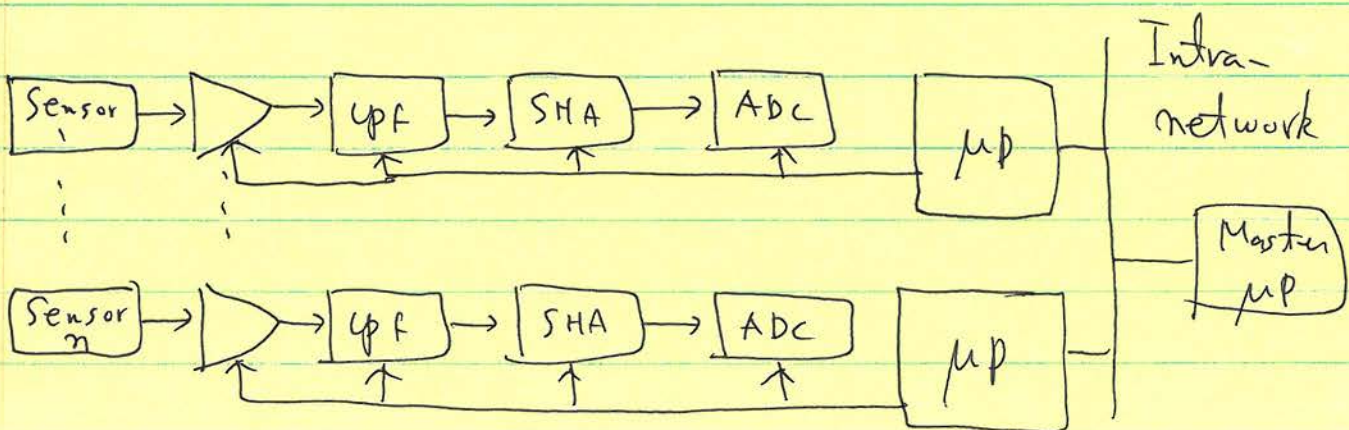
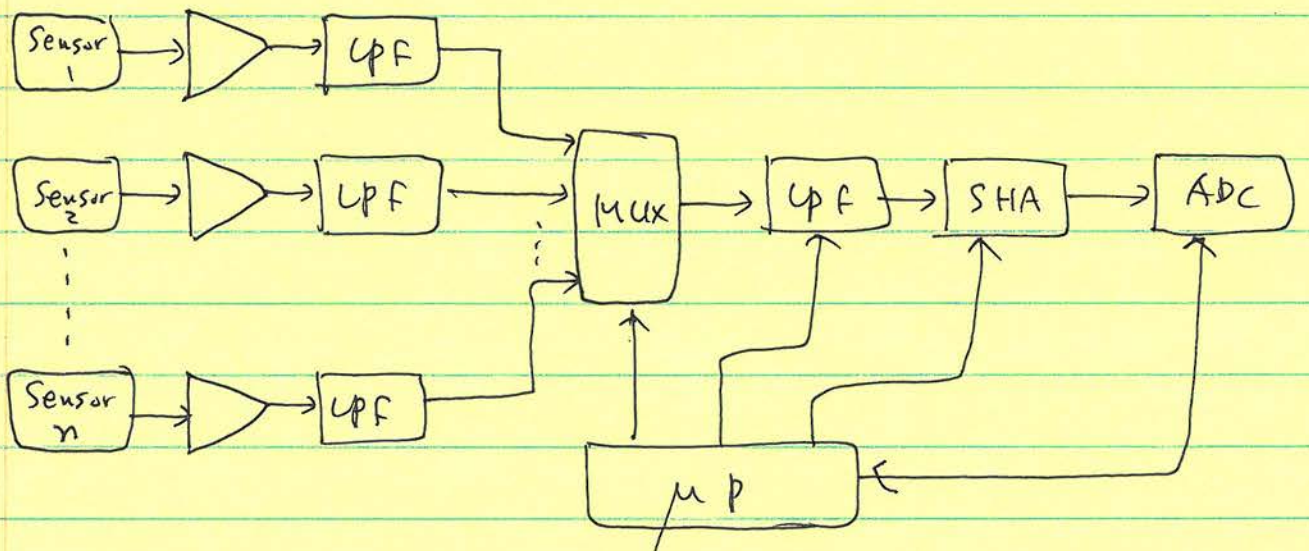
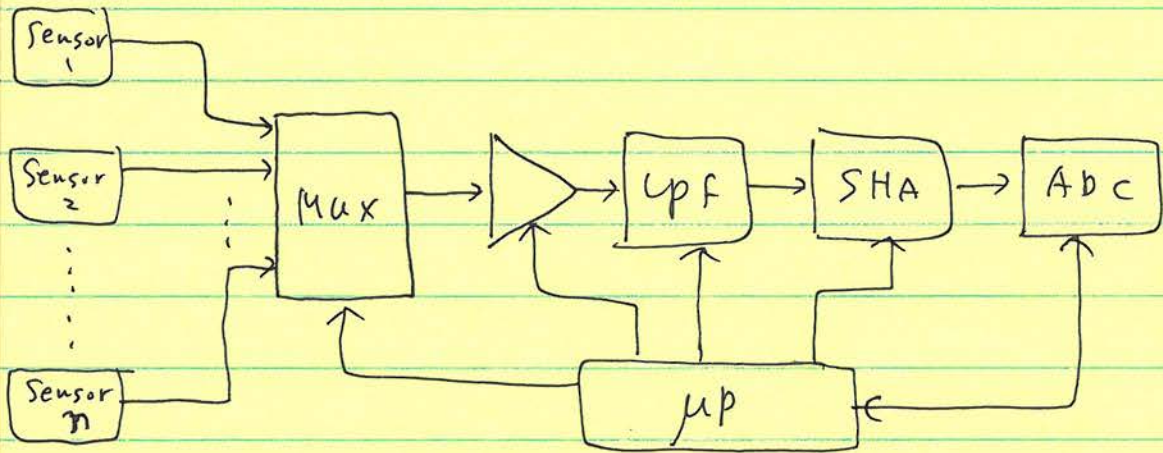
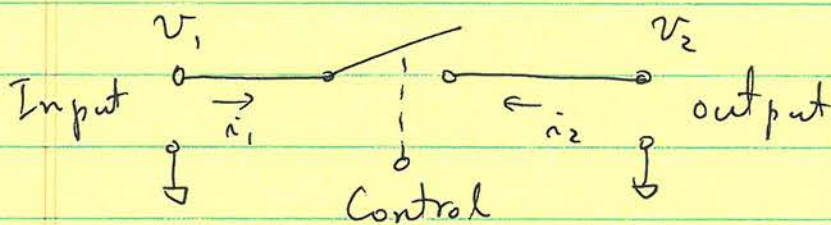


# \* Analog Signal Switching and Multiplexing

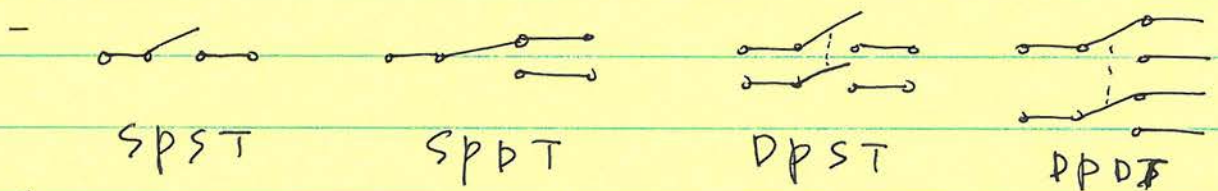


# ① Analog Switch



- Ideal Switch
  - closed :  $v_1 = v_2$  ,  $i_1 = i_2$
  - open :  $v_2 = 0$  ,  $i_1 = i_2 = 0$

- NO : normally open
- NC : normally closed



(Single-pole Single-throw)

- DT
  - break-before-make
  - make-before-break

- $\begin{matrix} \uparrow \\ \downarrow \end{matrix} \frac{z}{\pi}$  Relay
  - BJT, MOSFET (JFET, MOSFET)



Reed relay :  $R_{on} \sim 150 m\Omega$   
 High isolation  
 Bulky

Semiconductor switch :  $R_{on} \sim \frac{1}{2} \sim \frac{1}{3} \Omega$   
 Low isolation (in general)  
 Small

-  $R_{on}$  &  $R_s$  vs  $R_c$  &  $C_{on}$  &  $C_c$  vs  
 stray capacitance & time constant  $\tau$



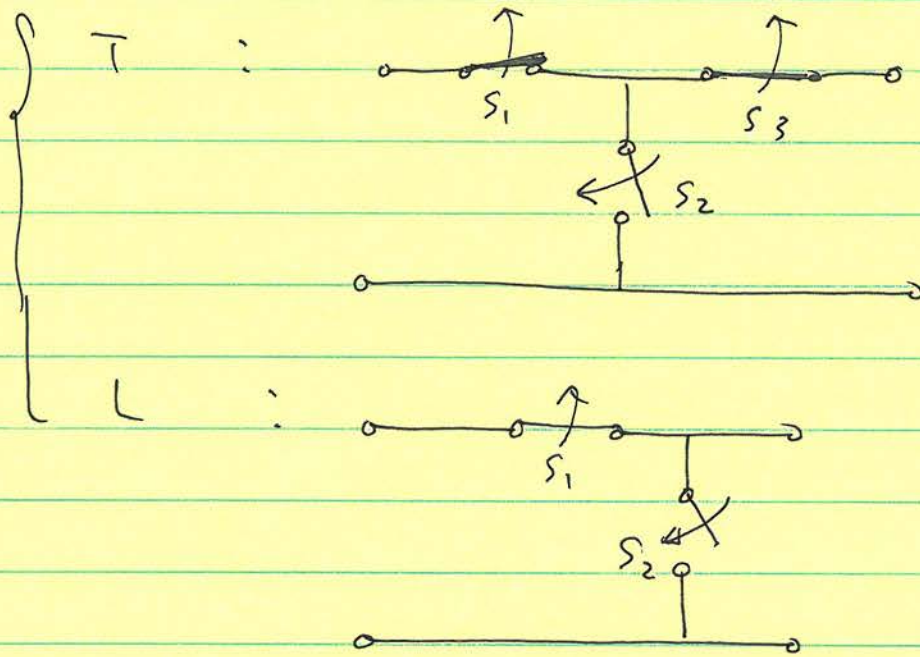
$\Rightarrow$  Finite settling time  
 $\tau$

$\Rightarrow$  fast switching & fast <sup>high resolution</sup> ADC  $\frac{1}{n}$   
 delay  $\tau$ .

-  $C_{DS} = 0.1 \sim 5 pF$  : <sup>off</sup> isolation  $\Rightarrow$   $\tau$   $\propto R_c C_c$

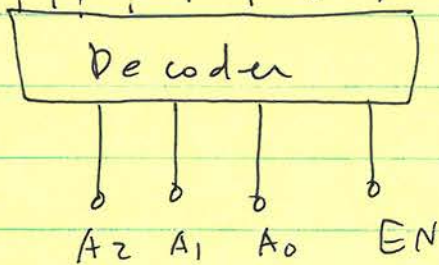
↑  
 drain & source  $\tau$  Capacitance

- High frequency  $\Rightarrow$  off isolation  $\approx$   $> 10^2 \tau$   
 $\Rightarrow$  stray capacitance  $\tau$



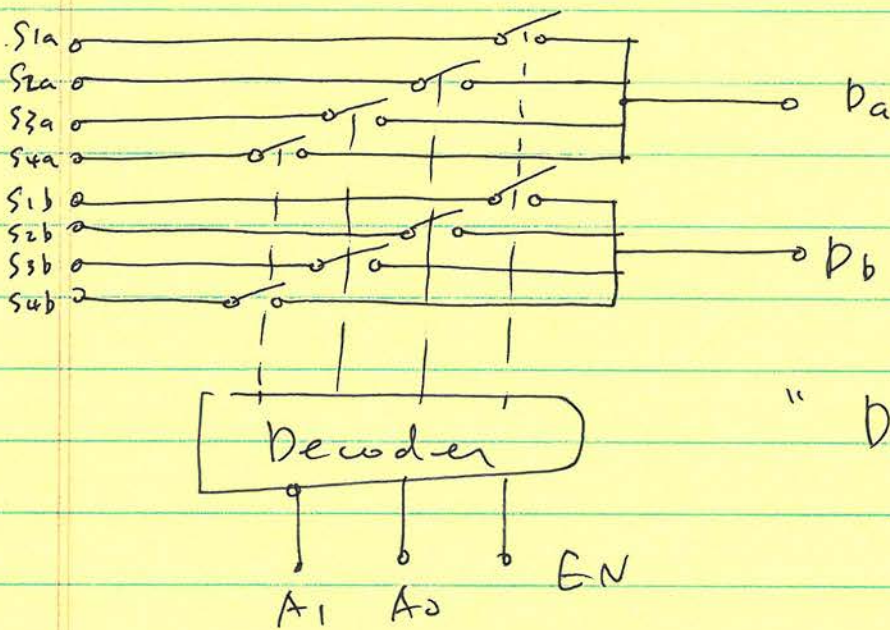
- Switching time  $\left\{ \begin{array}{l} t_{on} \\ t_{off} \end{array} \right.$

## ② Analog Mux / DEMUX



" Single-ended Mux / DEMUX "





" Differential  
 Mux / DEMux "

- Crosstalk

