

# DC Characteristics

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# DC Characteristics

- Fundamentals
  - Almost all current digital integrated circuits are built in CMOS technologies
  - CMOS has relatively simple input and output characteristics
    - Inputs look like capacitors
    - Outputs look like a resistor in series with a switch

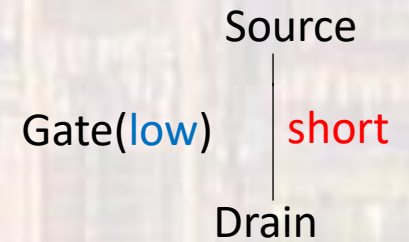
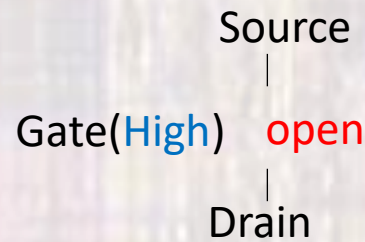
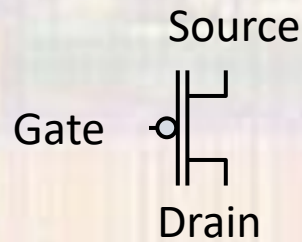
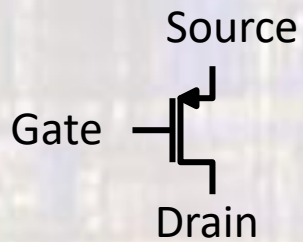
# DC Characteristics

- Terminology
  - High = '1' = 3.3V = vdd = set
  - Low = '0' = 0.0V = gnd = clear
  - On = terminals connected together = short = conducting
  - Off = terminals not connected = open
- Note: our system uses 3.3V, other systems will use other voltages – 12.0V 5.0V, 3.3V, 2.8V, 1.2V, 0.9V

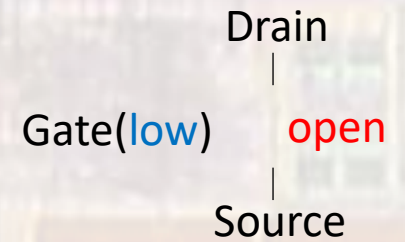
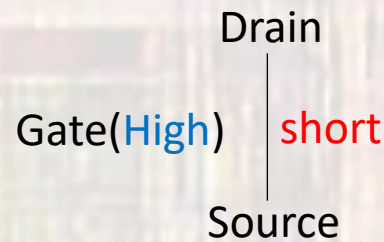
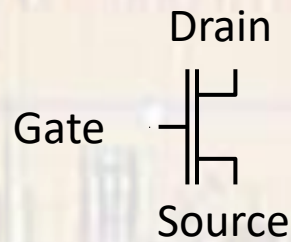
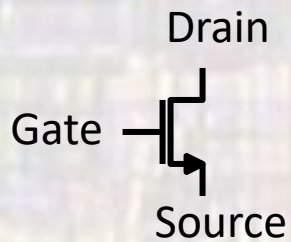
# DC Characteristics

- MOSFETs

- Pmos



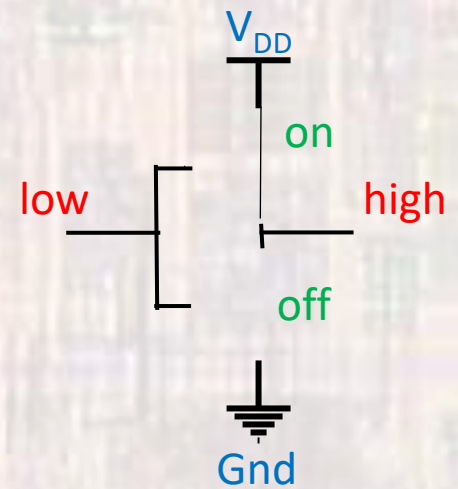
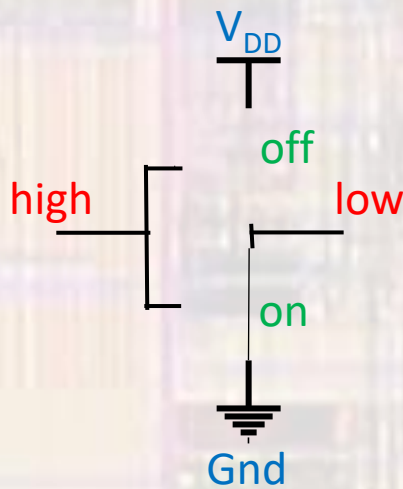
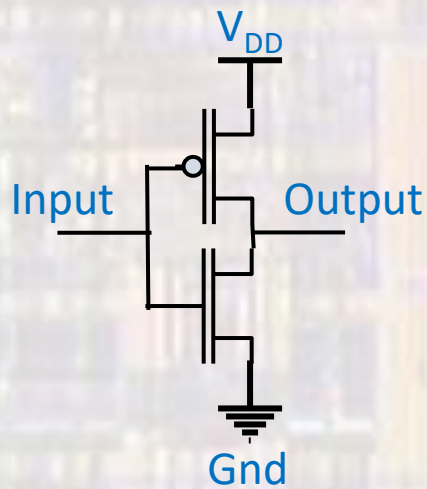
- Nmos





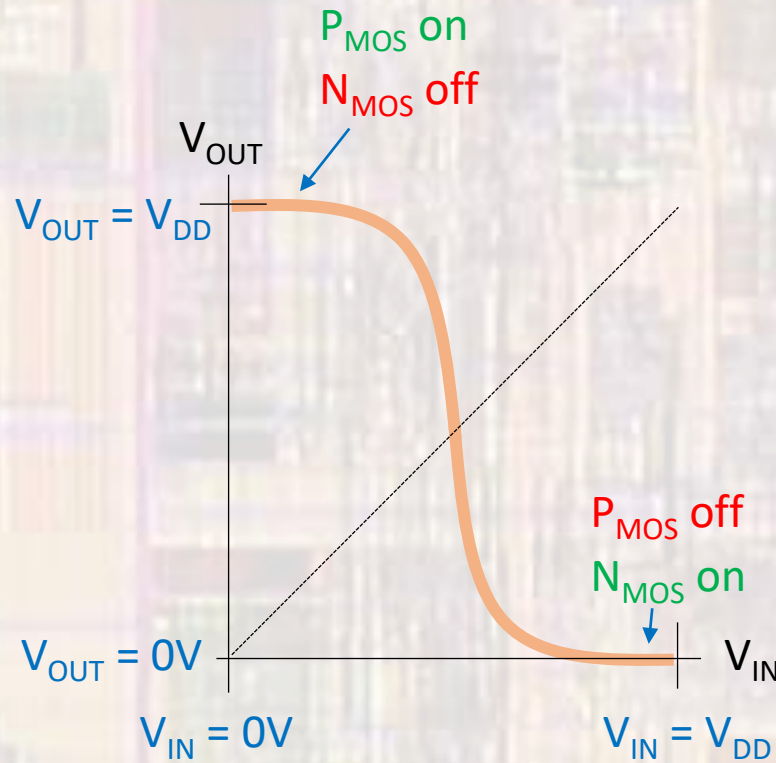
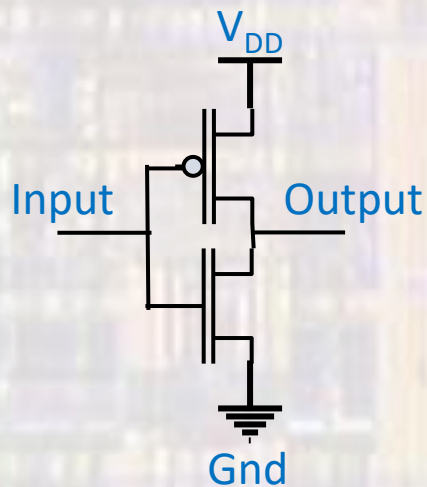
# DC Characteristics

- Inverter



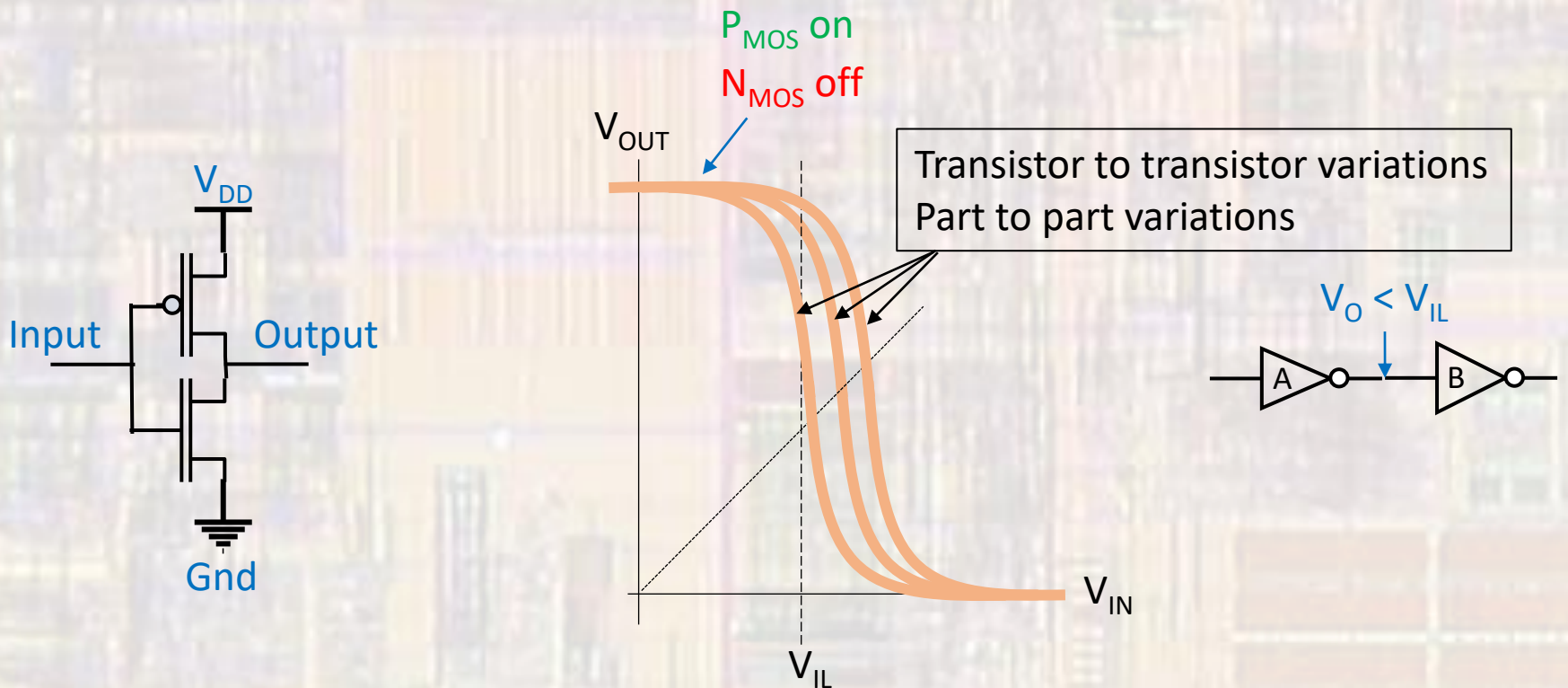
# DC Characteristics

- DC Characteristics
  - Ideal



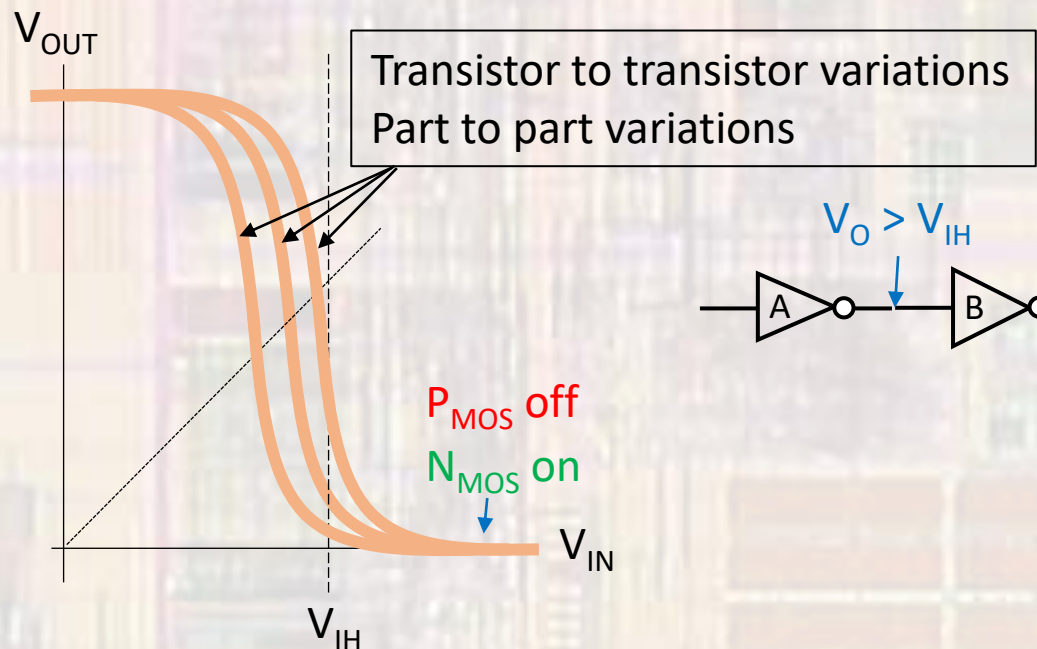
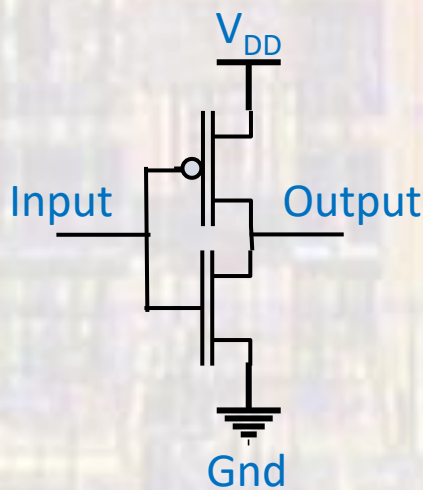
# DC Characteristics

- DC Characteristics –  $V_{IL}$ 
  - Highest input voltage that is guaranteed to be treated as a low input



# DC Characteristics

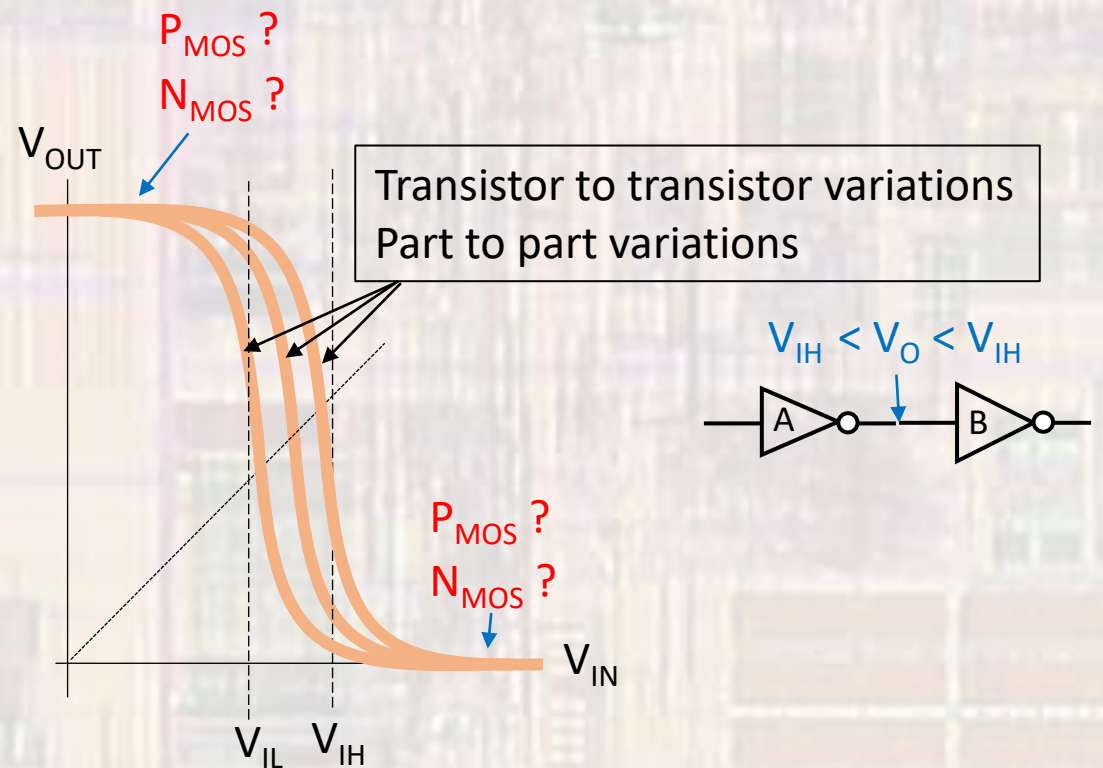
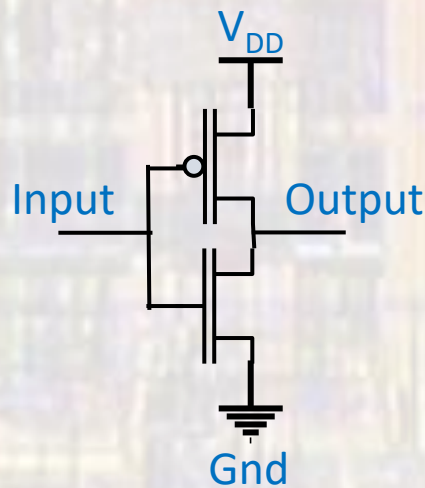
- DC Characteristics –  $V_{IH}$ 
  - Lowest input voltage that is guaranteed to be treated as a high input





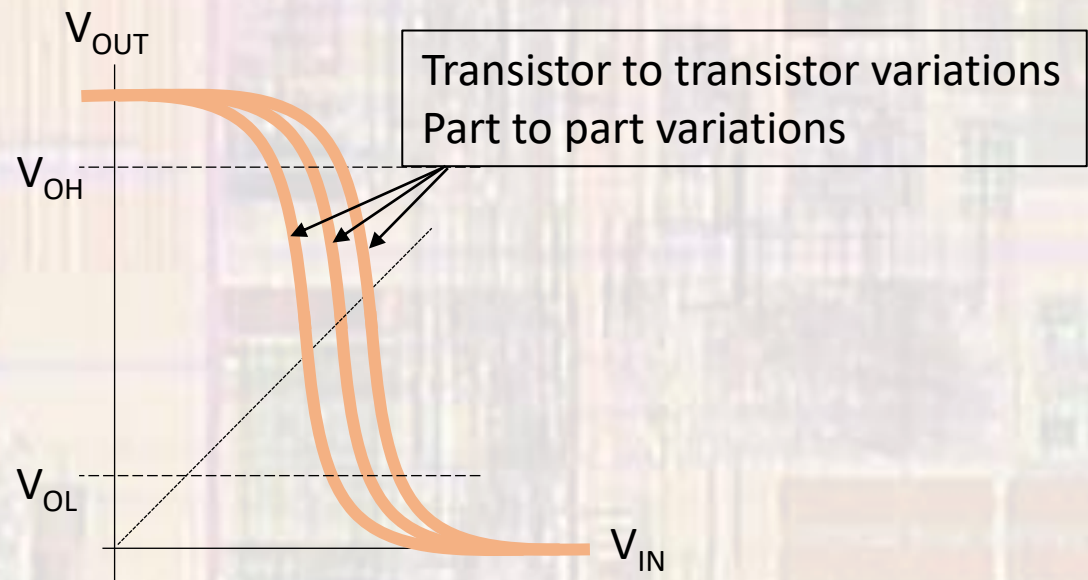
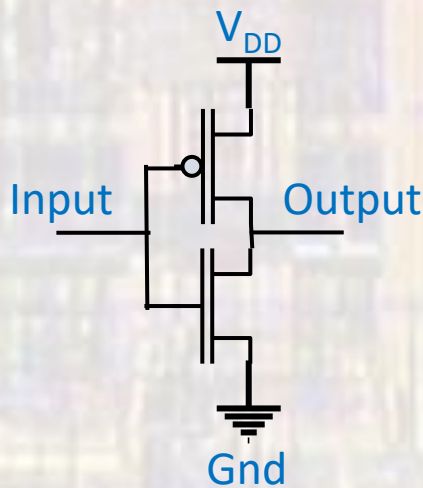
# DC Characteristics

- DC Characteristics –  $V_{IN}$  between  $V_{IL}$  and  $V_{IH}$ 
  - Behavior is unpredictable



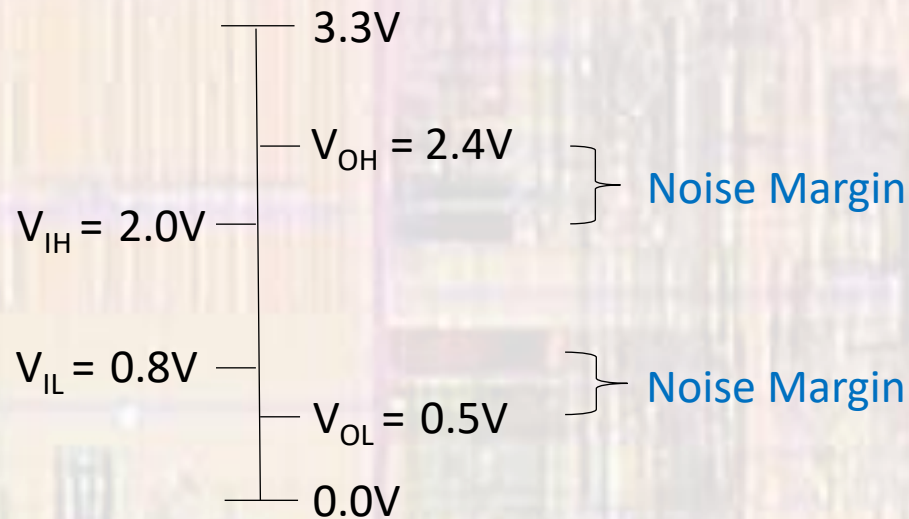
# DC Characteristics

- DC Characteristics –  $V_{OL}$ ,  $V_{OH}$ 
  - $V_{OL}$  - Guaranteed highest output voltage for a low output
  - $V_{OH}$  - Guaranteed lowest output voltage for a high output



# DC Characteristics

- Physical world
  - Voltage levels
    - Real world: 3.3V System



# DC Characteristics

- Physical world
  - Voltage levels
    - Real world: 3.3v System

