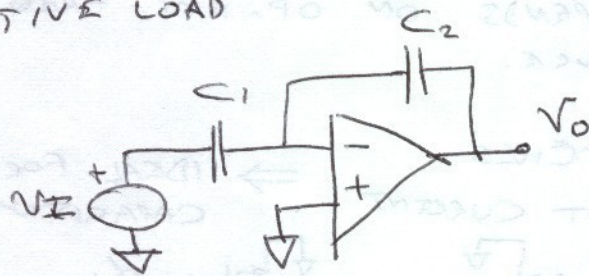


INTERNAL AMPLIFIERS

- OUTPUT BUFFERS → DRIVE EXTERNAL LOADS
 - VARIABLE
 - 100S PF
 - kΩ
- INTERNAL BUFFERS → DRIVE INTERNAL LOADS
 - NORMALLY CAP.
 - ~ 1 PF
 - KNOWN

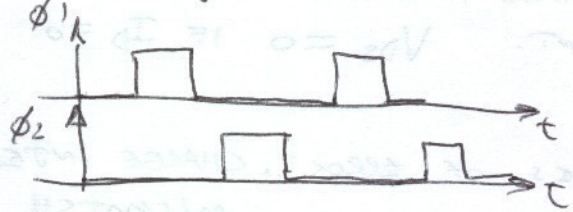
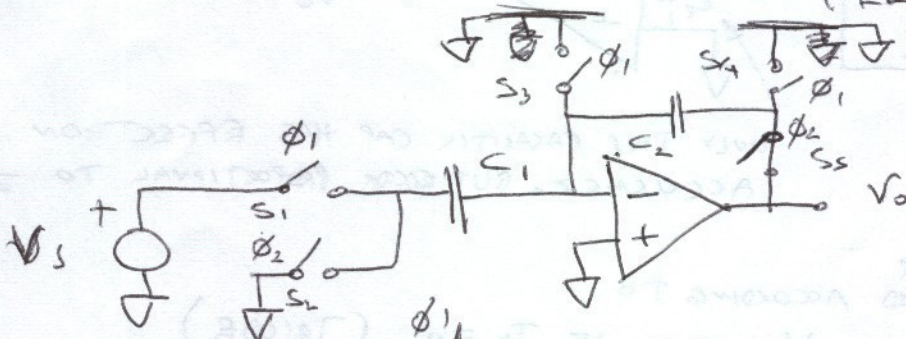
SWITCHED CAPACITOR AMPLIFIER

- CAPACITORS INSTEAD OF RESISTORS
- GOOD MATCHING
- NO RESISTIVE LOAD

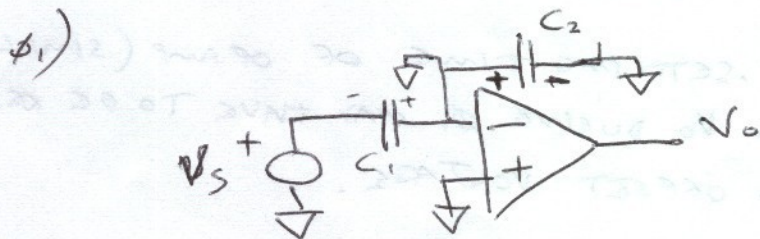


$$\frac{V_o}{V_i} = - \frac{\frac{1}{j\omega C_2}}{\frac{1}{j\omega C_1}} = - \frac{C_1}{C_2}$$

BUT WORKS WITH AC ONLY. → NO DC FEEDBACK

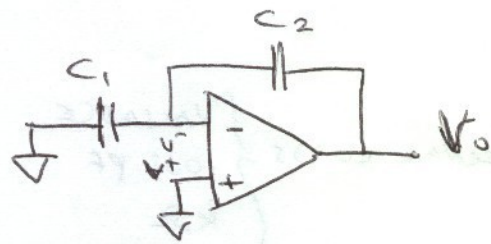


ϕ_1, ϕ_2
NON OVERLAPPING SWITCHES



$$Q_i = (0 - V_s) C_1 + 0 C_2 = -V_s C_1$$

⑥*
A2)



FEEDBACK MAKES $V^- = V^+ = 0$

$Q_2 = 0 \quad C_1 \bar{V}_0 C_2 = Q_1$ DUE TO CHARGE CONSERVATION

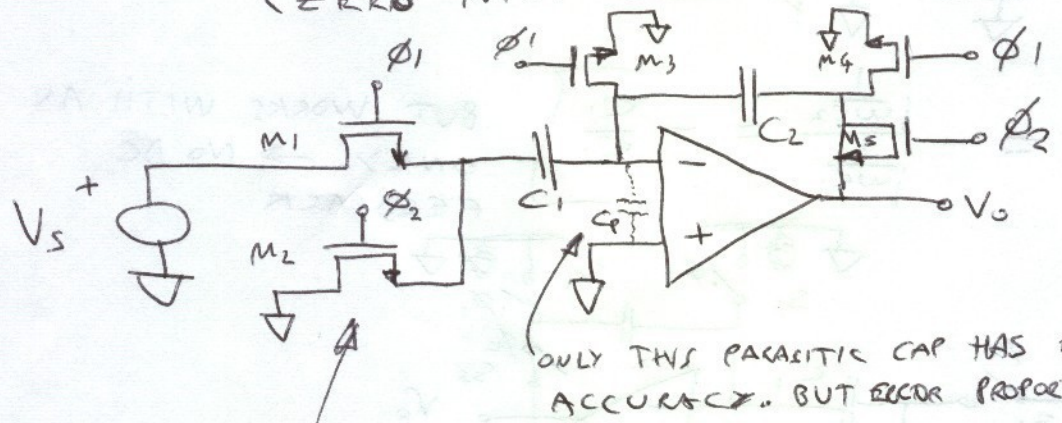
$-V_0 C_2 = -V_s C_1$

$\frac{V_0}{V_s} = + \frac{C_1}{C_2}$

NOTE IT IS POSITIVE

- THE TRANSITION DEPENDS ON OP-AMP. FREQ. RESPONSE AND SWITCH RESISTANCE.

- CMOS → GOOD SWITCHES ⇒ IDEAL FOR SWITCHED CAPACITORS
(ZERO INPUT CURRENT)



ALSO MAY NEED PMOS HERE. IF $V_0 > V_{DD} - V_{th}$

ONLY THIS PARASITIC CAP HAS EFFECT ON ACCURACY. BUT ERROR PROPORTIONAL TO $\frac{1}{A}$ OPAMP GAIN.

DRAIN AND SOURCE INTERCHANGED ACCORDING TO CURRENT. $V_{DS} = 0$ IF $I_D = 0$ (TRIODE)

- OTHER SOURCES OF ERROR: CHARGE INJECTED FROM SWITCHES, MISMATCH
- IMPORTANT PARAMETERS: SETTLING TIME OF OPAMP (SIMULATIONS)
 - V_0 DURING ϕ_1 MAY HAVE TO BE RESET.
 - OFFSET VOLTAGE.