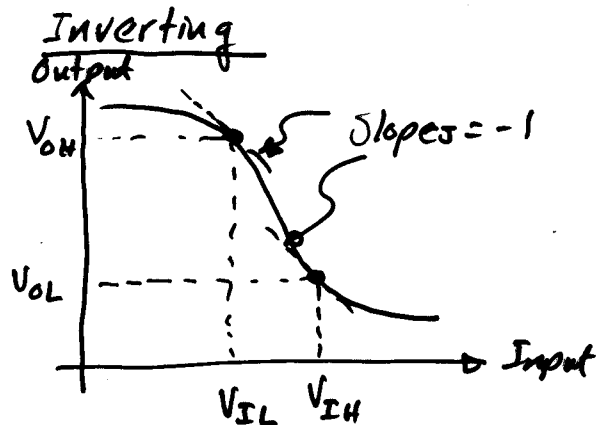
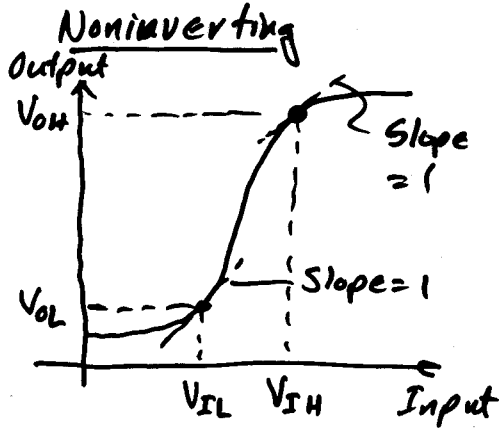
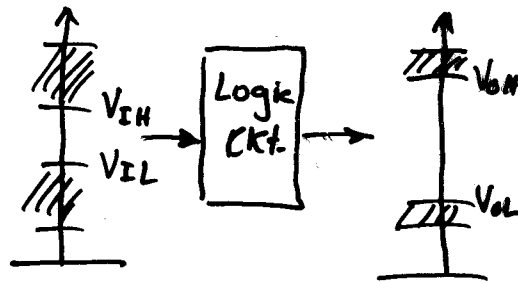
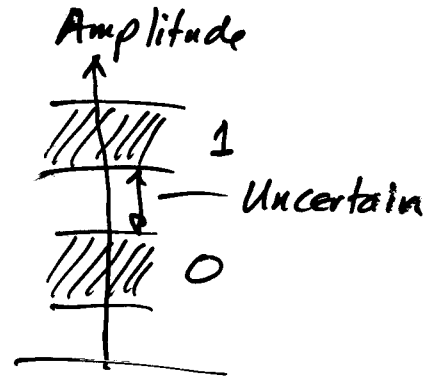


Implementation of Logic Circuits

Characteristics of electronic circuits necessary for processing digital information.

- 1.) Binary output must be a function of the binary inputs.
- 2.) Amplitude should be quantizable.
- 3.) Amplitude levels should be regenerated. Requires the VTC to have a gain > 1 .

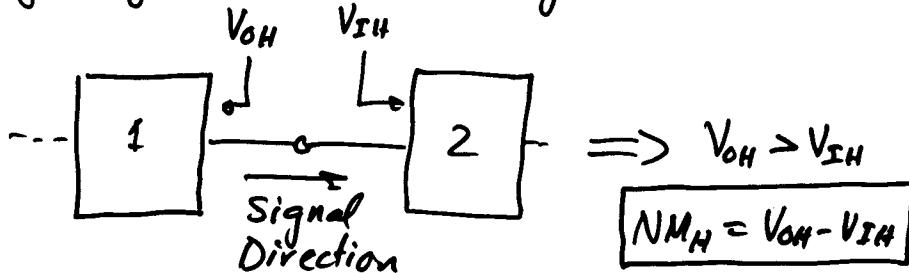


- 4.) Output should not influence the inputs (directivity)
- 5.) Fanout - The output of one logic circuit must be capable of driving more than one input of a similar ckt.
Fanin - number of independent inputs

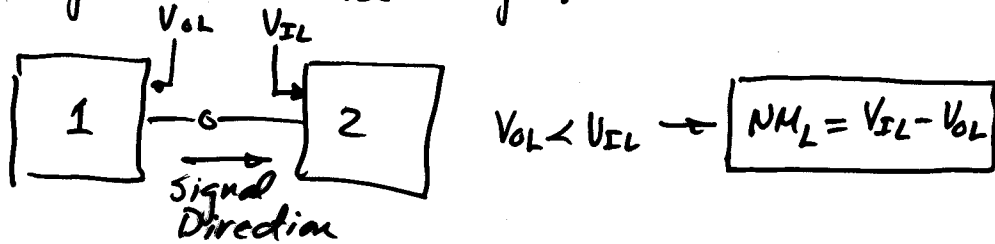
Noise Margins

Noise is an unwanted signals. If the unwanted signal is too large, it may cause logic errors.

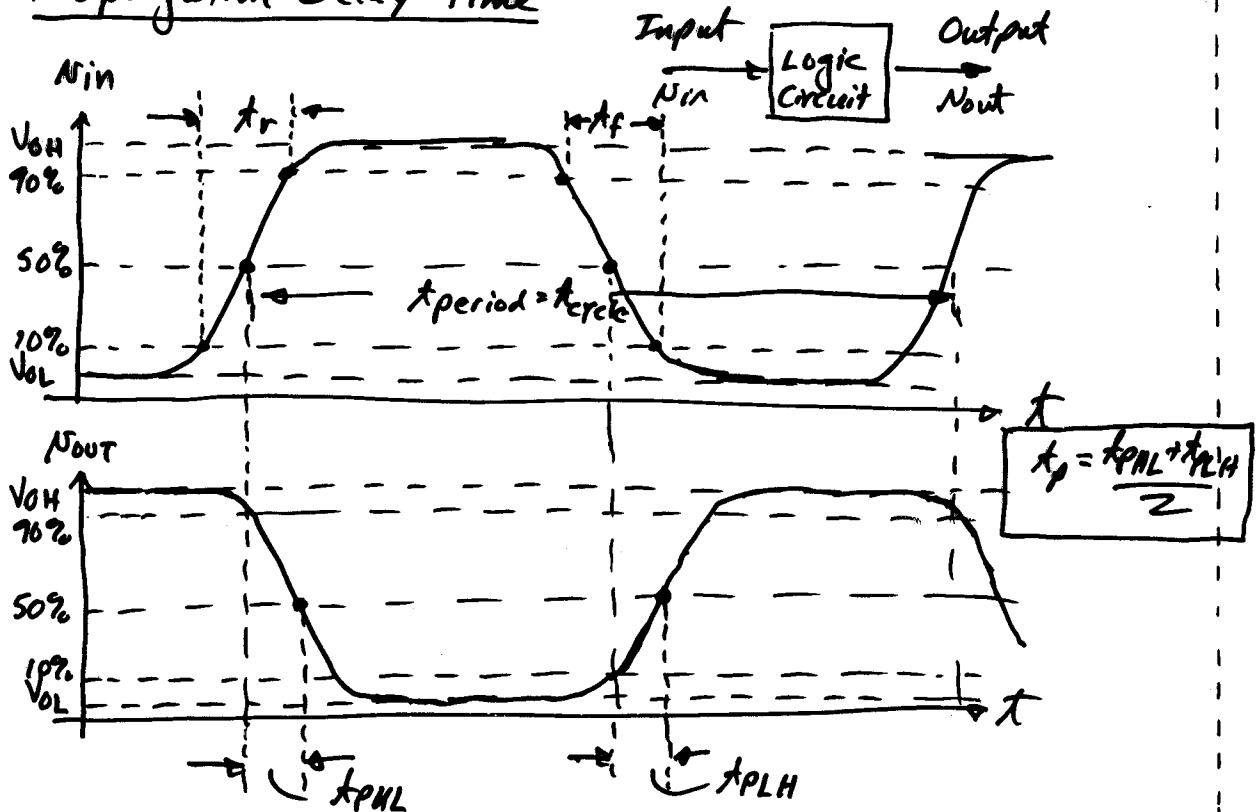
High Logic State Noise Margin:



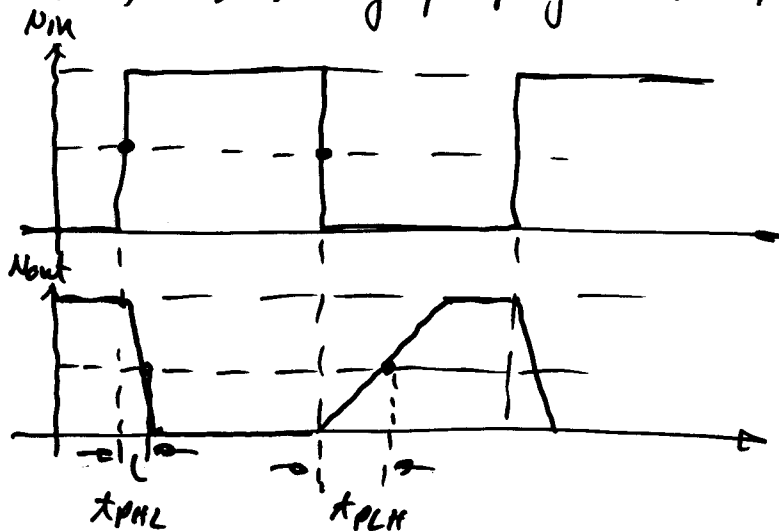
Low Logic State Noise Margin:



Propagation Delay Time



Motivation for defining propagation delay -



Power

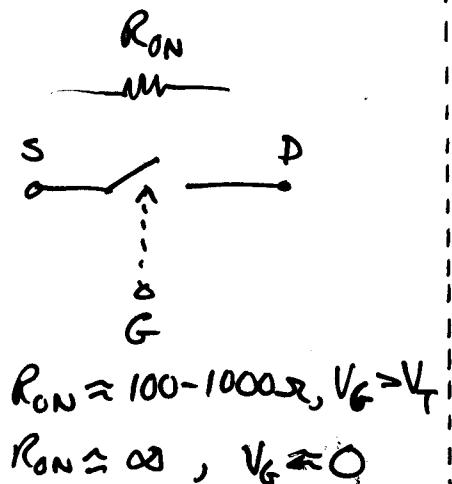
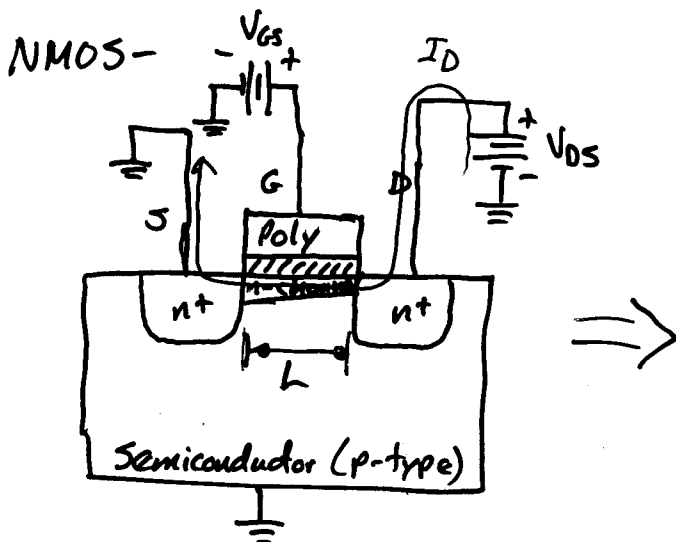
$$P_{total} = P_{static} + P_{dynamic} = (I_{DC} + I_{leakage})V_{DD} + CV_{DD}^2f$$

$I_{leakage}$ = current flowing when the logic off

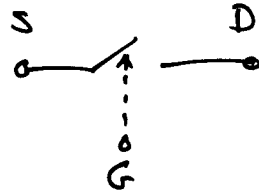
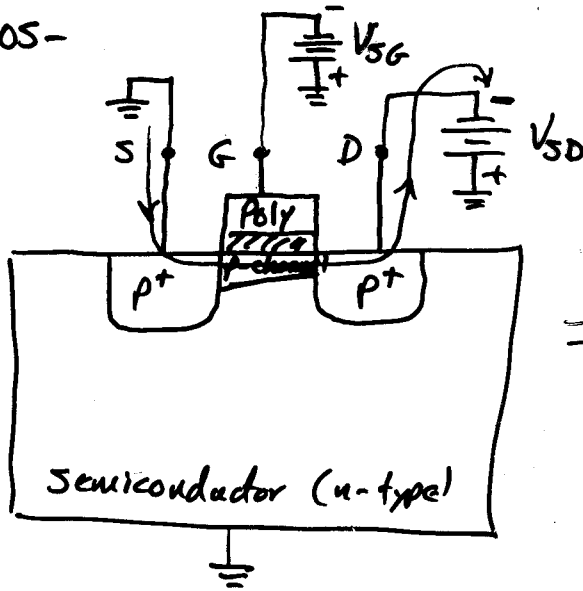
C = output capacitance

f = clock frequency

MOS Transistor Structure and Operation



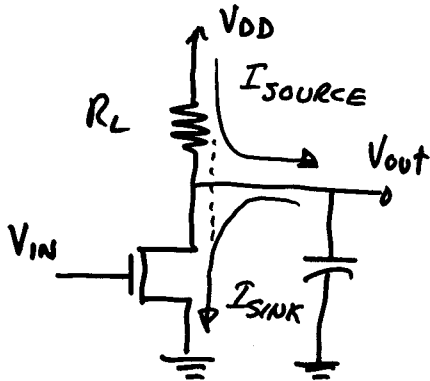
PMOS-



$R_{ON} \approx 100 - 1000 \Omega, V_{SG} > V_T$
 $R_{ON} \approx \infty, V_{SG} \leq 0$

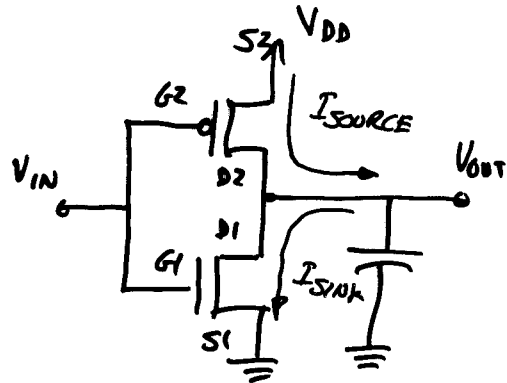
CMOS versus NMOS or PMOS

NMOS Inverter:



$I_{SINK} \gg I_{SOURCE}$

CMOS Inverter:



$I_{SOURCE} \approx I_{SINK}$

Consider the influence of substrate (bulk) -

