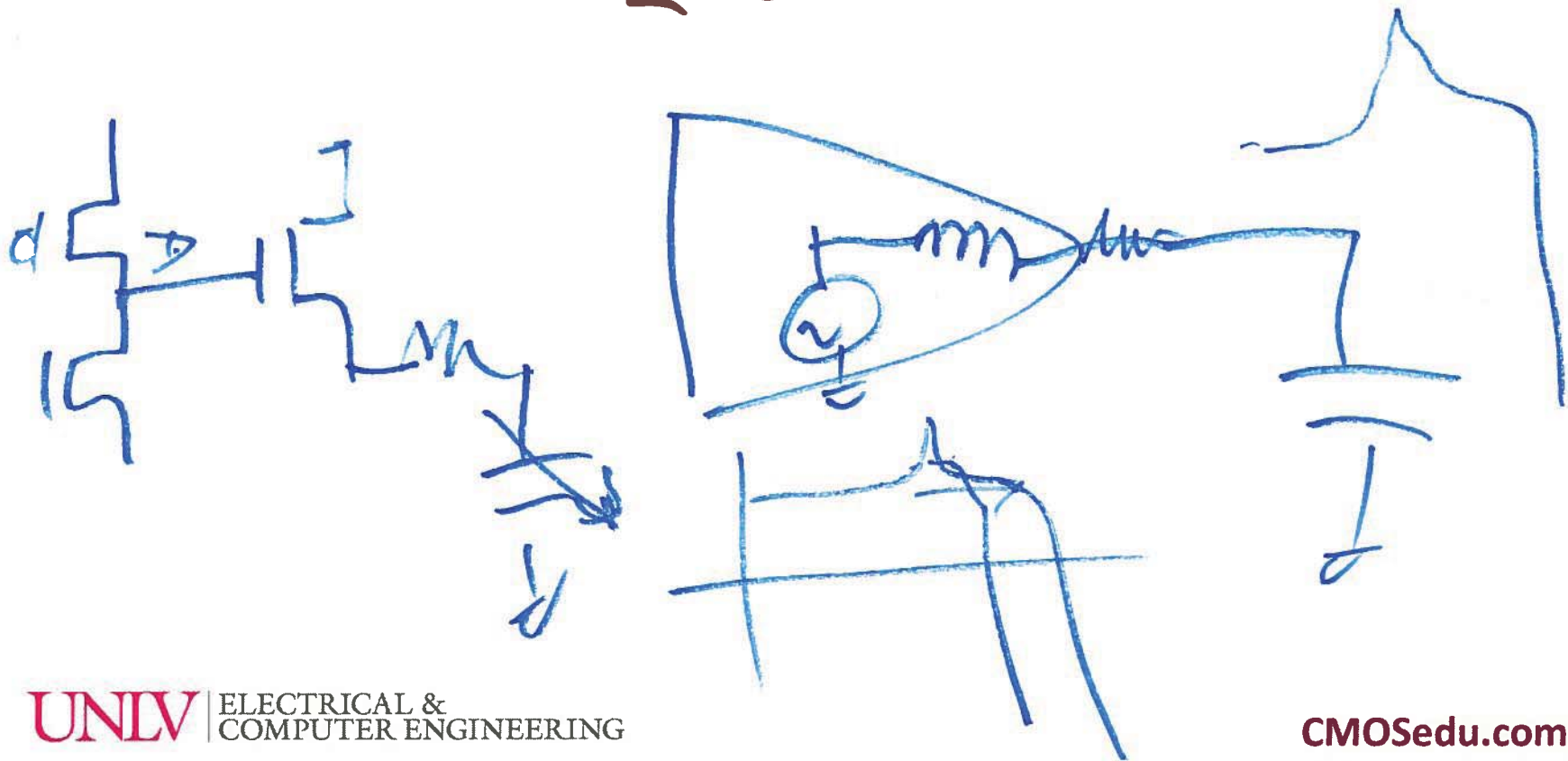


ECU 720 Advanced Analog IC Design

April 26, 2016

Lecture 26



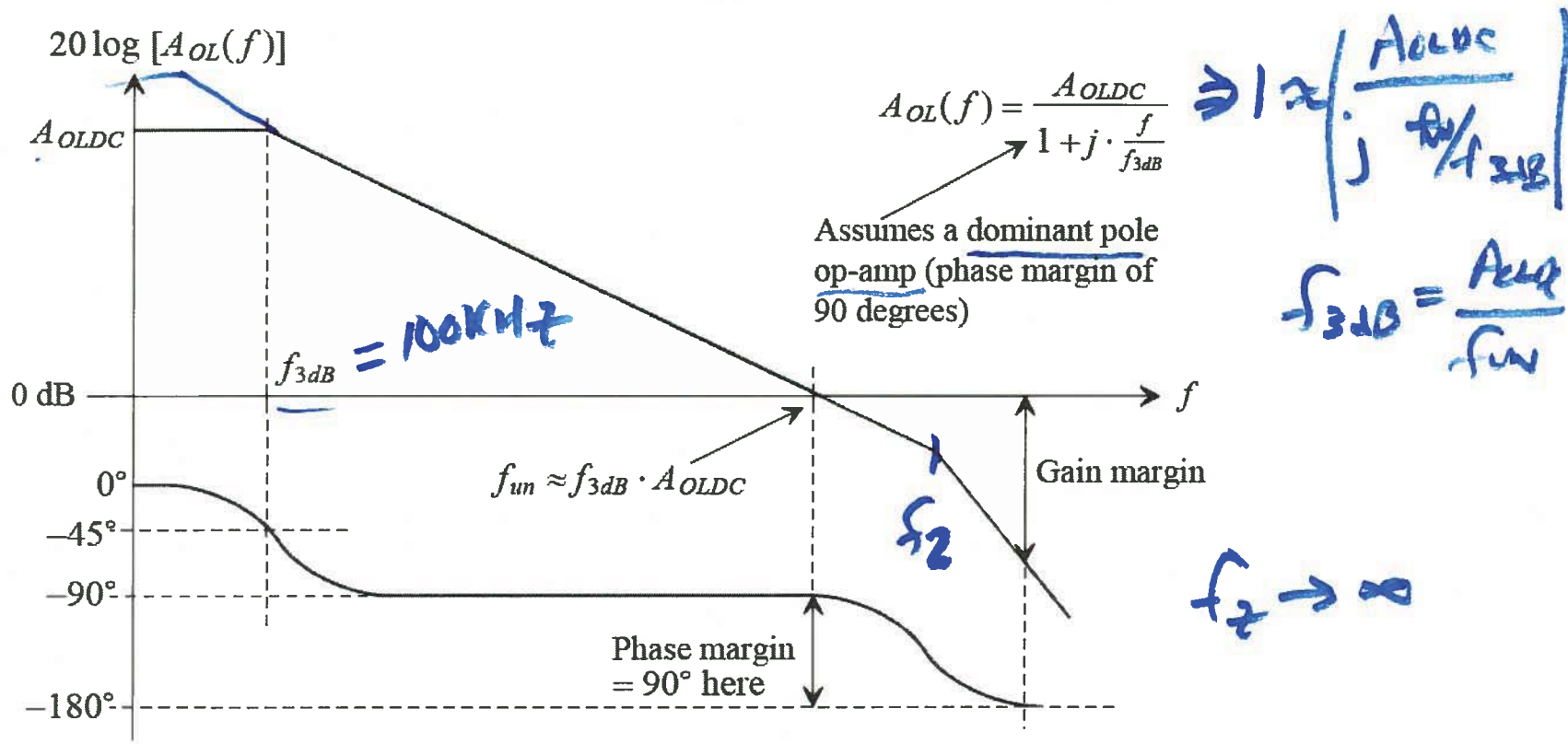


Figure 30.21 Magnitude and phase responses of an op-amp.

- To be added

$$\rightarrow \frac{100 \text{ MHz}}{1,000} =$$

$$f_{un} = 100 \text{ MHz}$$

$$A_{OLDC} = 60 \text{ dB} = 1,000$$

10-bit Converter

$$V_{REF} = 5V$$

A_{OL} needed so that error due to finite A_{OL} $\ll \frac{1}{2} \text{LSB}$

MAX INT

$$V_{REF} - 1\text{LSB} \quad 1\text{LSB} = \frac{5}{2^{10}} \approx 5\text{mV}$$

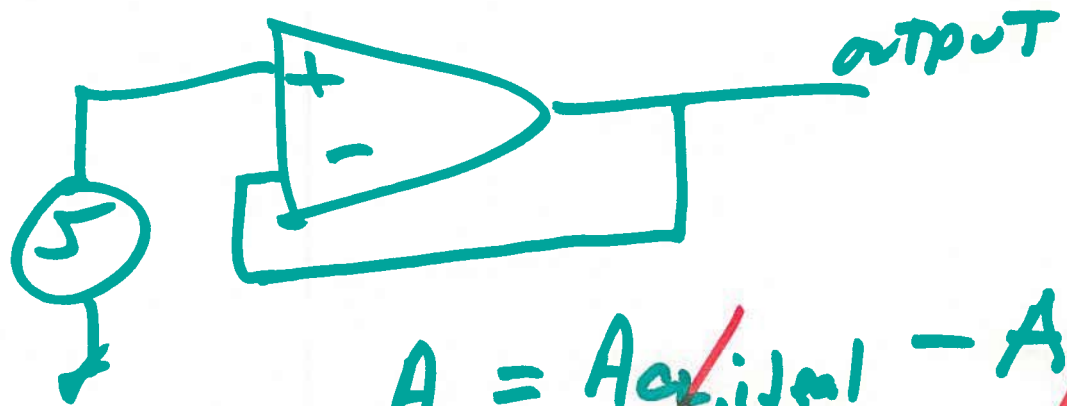
$$\approx 1\text{LSB} \cdot 2^N$$

error to be $\ll 2.5\text{mV}$

$$= \frac{1}{2} \text{LSB} \cdot 2^N$$

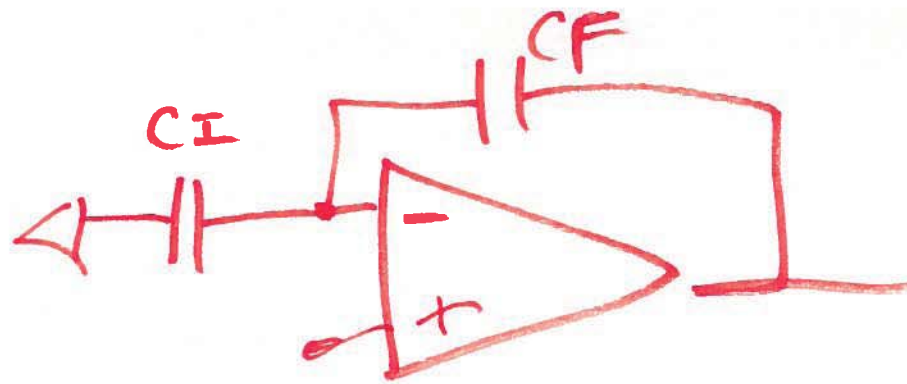
$$= 1\text{LSB} \cdot 2^{N+1}$$

$$A_{OL} \rightarrow 2^{N+1} / \beta \leftarrow \frac{1}{\frac{1}{A_{OL}} + \beta} =$$



$$A_{OL} = A_{CL} = A_{CL, ideal} - A_{error}$$

$$= \frac{1}{\beta} - \frac{1}{\beta \cdot 2^{N+1}}$$



$$|A_{cl}| = \frac{C_I}{C_F} - \Delta A = \frac{A_{OLDC}}{1 + \beta \cdot A_{OLDC}}$$

$$\beta = \frac{C_F}{C_F + C_I}$$

$$|A_{OLDC}| \gg 2^{N+2}$$



$$V_{OUT} = V_{OUT\text{final}} \left(1 - \frac{1}{2^{N+1}} \right) = V_{OUT\text{final}} \cdot \left(1 - e^{-t/\tau} \right)$$

$$\tau = \frac{1}{2\pi \cdot \beta \cdot f_{clk}}$$

$$f_{clk} \gg 0.44 \cdot (N+1) f_{clk}$$

4)

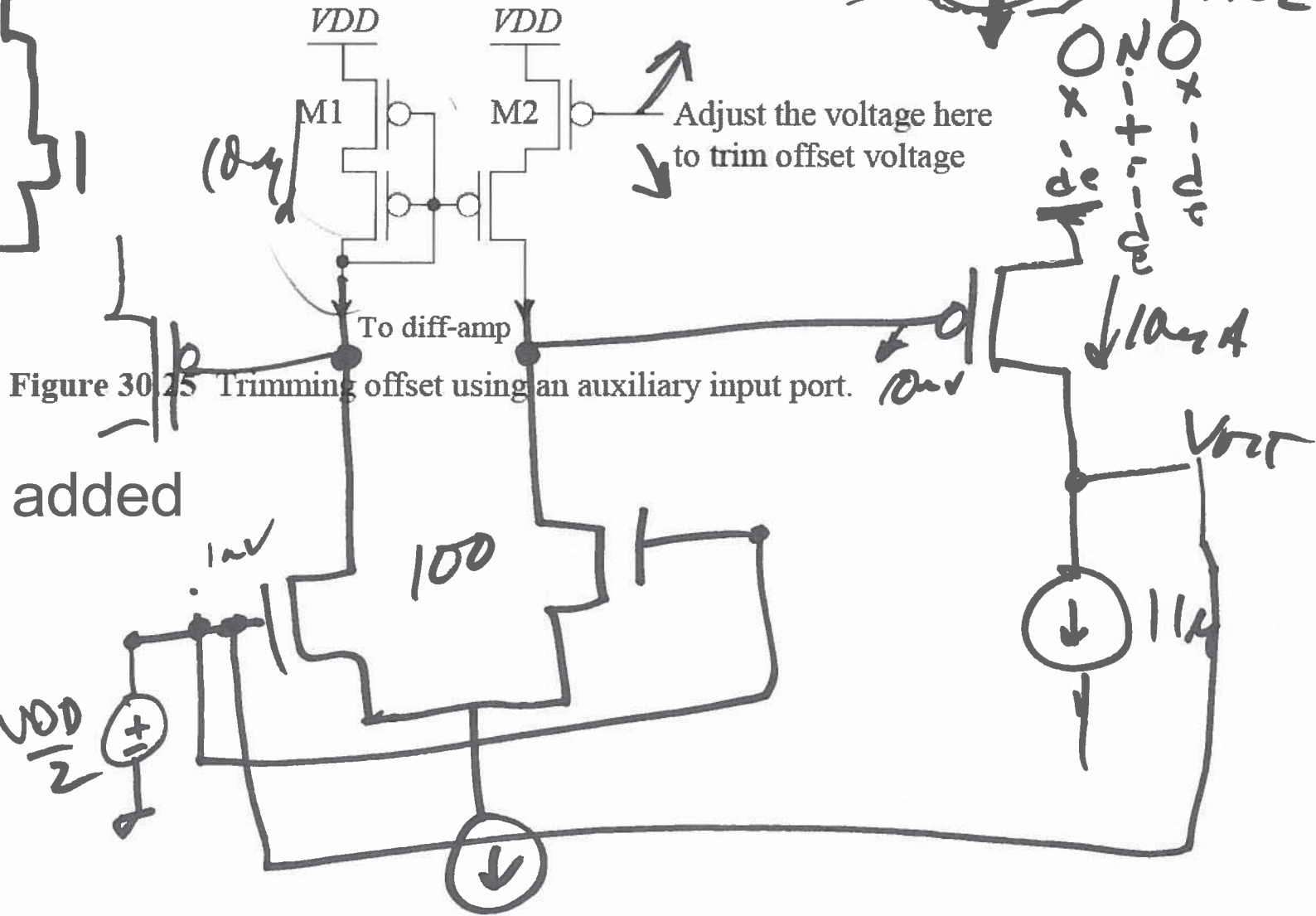
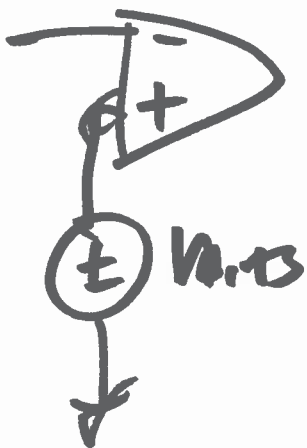


Figure 30.25 Trimming offset using an auxiliary input port.

- To be added



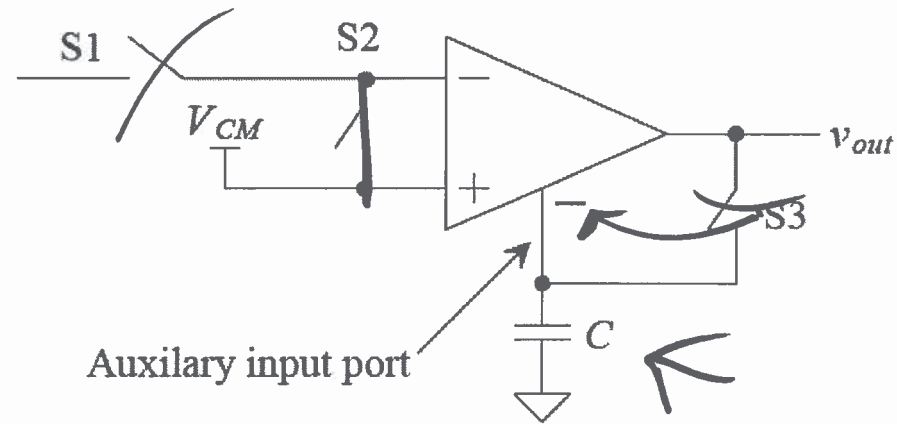


Figure 30.26 Using an auxiliary input port to lower offset.

- To be added

6)

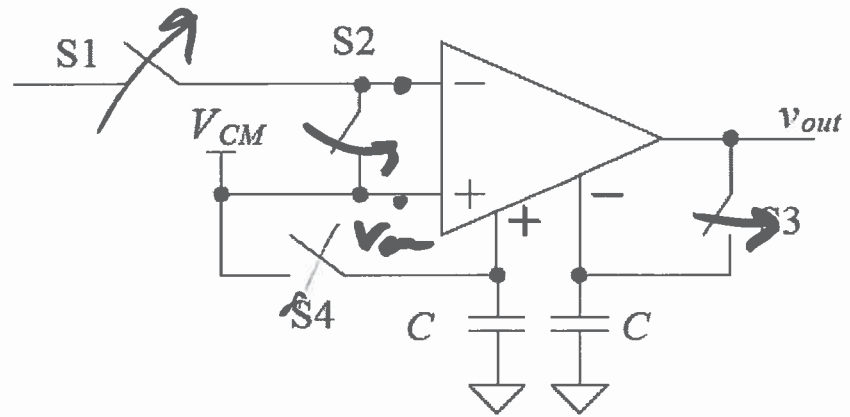
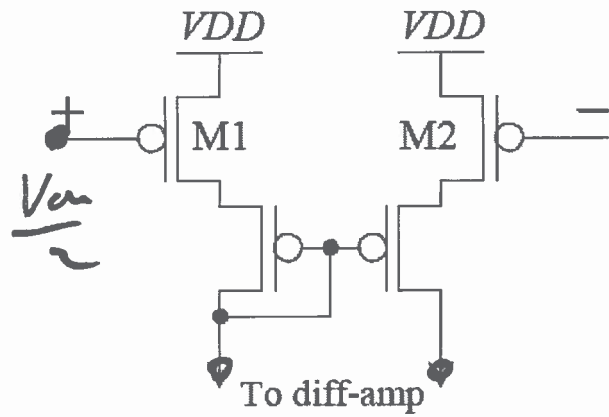


Figure 30.27 Using an auxiliary input port to lower offset (two terminals).

- To be added

7)

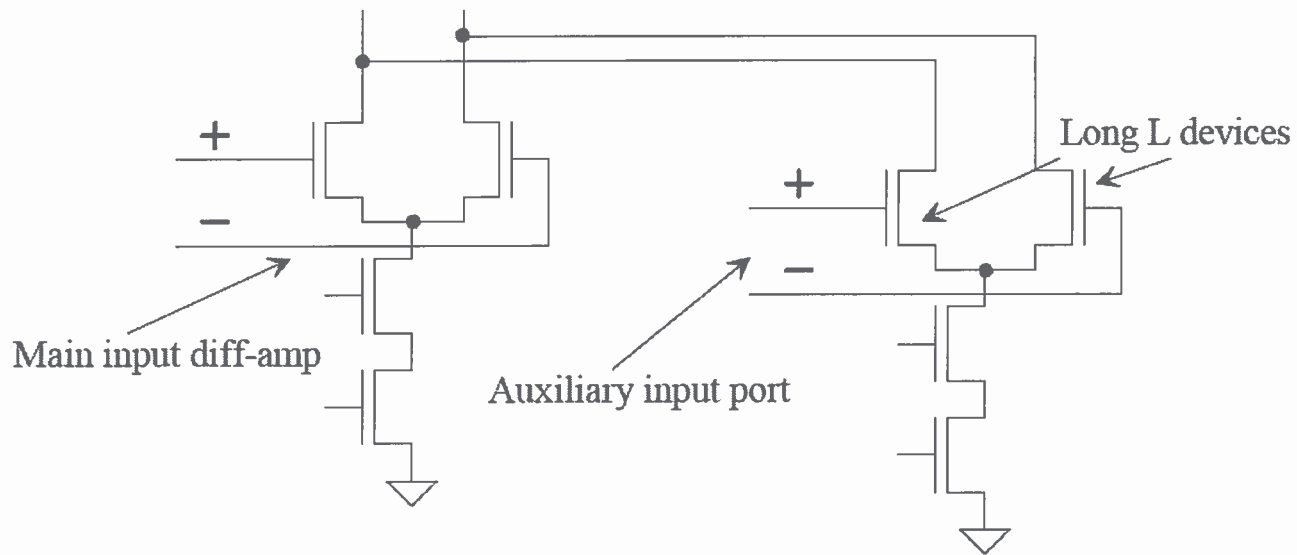


Figure 30.28 Using an auxiliary diff-amp for balancing current in an op-amp's input.

- To be added

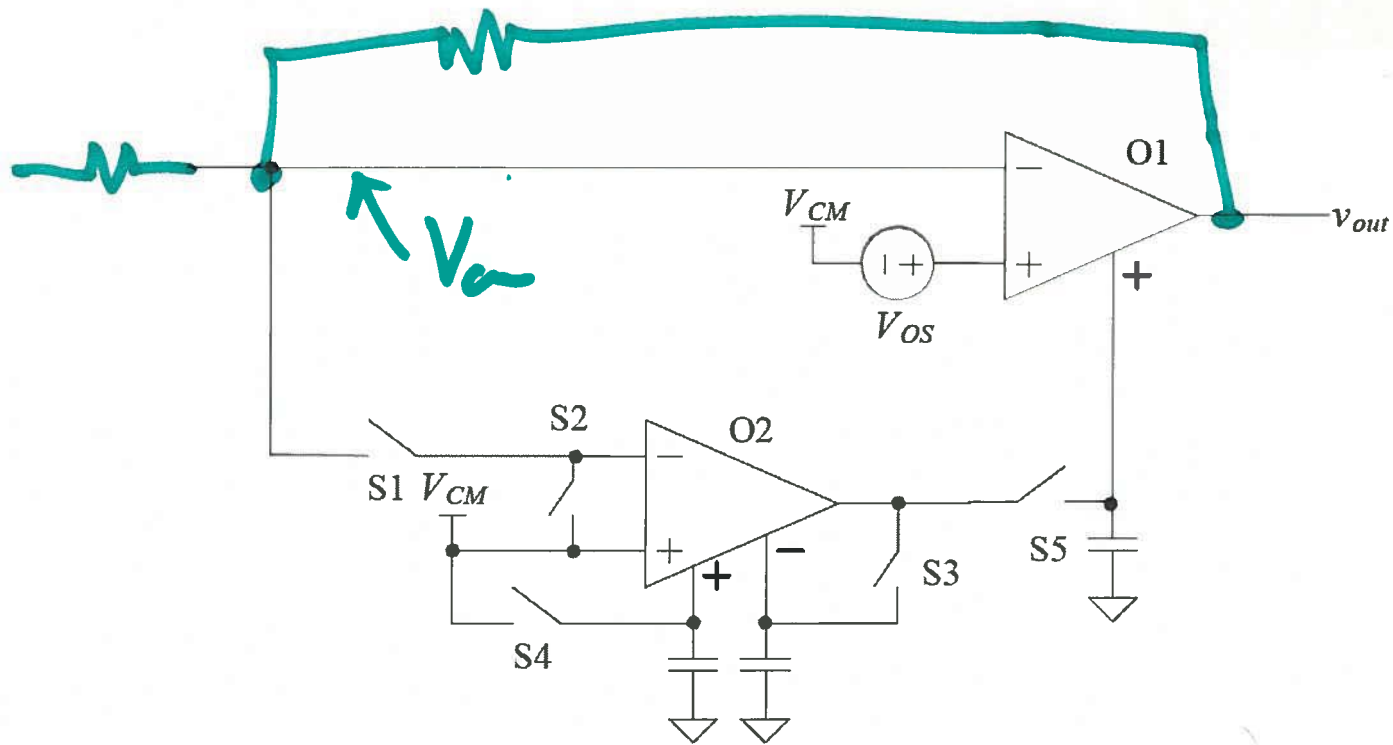


Figure 30.29 Continuous-time offset removal.

- To be added

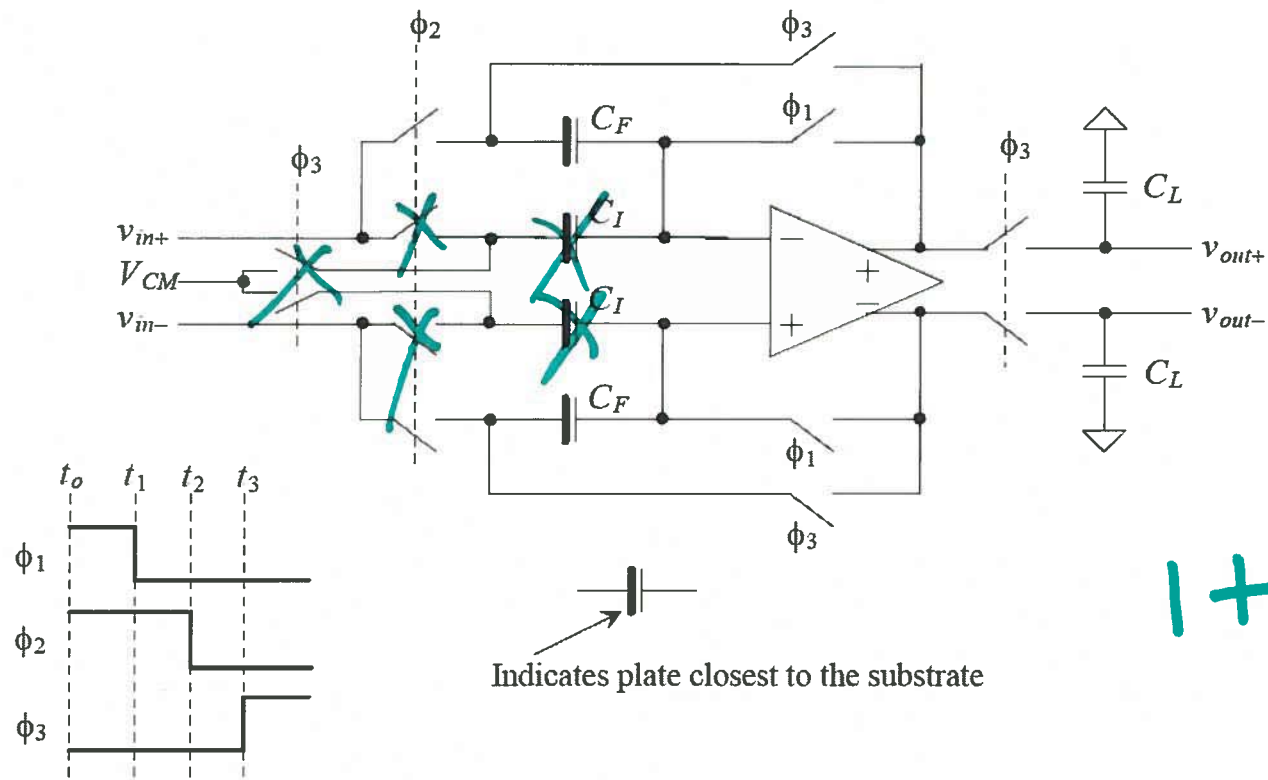
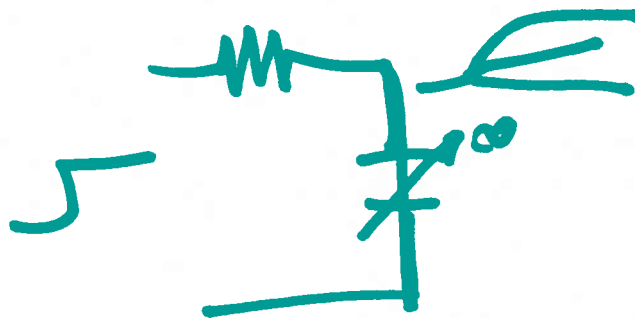


Figure 30.30 Data converter S/H building block.

- To be added



10)

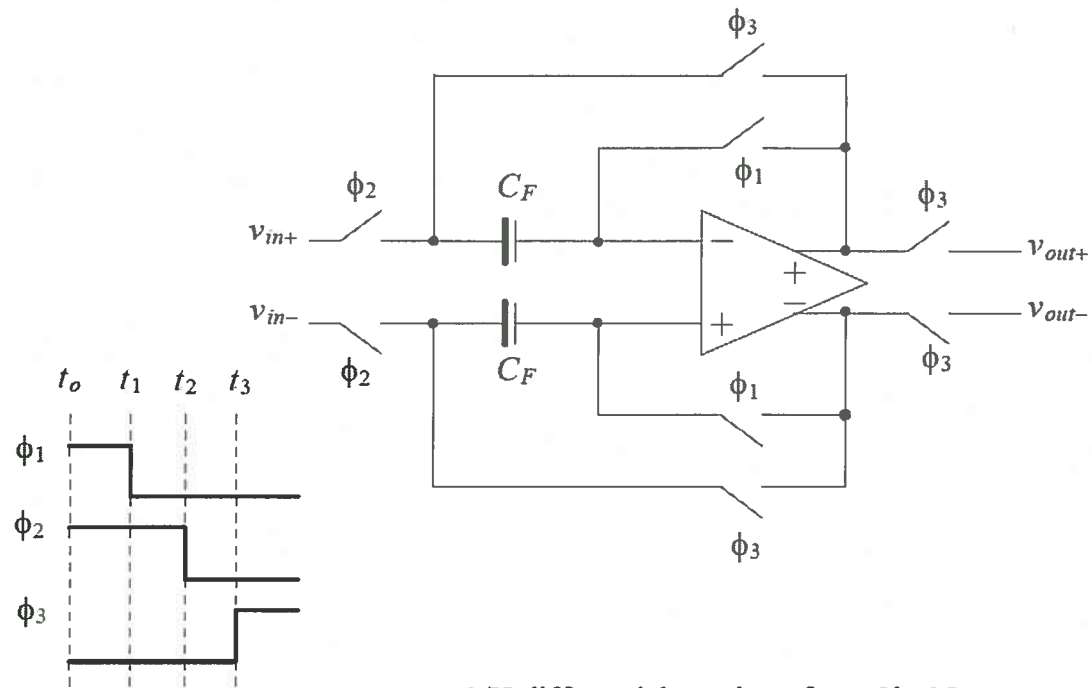


Figure 30.31 S/H differential topology from Ch. 25.

- To be added



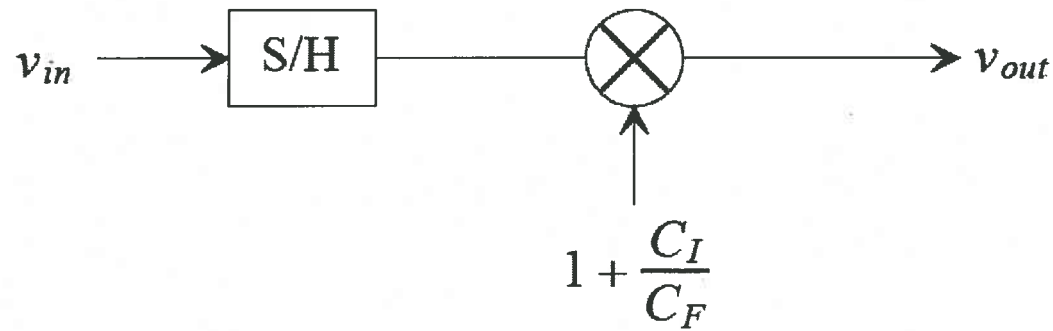


Figure 30.32 Block diagram for the S/H of Fig. 30.30.

- To be added

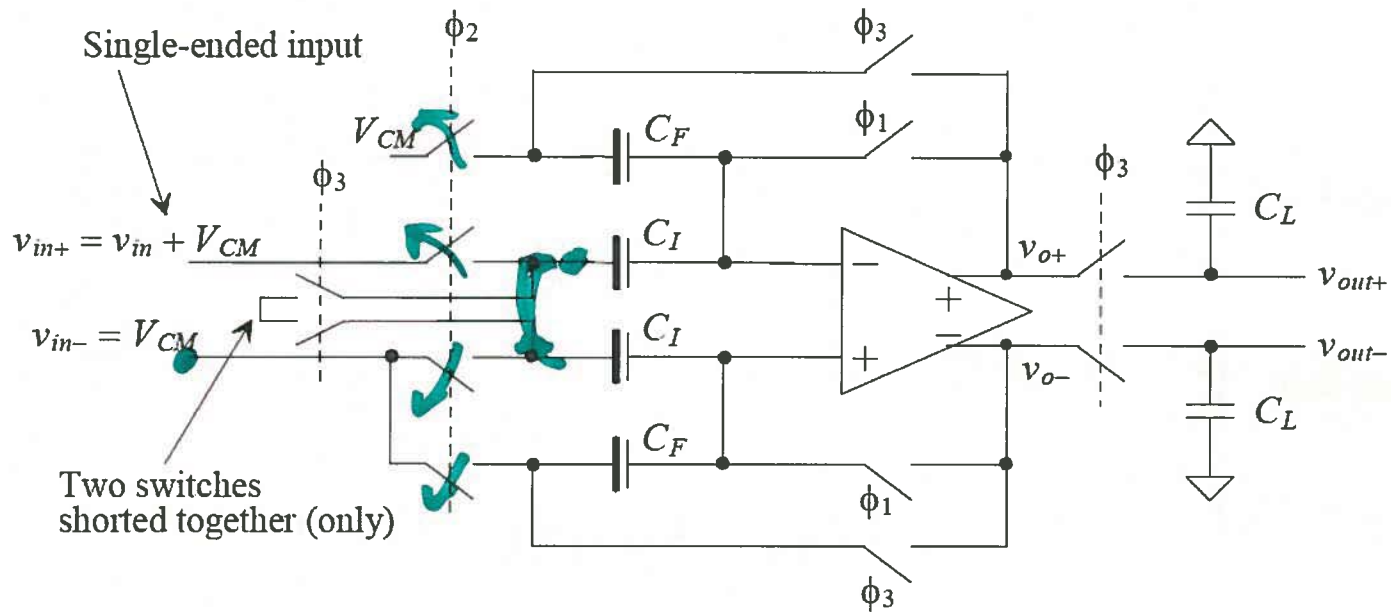


Figure 30.34 Single-ended to differential S/H.

practical way to

- To be added

13)