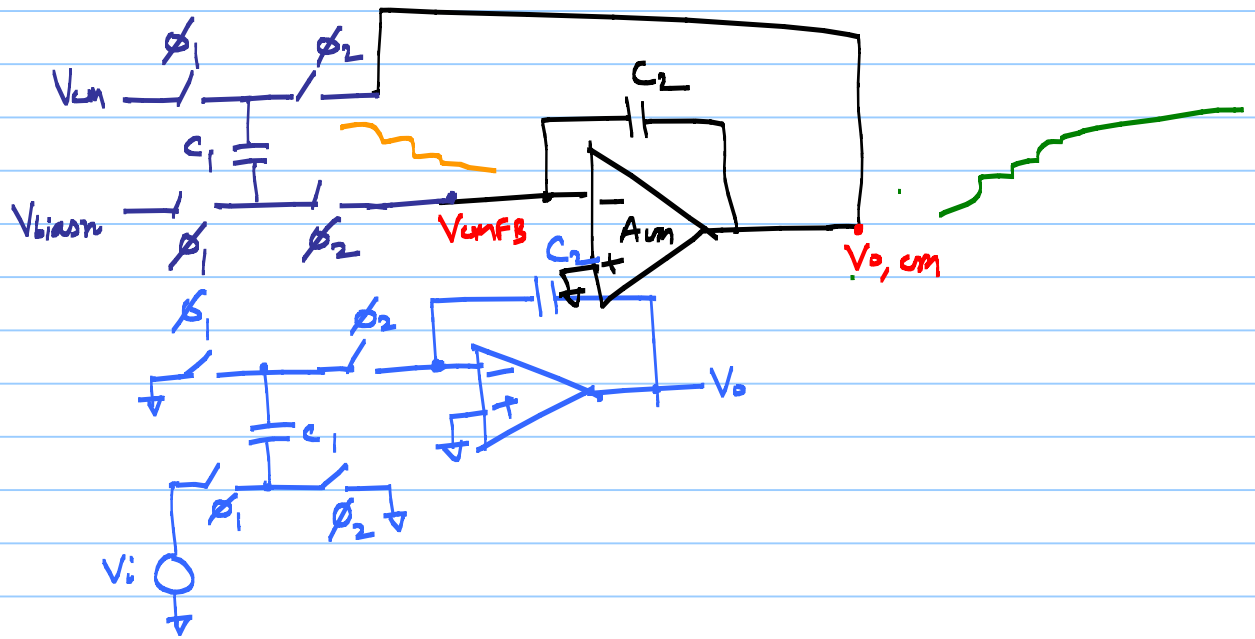


CM averaging

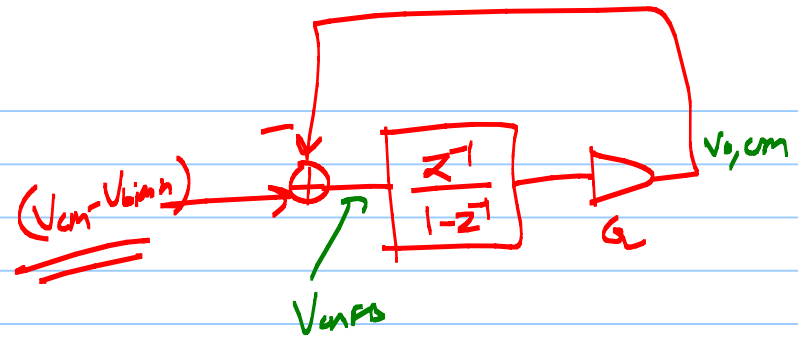
+ Voltage level shifting

CM equivalent circuit



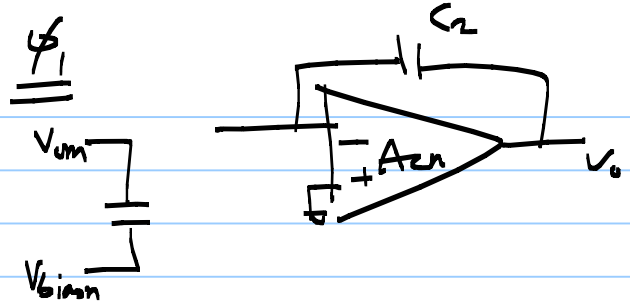

ϕ_1
ϕ_2
V_{cm}
C_2
C_1
V_{biasn}
V_{cmFB}
A_{vm}
$V_{o,cm}$
V_o
V_i

$A_{cm} \to \infty$



In steady-state

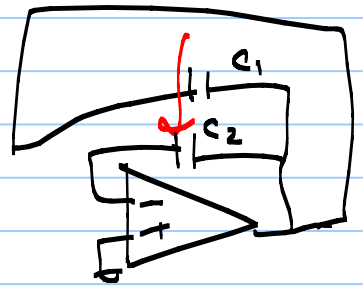
$V_{o,cm}$ = constant



$\Rightarrow$

$Q(\phi_1) = Q(\phi_2)$ $\quad \left(\frac{V_{op}+V_{on}}{2}\right)$

$C_1(V_{cm} - V_{biasn}) = C_1(V_{o,cm} - V_{cmFB})$ $\quad \phi_2$



$V_{o,cm} - V_{cmFB} = V_{cm} - V_{biasn}$

$\Rightarrow \quad V_{o,cm} - V_{cm} = V_{cmFB} - V_{biasn} \triangleq 0$

V_{biasn}

$\boxed{V_{ocm} \triangleq V_{cm}}$