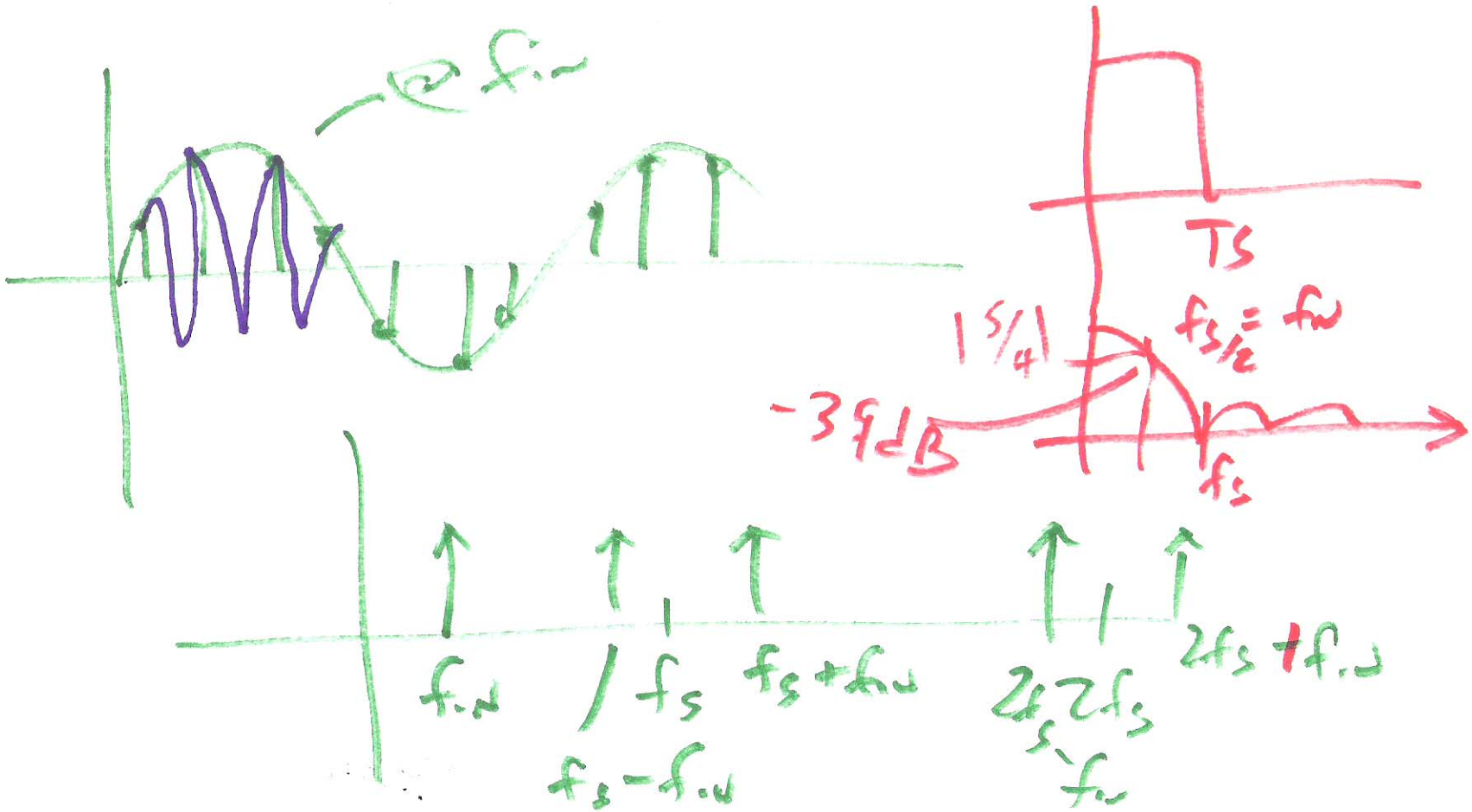
ECG 721

Implementing the S/H

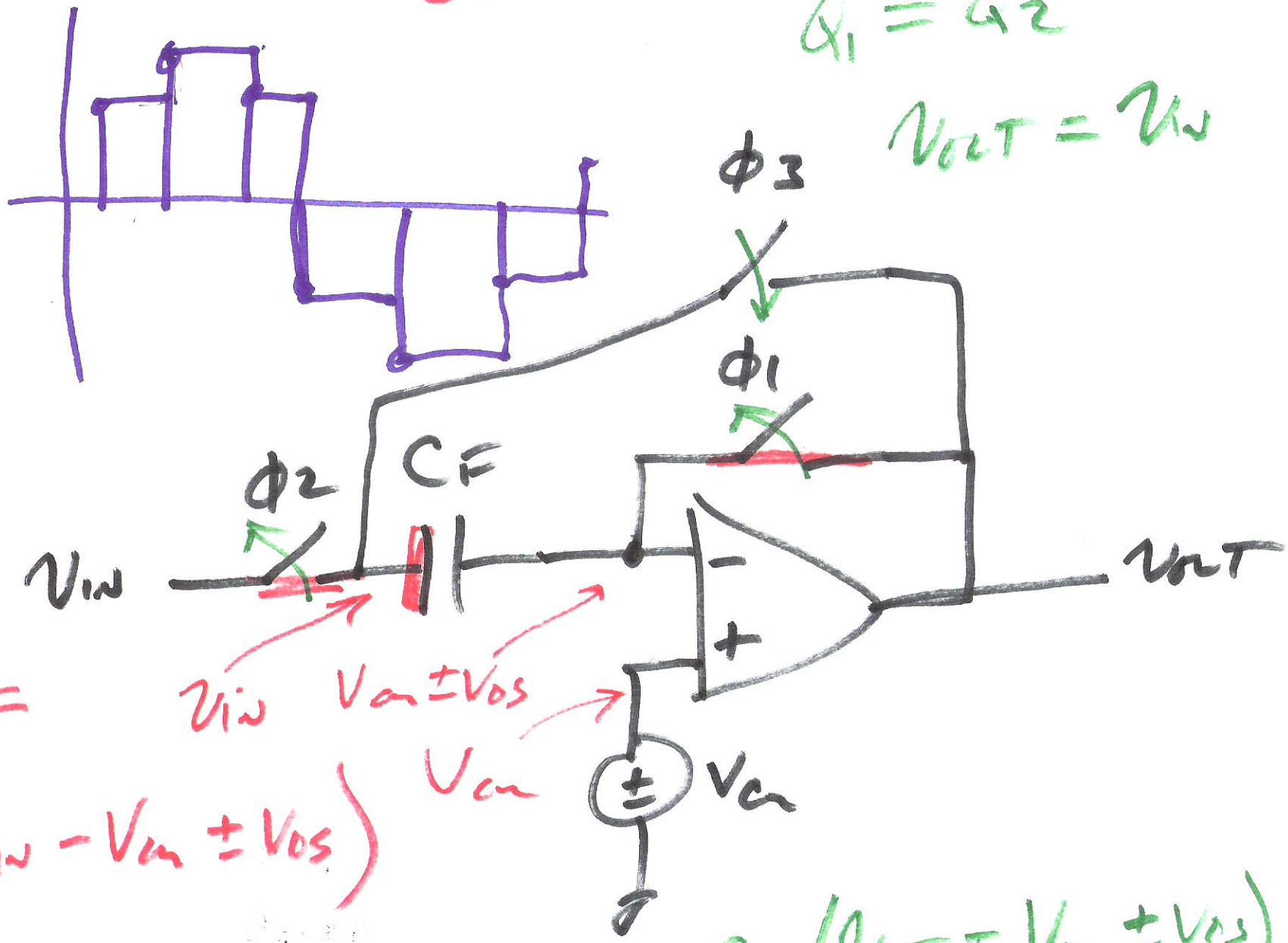
Sept. 27, 2014



$CV = Q$

$Q_1 = Q_2$

$V_{OUT} = V_{IN}$



$Q_1 = C_F(V_{IN} - V_{cm} \pm V_{OS})$

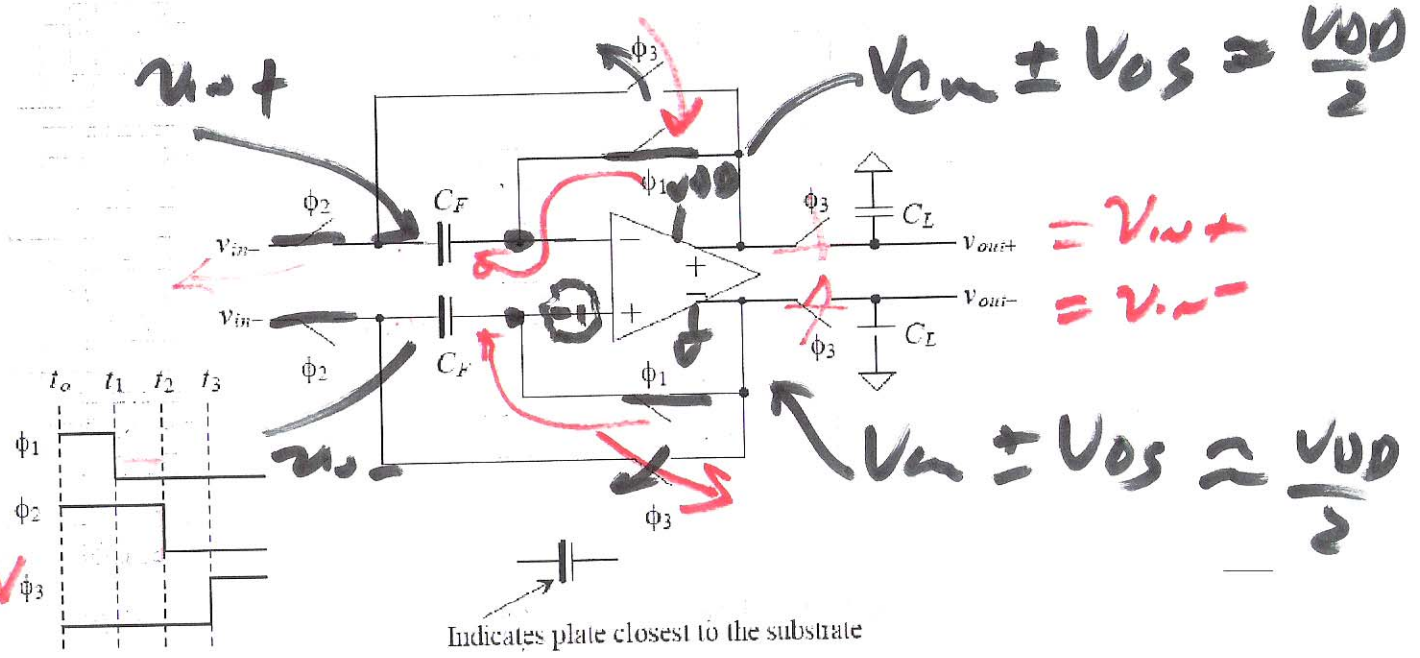
V_{IN} $V_{cm} \pm V_{OS}$

V_{cm}

$Q_2 = C_F(V_{OUT} - V_{cm} \pm V_{OS})$

VDD = 1

GND

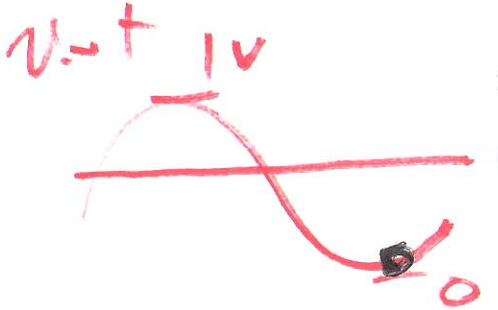


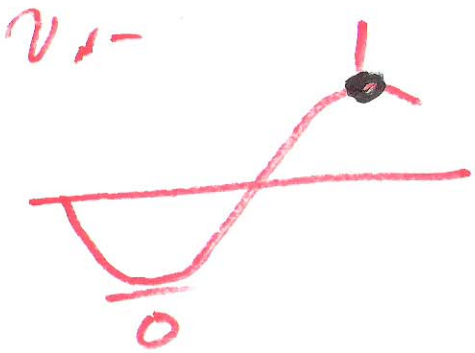
v_{in+} = $V_{CM} \pm V_{OS} \approx \frac{V_{DD}}{2}$

$= v_{in+}$

$= v_{in-}$

$V_{CM} \pm V_{OS} \approx \frac{V_{DD}}{2}$



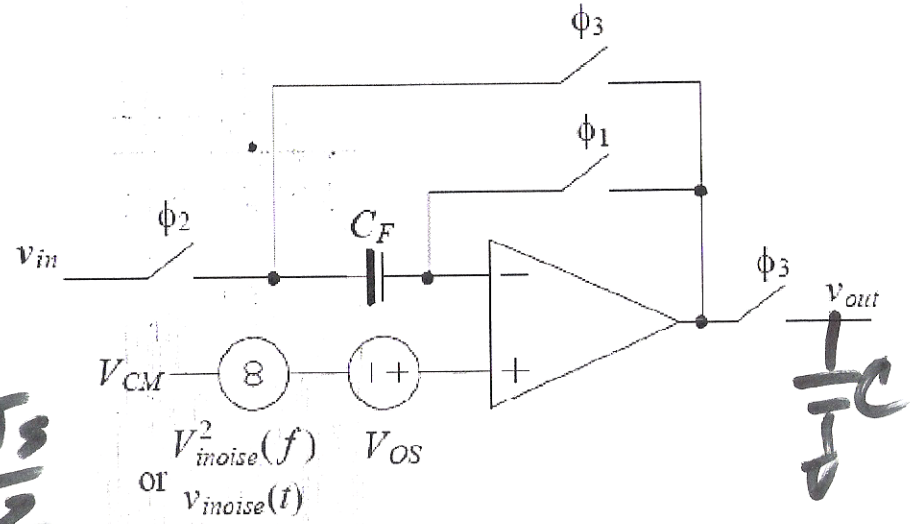


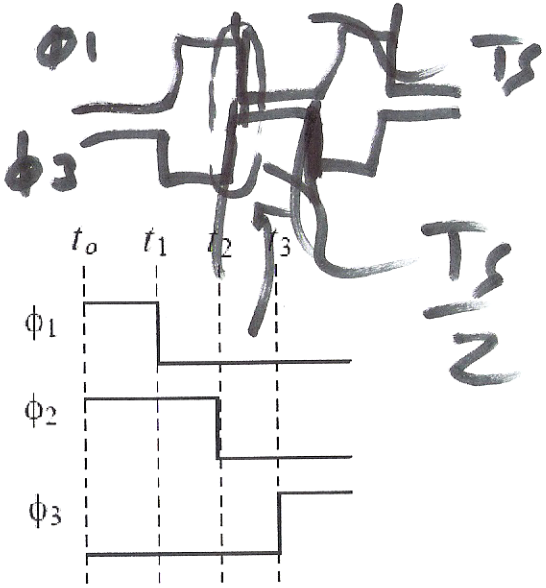
$V_{IN} = V_{IN+} - V_{IN-} = 1 - 0 = 1V$

$0 - 1 = -1V$

Figure 2.39 Fully-differential S/H differential topology.

3)





$t_3 = t_3 + \frac{T_S}{2}$

Figure 2.41 S/H with input-referred offset and noise shown.

$$Q_F^{\phi_1} = C_F\left(v_{in}(t_3) - V_{cm} \pm V_{OS} - v_{inoise}(t_3)\right)$$

$$Q_F^{\phi_3} = C_F\left(v_{out}(t) - V_{cm} \pm V_{OS} - v_{inoise}(t)\right)$$

$$v_{out}(t) = v_{in}(t_3) + v_{inoise}(t) - v_{inoise}(t_3)$$

$$V_{out}(f)\cdot e^{j2\pi ft} = V_{in}(f)\,e^{-j2\pi f t_3} + V_{inoise}(f)\left(e^{-j2\pi ft} - e^{-j2\pi f t_3}\right)$$

4)

$$V_{OUT}(f) = \underset{NOISE}{V_{IN}}(f)\,\frac{\left(1 - e^{-j2\pi f \frac{T_s}{2}}\right)}{1 - z^{-1/2}}$$

$$\left|\frac{V_{OUT}(f)}{V_{IN}(f)}\right| = 2\left|\sin \pi f_s \cdot \frac{T_s}{2}\right|$$

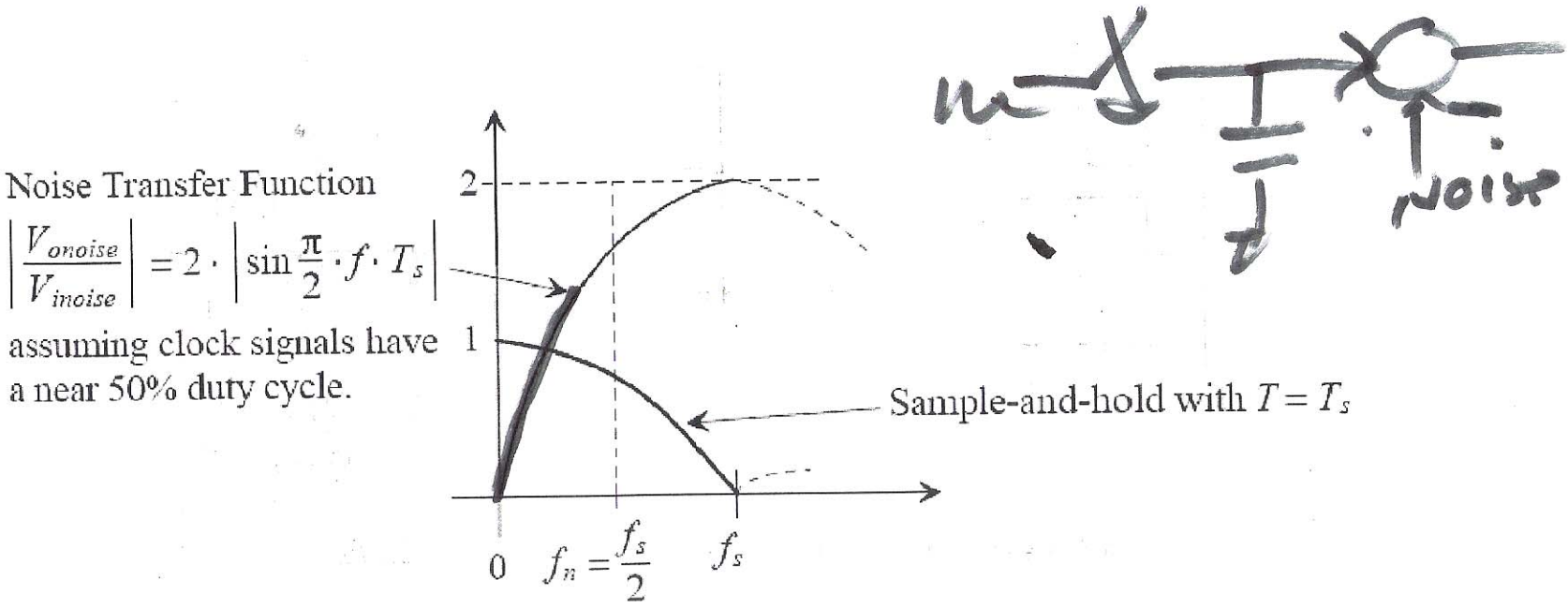


Figure 2.42 The noise transfer function of a S/H.

Autozero followed S/H is called Correlated Double Sampling. (CDS)

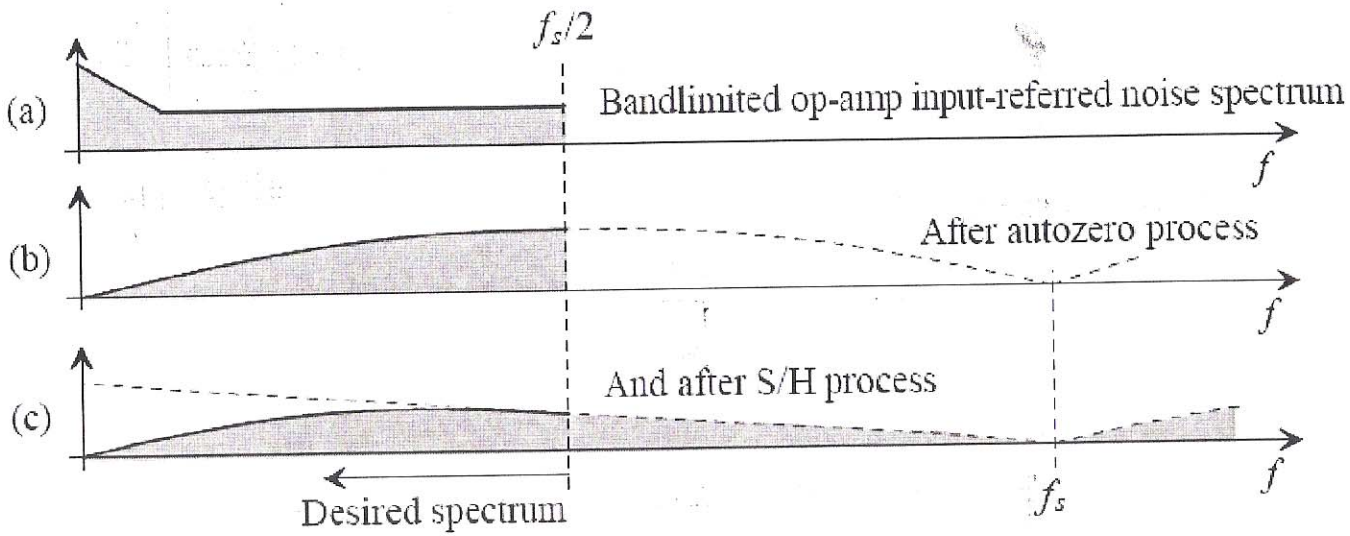


Figure 2.43 Example spectrums when S/H in Fig. 2.39 is used.

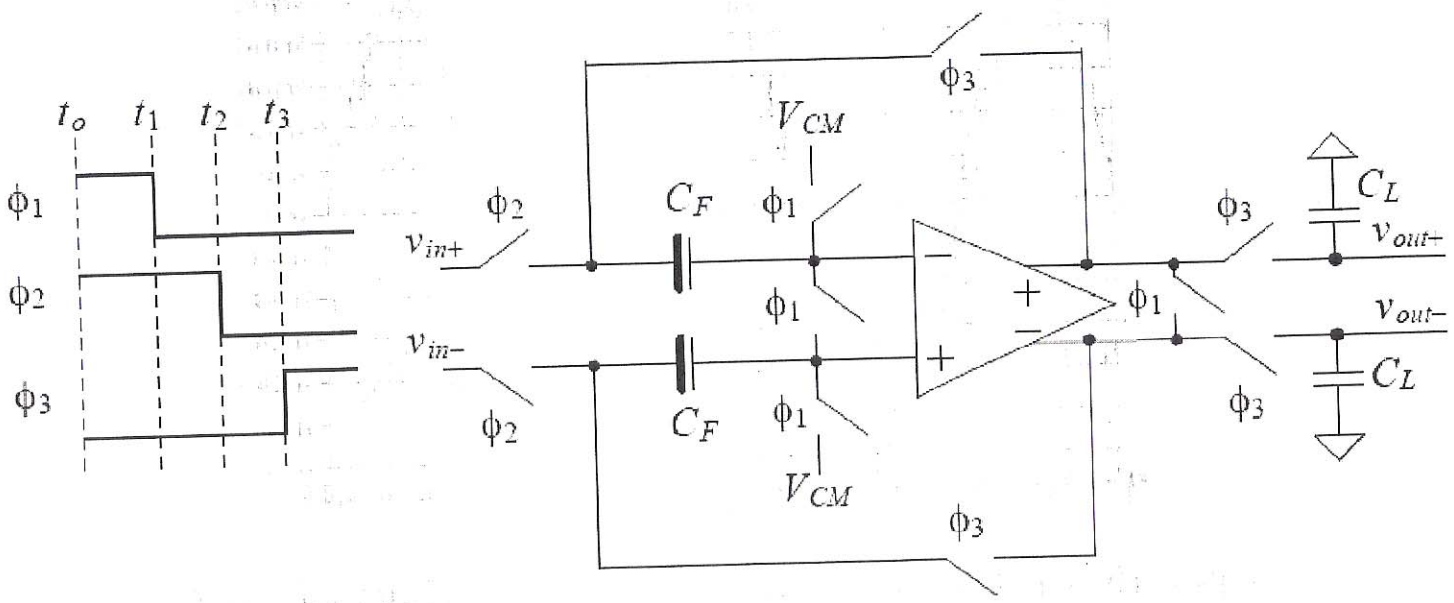


Figure 2.45 Fully-differential S/H differential topology without using CDS.

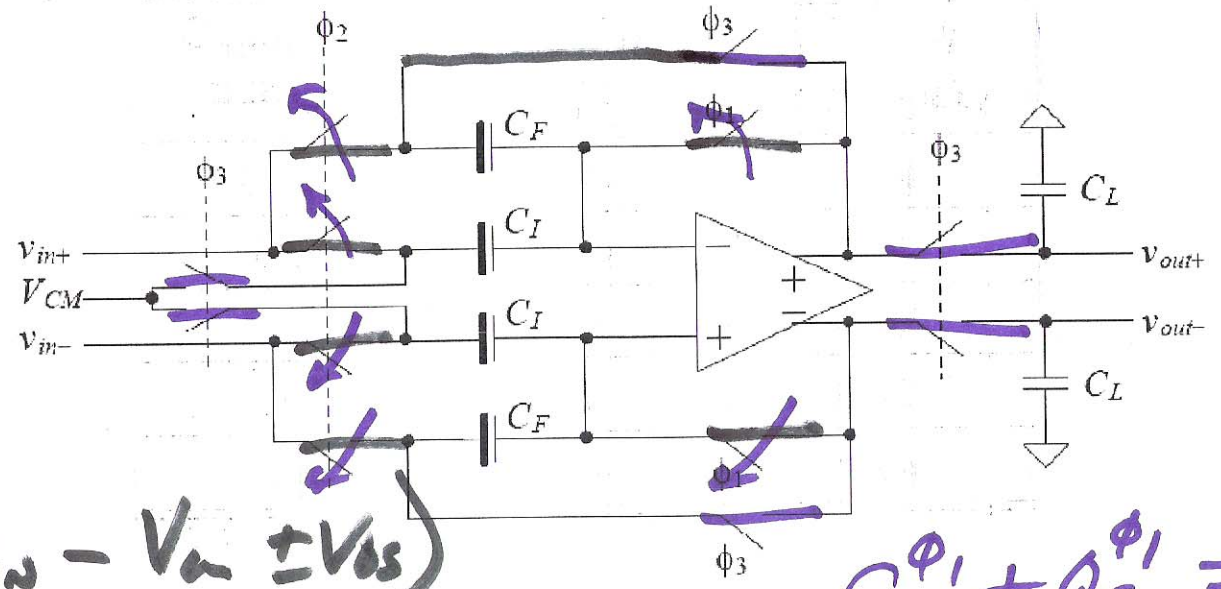


Figure 2.46 A S/H with gain.

$$Q_I^{\phi_1} = C_I(V_{in} - V_m \pm V_{os})$$

$$Q_F^{\phi_1} = C_F(V_{in} - V_m \pm V_{os})$$

$$Q_I^{\phi_1} + Q_F^{\phi_1} = Q_I^{\phi_3} + Q_F^{\phi_3}$$

$$(C_I + C_F)(V_{in} - V_m \pm V_{os})$$

$$Q_I^{\phi_3} = C_I(V_m - V_m \pm V_{os}) = C_I(\pm V_{os})$$

$$Q_F^{\phi_3} = C_F(V_{out} - V_m \pm V_{os})$$

$C_I(\pm V_{os})$ $+C_F$ $(V_{in} - V_m \pm V_{os})$

$$C_I V_{in} - C_I V_{os} \pm C_I V_{os} + C_F V_{in} - C_F V_{os} \pm C_F V_{os}$$

$$= C_I(\pm V_{os}) + C_F(v_{out}) - C_F V_{os} \pm C_F V_{os}$$

$$V_{out}\Big|_{-}^{+} = \frac{C_I}{C_F} V_{in}\Big|_{-}^{+} + V_{in}\Big|_{-}^{+} - \frac{C_I}{C_F} V_{os}$$

for full V-dif

$$\frac{V_{out}}{V_{in}} = 1 + \frac{C_I}{C_F}$$

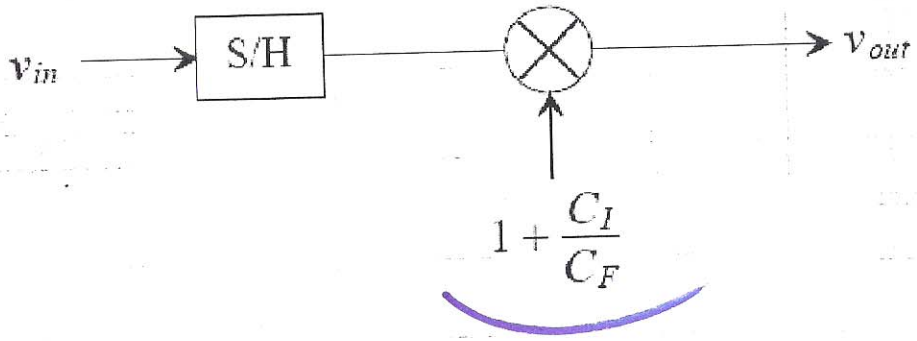


Figure 2.47 Block diagram for the S/H of Fig. 2.46.

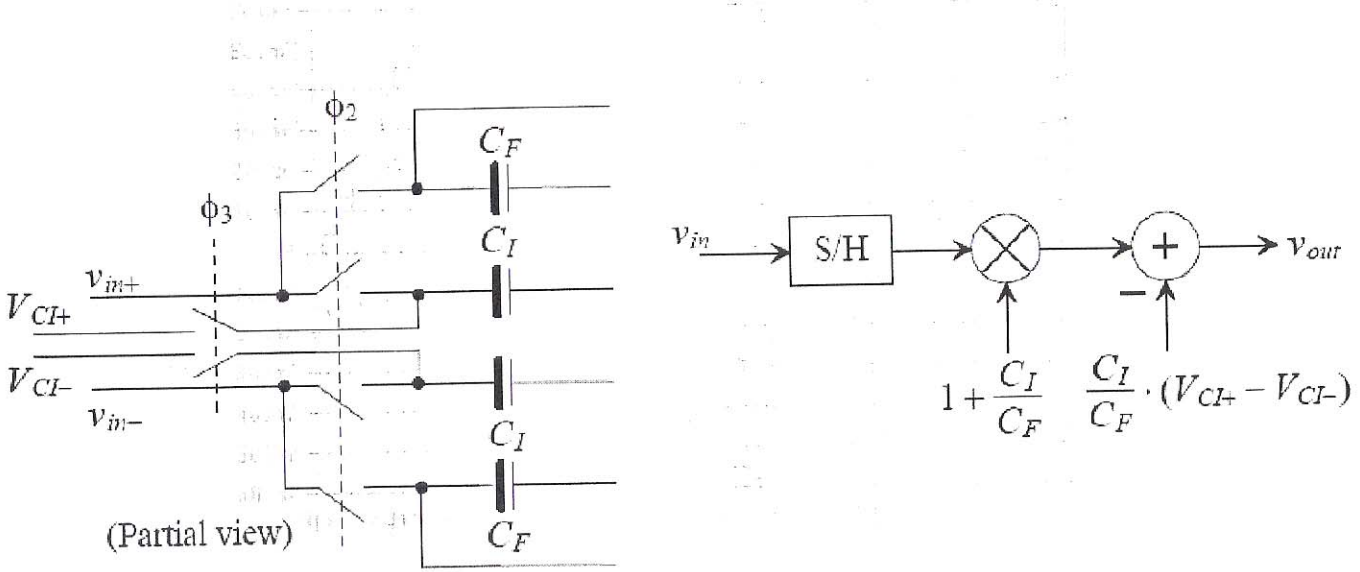


Figure 2.49 Implementing subtraction in the S/H.