Digital Logic Design

4190.201.001

2010 Spring Semester

Supplementary Slide for the lab

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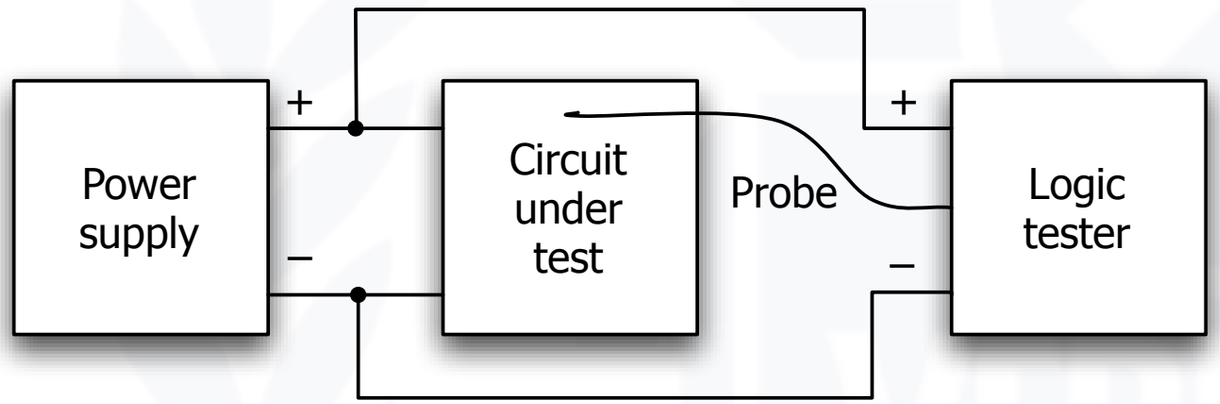
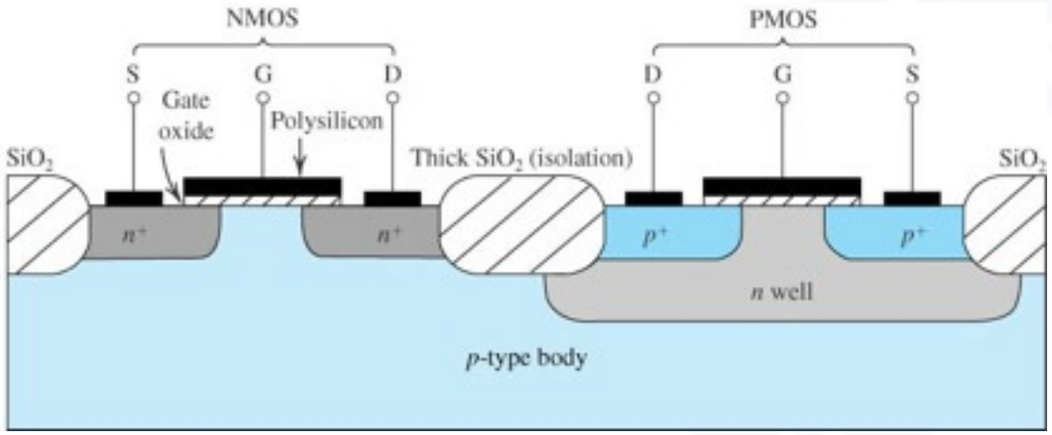
Logic Tester

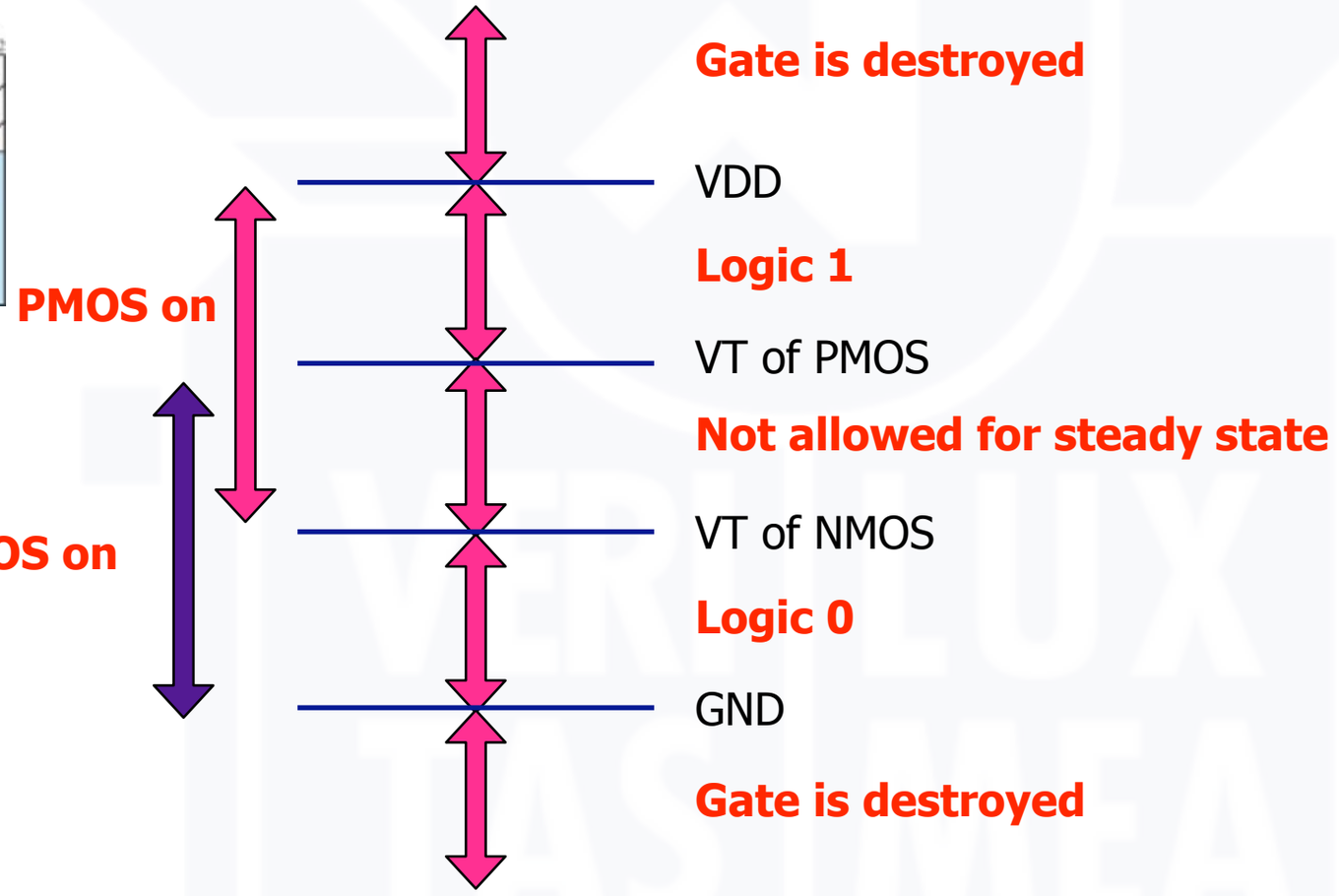
- Detect high and low
  - Share the same power supply
  - Share the reference voltage, i.e., GND

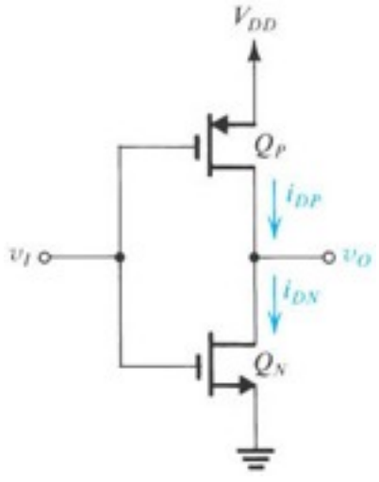


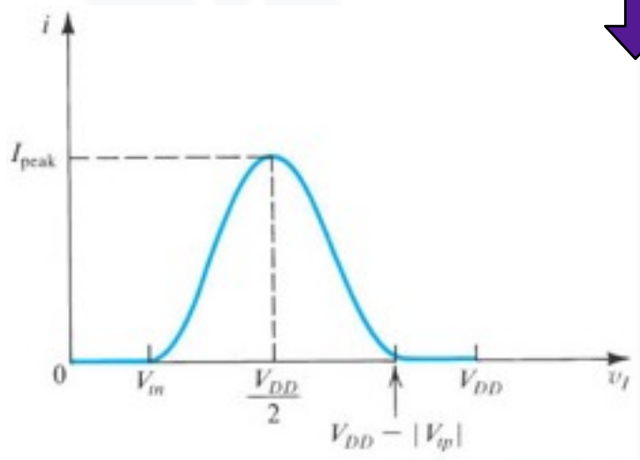
CMOS Logic Gates

- Threshold voltage of MOSFETs





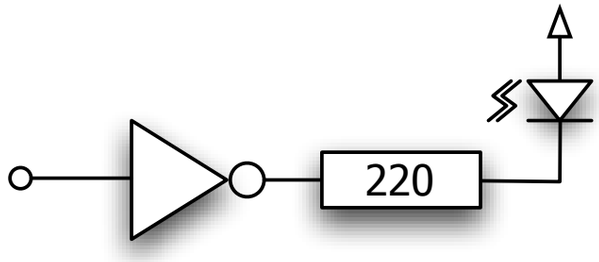




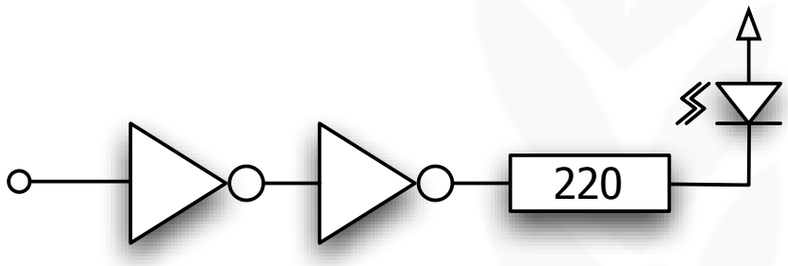
ELPL Embedded Low-Power Laboratory

Logic Tester

- Detect high
  - Should have no loading effect



- Detect low
  - Should have no loading effect



Symbol	Parameter		Min	Typ	Max	Unit
V_{CC}	Supply Voltage	54 74	4.5 4.75	5.0 5.0	5.5 5.25	V
T_A	Operating Ambient Temperature Range	54 74	−55 0	25 25	125 70	°C
I_{OH}	Output Current — High	54, 74			−0.4	mA
I_{OL}	Output Current — Low	54 74			4.0 8.0	mA

74LS04

- How current sink for the LED drive?
  - Output impedance

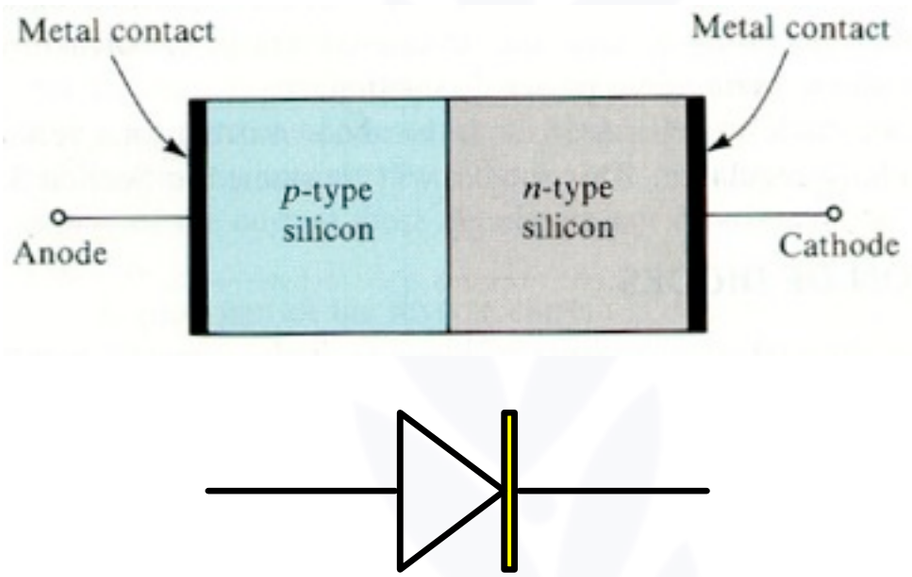
SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{CC}	supply voltage		−0.5	+7.0	V
I_{IK}	input diode current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	–	±20	mA
I_{OK}	output diode current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	–	±20	mA
I_O	output source or sink current	-0.5 V $< V_O < V_{CC} + 0.5$ V	–	±25	mA

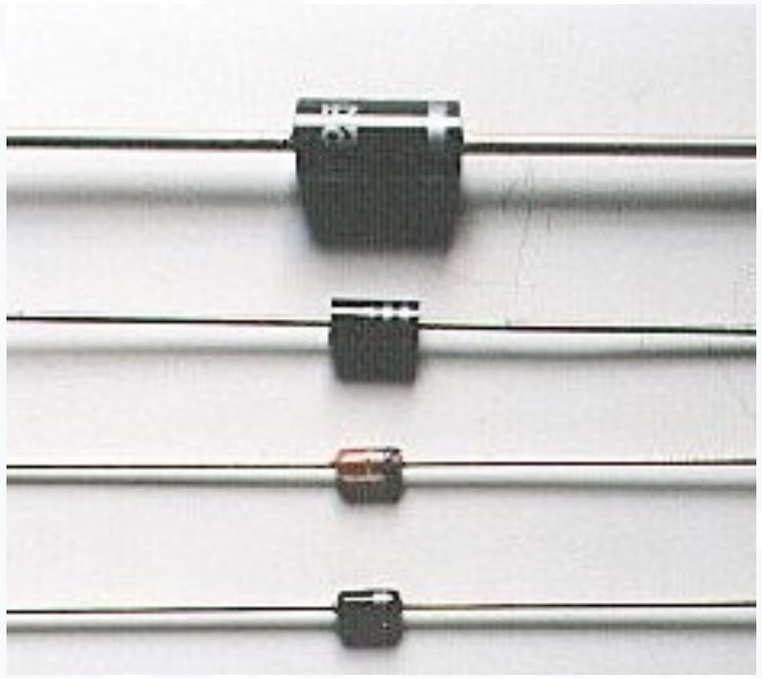
74HCT04

ELPL Embedded Low-Power Laboratory

Diode (1)

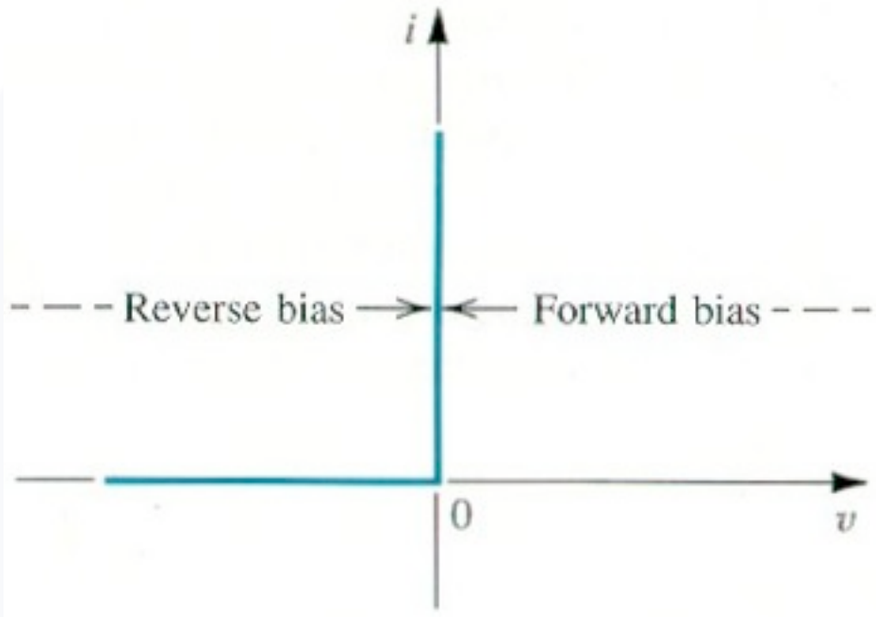
- P-N junction diode
  - 1N4148





Diode (2)

- Ideal diode
  - Forward bias: V1 > V2
  - Reverse bias: V1 < V2



Diode (4)

- Real diode
  - Break down
- Silicon Diode
- Germanium Diode

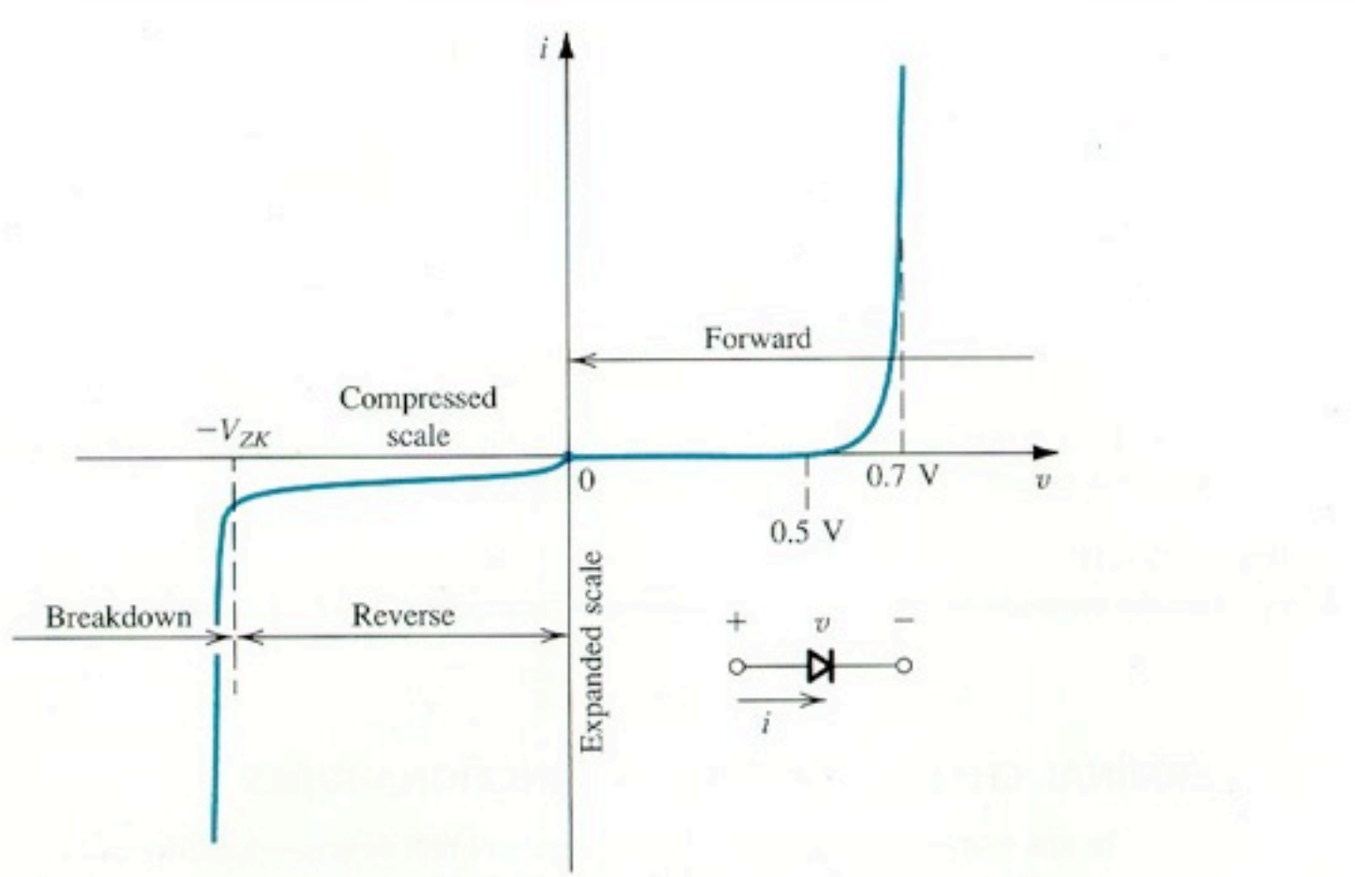
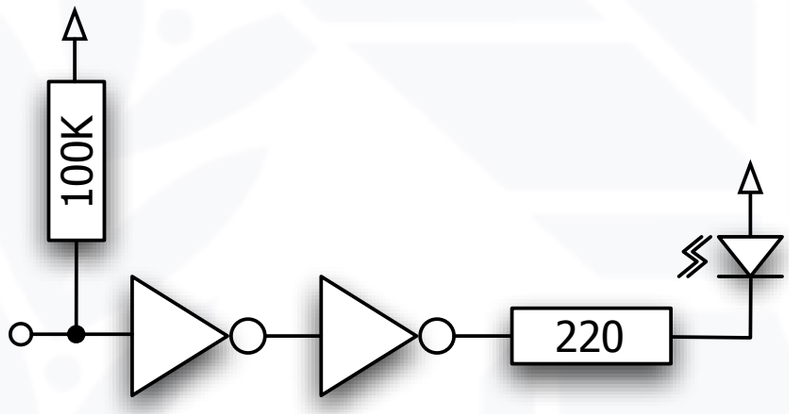
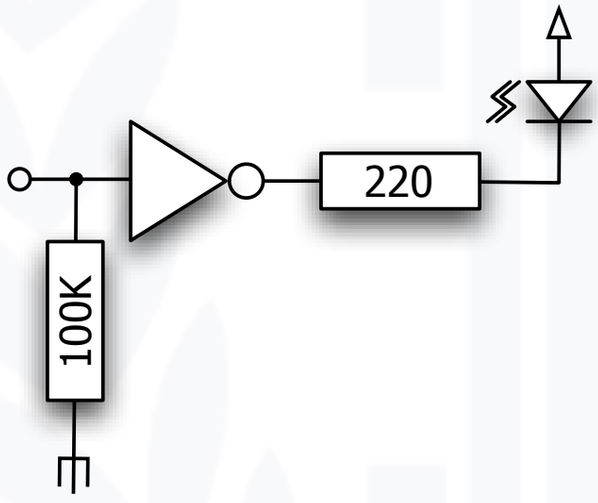


Fig. 3.8 The diode i–v relationship with some scales expanded and others compressed in order to reveal details.

Logic Tester

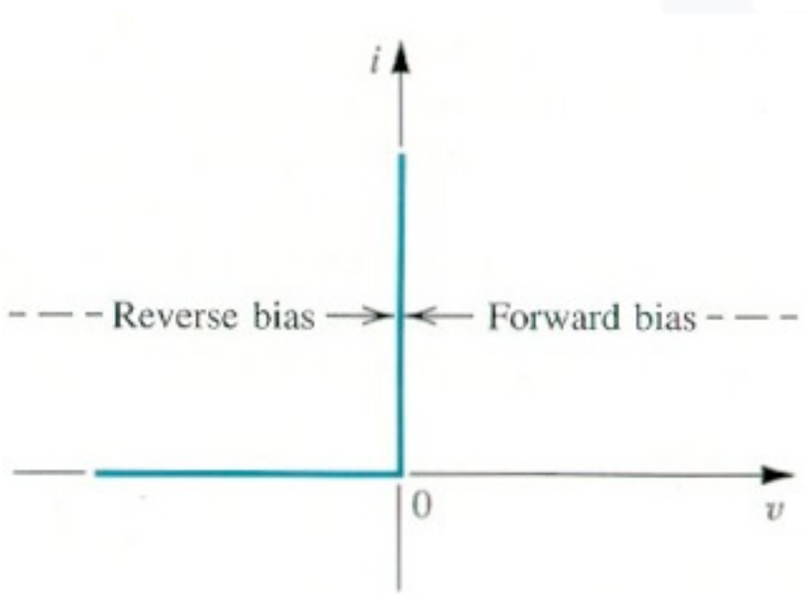
- Prevent from floating
  - Can we combine these together?

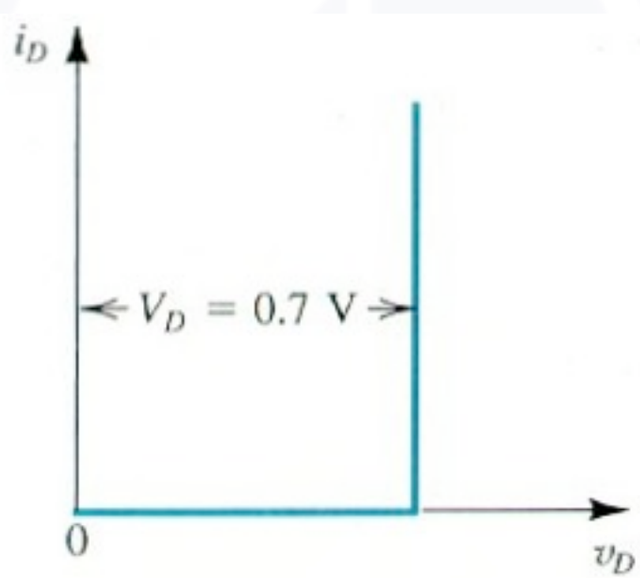


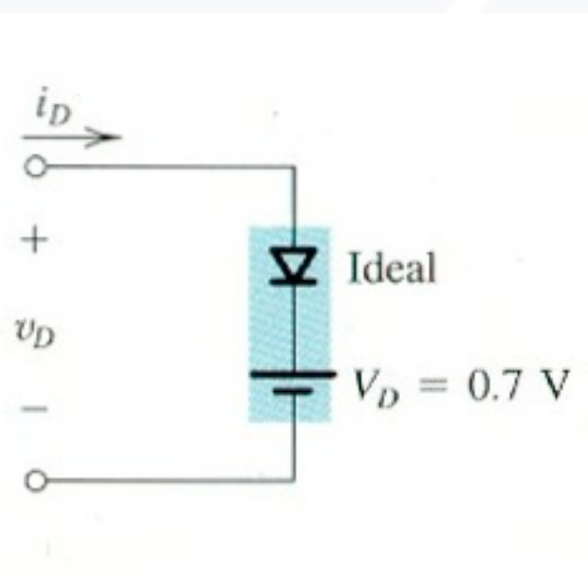


Diode (6)

- Diode in digital circuits
  - Silicon Diode: switching and rectification
  - Germanium Diode: detection







Logic Tester

- Final design