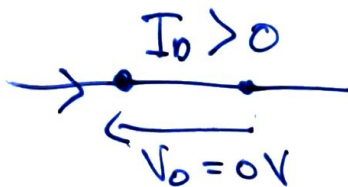# Elec mimos

Diodes models

A model is a way of describing the behaviour of a system by using a mathematical formula or a schematic simplification.
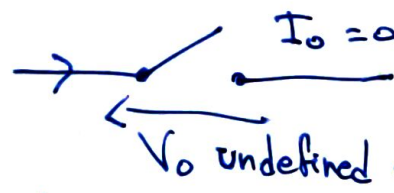
→ We have two diode models which means that we have two ways to approximate how a diode functions.
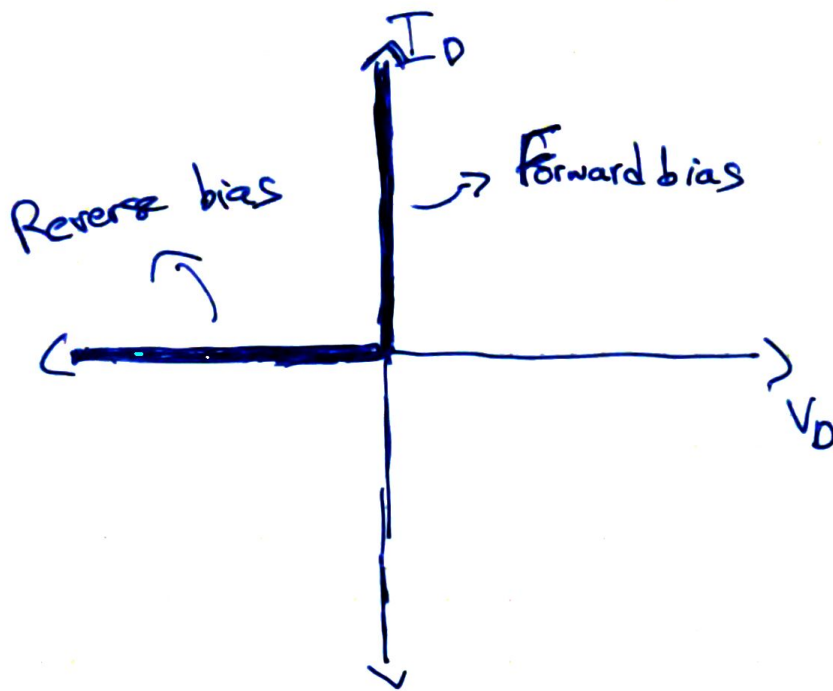
1. ## The ideal model

   * Here the diode is assumed to be a perfect switch

   Forward bias : $I_0 > 0$ (closed switch)
                     $V_0 = 0V$

   Reverse bias : $I_0 = 0$ (open switch)
                     V_0 undefined or $< 0V$

   * Most used model, especially power applications where voltage varies from tens to thousands.

Reverse bias
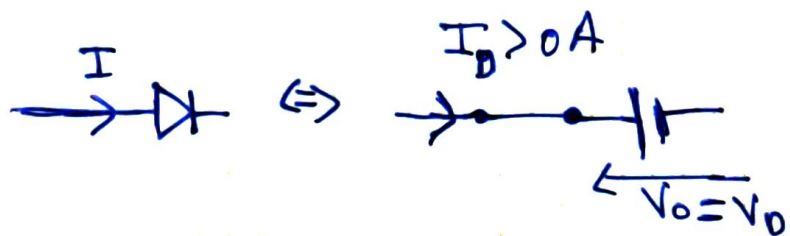
Forward bias

I_D

V_D

2. The threshold model

- We have a threshold voltage (V_0) for conduction
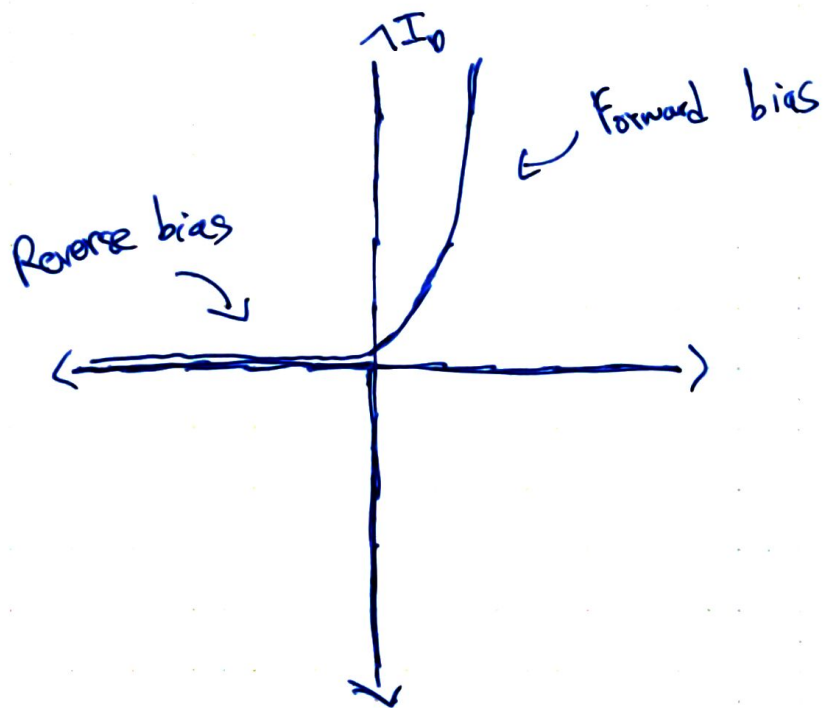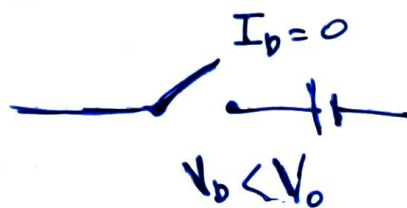- The threshold voltage depends on the diode material

   Silicon: $V_0 = 0.7$

   Germanium: $V_0 = 0.3$

- Used for low voltages.

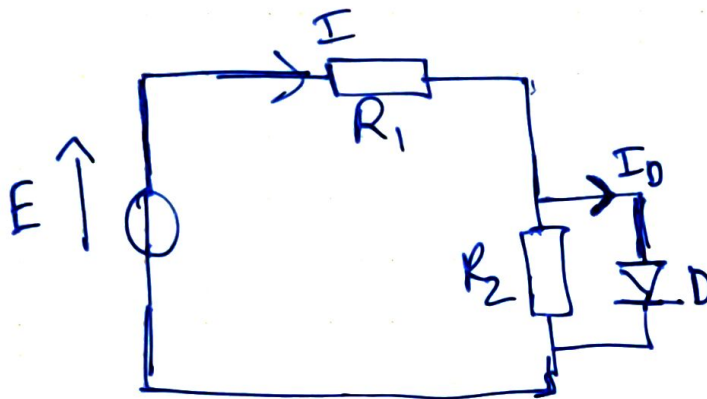- Diode is approximated to a voltage source + a switch

Forward bias:

I →|▷|

⟺

$I_D > 0 A$

→•—————•—|⊢

←$V_0 = V_D$

Reverse bias:

$I_D = 0$

————/ •—————|⊢

$V_D < V_0$

↑I_D

Forward bias ←

Reverse bias ↘

←————————————————→

Example:

* Determine if the diode is conducting or not, if conducting, calculate I_D
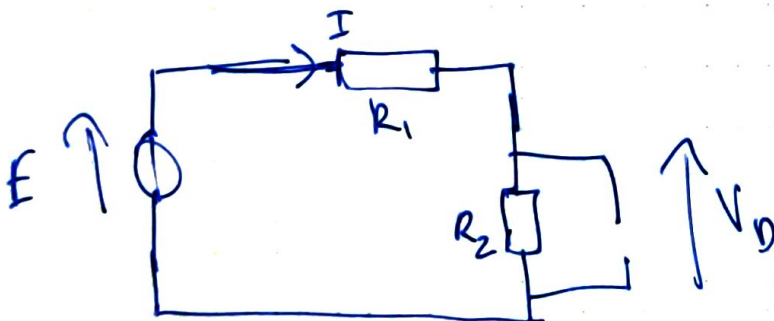
  Use threshold model with $V_0 = 0.7V$

$E = 10V$

$R_1 = 100\,\Omega$

$R_2 = 40\,\Omega$

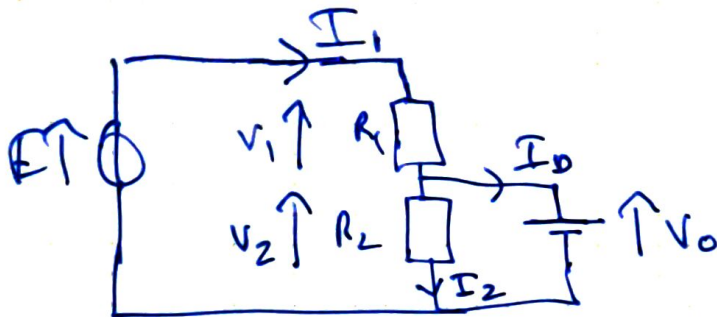We assume that D is not conducting which means $I_D = 0$ and $V_D < V_0$

(Proof by contradiction)

$$V_D = \frac{E R_2}{R_1 + R_2} = \frac{400}{140} = 2.85V$$

But $V_D > V_0$ ∴ It is conducting (assumption is wrong)

For $I_0 \Rightarrow$

$$V_2 = V_0$$

$$E - V_1 - V_2 = 0 \qquad \Big\} KVL$$

$$I_1 - I_2 = I_0$$

$$V_1 = E - V_2 = E - V_0 = R_1 I_1$$

$$\Rightarrow I_1 = \frac{E - V_0}{R_1}$$

$$V_2 = R_2 I_2 = V_0$$

$$\Rightarrow I_2 = \frac{V_0}{R_2}$$

$$\therefore I_0 = \frac{E - V_0}{R_1} - \frac{V_0}{R_2} = \frac{10 - 0.7}{100} - \frac{0.7}{40}$$

$$= 75.5 \ mA$$