Diodes

Ideal Diode

anode

Cathode

id $+$ Vd $-$

$-V_F (V\text{ forward}) = 0 \text{ (in ideal)}$

Characteristic Curve (Ideal Case):

id

ON

OFF

Vd
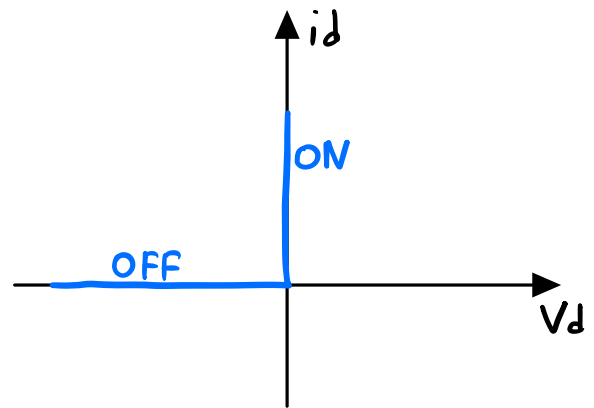
Ideal Diode (Modes of Operation):

Forward Biased

id $+$ $-$

Closed Circuit
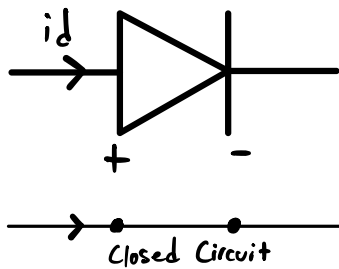
$-$Ideal Scenario, time it takes to switch between these states $\Delta t = 0$. (Only in Ideal)

Reverse Biased

$-$ $+$

Open Circuit

Practical Diode

$+$ V_F $-$

$V_{Breakdown}$

Reverse Bias Current

V_F

id

Vd

Slope $= \frac{1}{R_{ON}}$
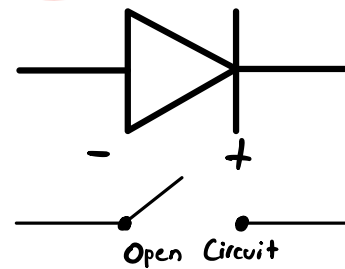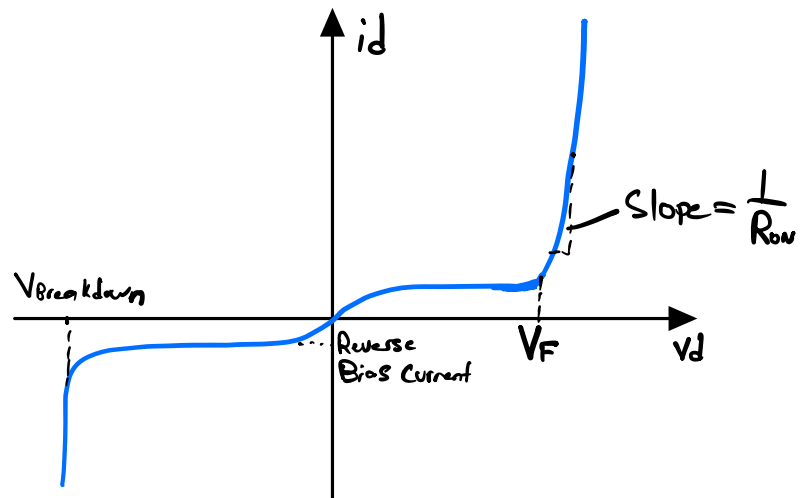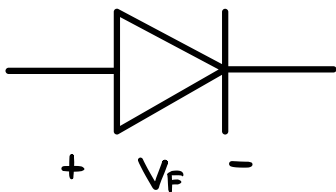
$-$Forward Voltage. Voltage drop across the diode when its conducting and current is flowing in the positive direction

$-$Reverse-Break-Down Voltage. The voltage when the diode is reverse biased where it will begin conducting in the reverse direction (ie: 1000V) $-$Damages diode

$-$On-Resistance

$-$Turn on/off times

Diode Turn off Time :

— Fast Recovery Diodes, Reverse Recovery time is shorter

i(t)

Forward Biased | Reverse Biased

Q_R (charges)

I_{RR} (Reverse Recovery Current)

t_{rr} Reverse Recovery Time
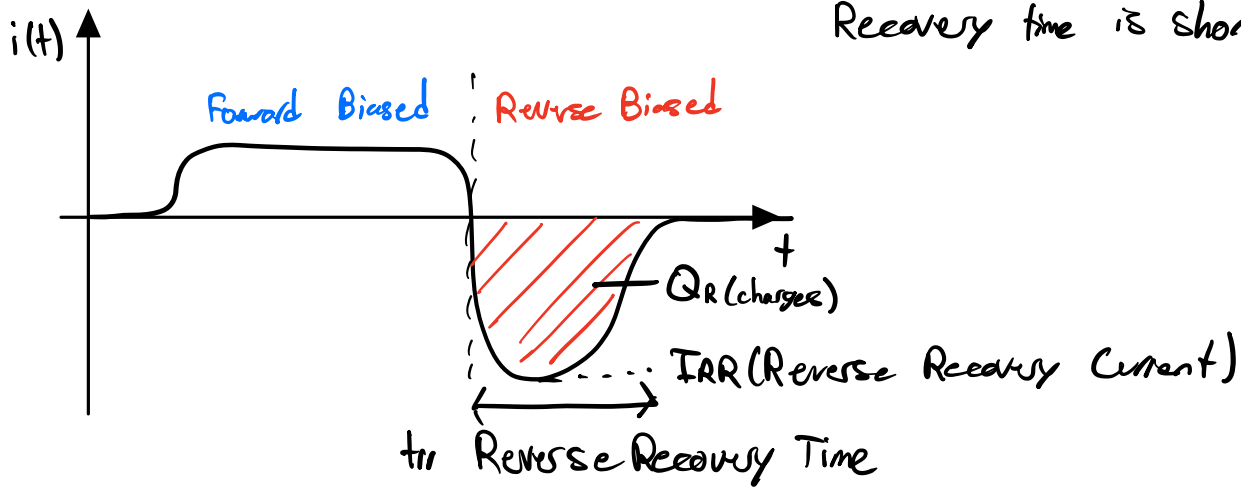
Losses

Conduction $\longrightarrow$ $P_{cond} = V_F \cdot I_F \cdot D$ (Dominant at Low Frequencies)

$P_{cond} = I_0^2 \cdot R_{DSON}$

Switching $\longrightarrow$ (Increases with turn ON/turn OFF time)

(Increases with Switching Frequency)

$P_{SW} = $ (Losses per switch (Q))(Time of one period)

ie: How many switches per second