



PN JUNCTION DIODE

SEMICONDUCTOR DIODE

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TOPIC OUTLINE

The Unbiased Diode

The Biased Diode

- Forward Bias
- Reversed Bias



THE UNBIASED DIODE

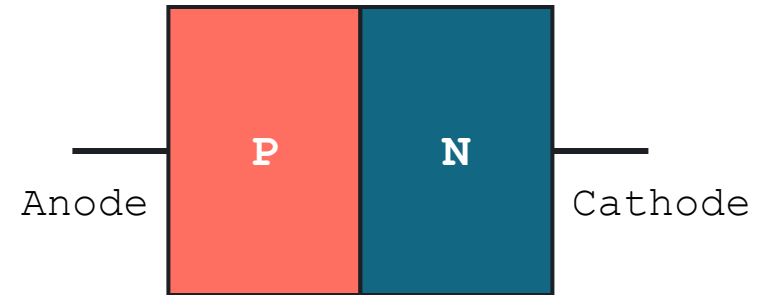


JUNCTION DIODE

A junction diode is a two-terminal semiconductor device formed by the junction of two electrodes or regions: the P-type and N-type materials.

The term "di" in diode signifies its two-electrode construction.

Basic Construction



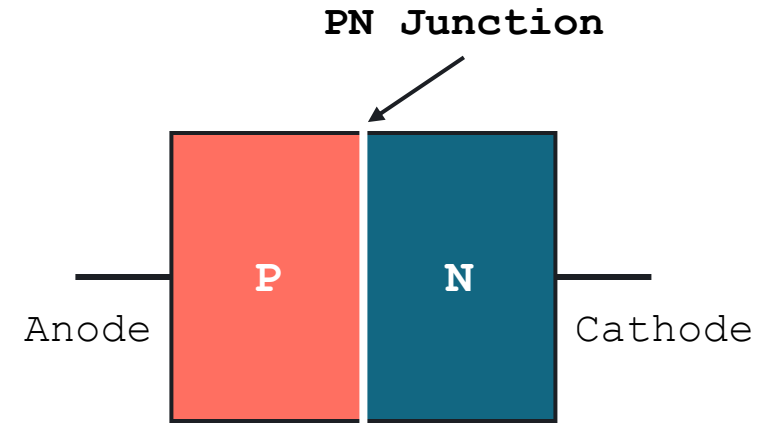
Schematic Symbol



PN JUNCTION

A PN junction is the boundary between the P-type and N-type material.

Basic Construction

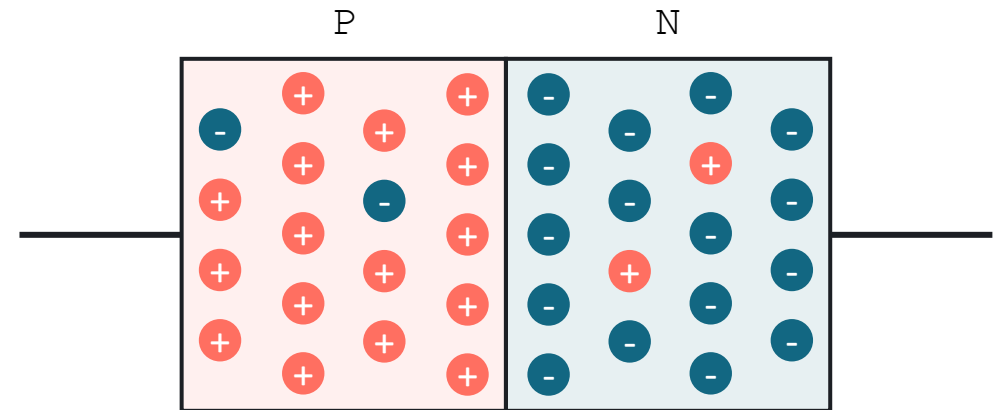


Schematic Symbol



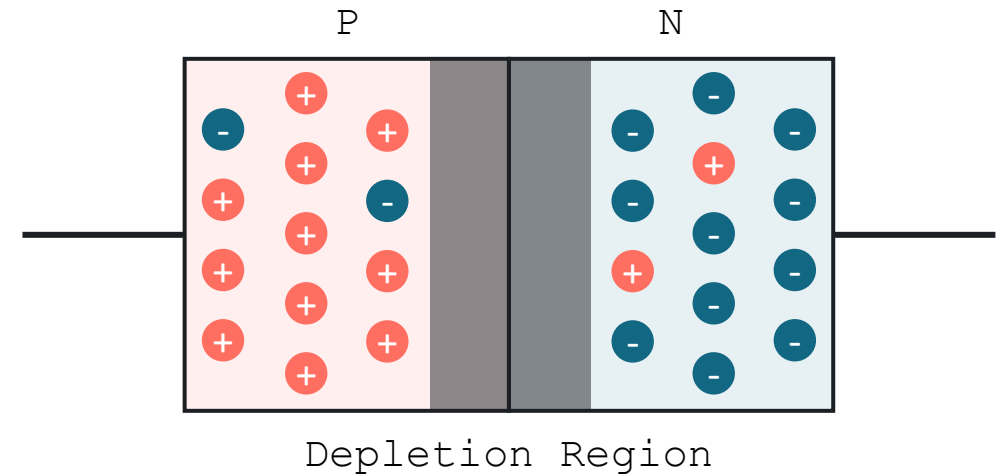
RECOMBINATION

Recombination is the process where a free electron fills a hole, causing both to disappear as charge carriers.



DEPLETION REGION

The depletion region is a narrow, charge-free zone that forms around the PN junction.



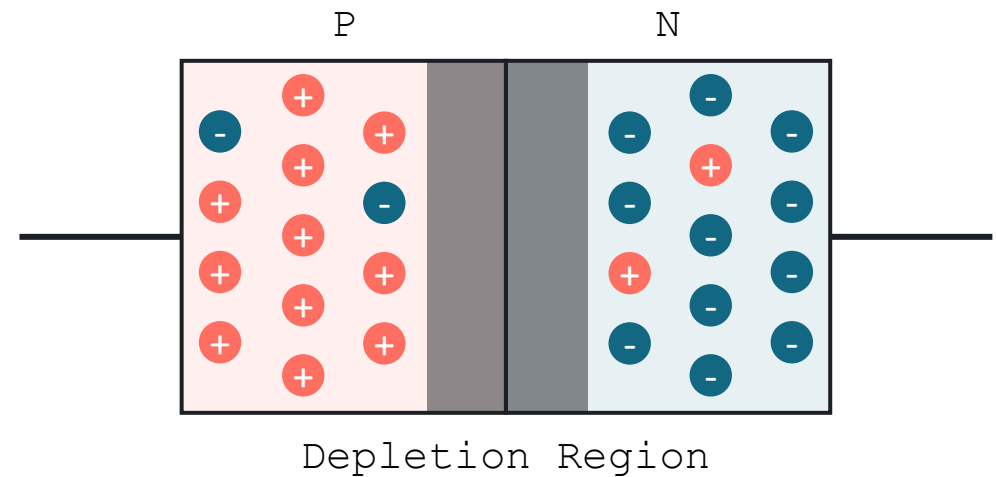
BARRIER POTENTIAL

Barrier potential is the electric potential that forms across a PN junction due to the diffusion and recombination of charge carriers, creating an electric field that **opposes** further movement of electrons and holes.

typical values

0.7 V for Silicon (Si)

0.3 V for Germanium (Ge)

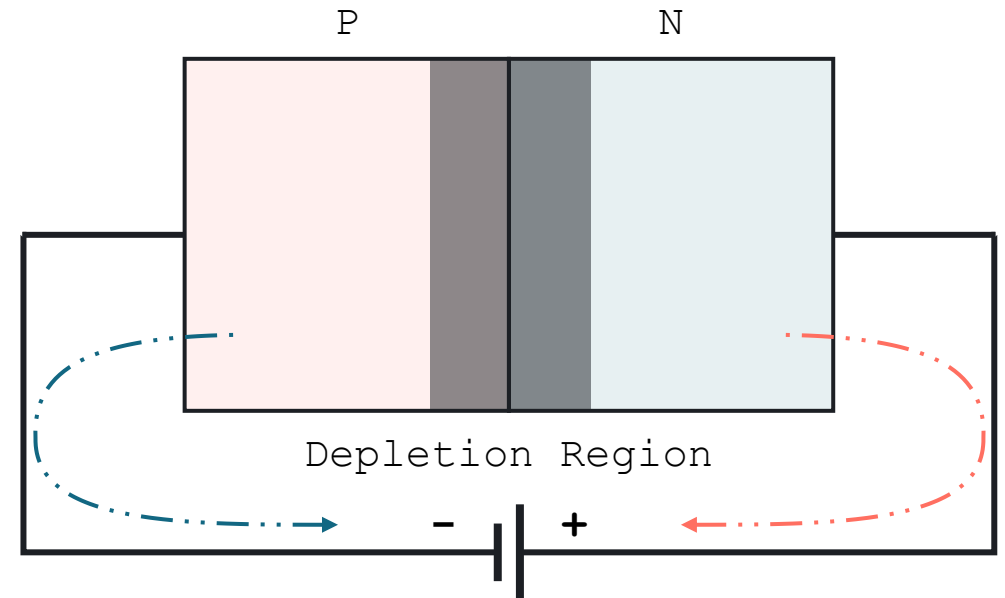


THE BIASED DIODE



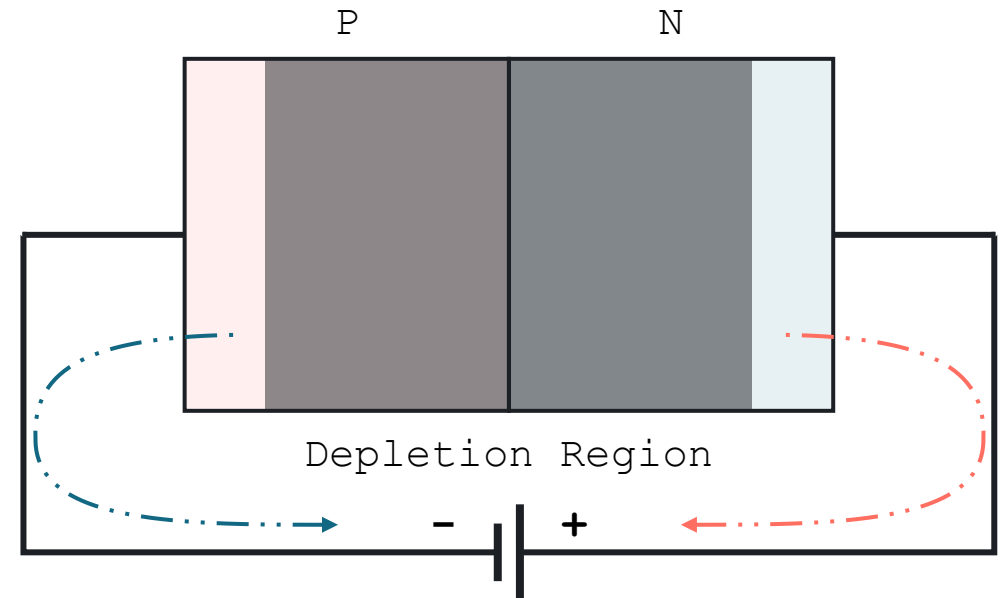
BIASED DIODE

Biasing a diode means applying a voltage to it to control whether it conducts current or not.



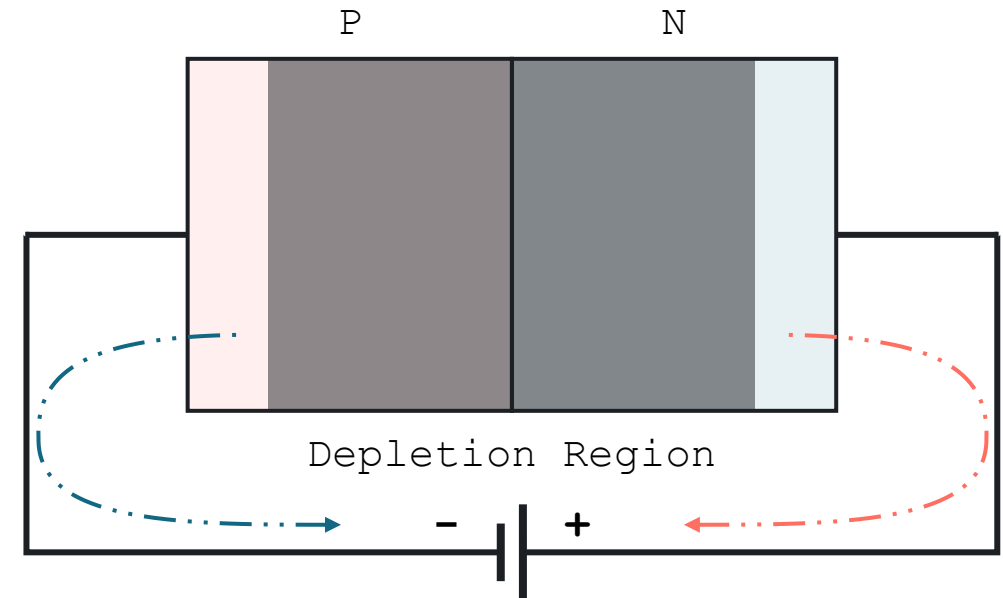
REVERSE BIAS

Reverse bias increases the depletion region and prevents current from flowing in a PN junction.



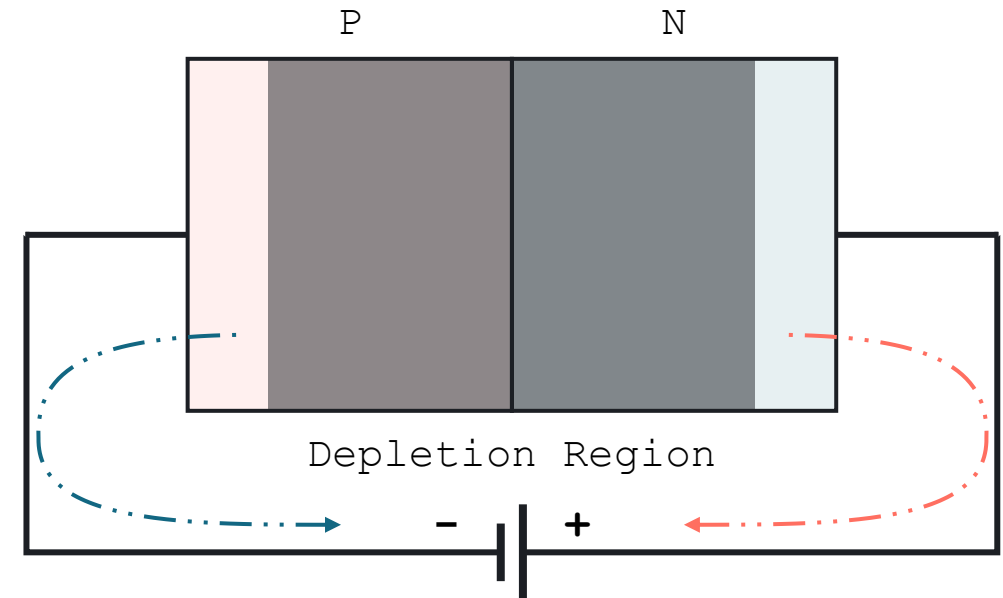
REVERSE SATURATION CURRENT

Reverse saturation current is the small current that flow through a reversed-biased PN junction due to thermally generated minority carriers.



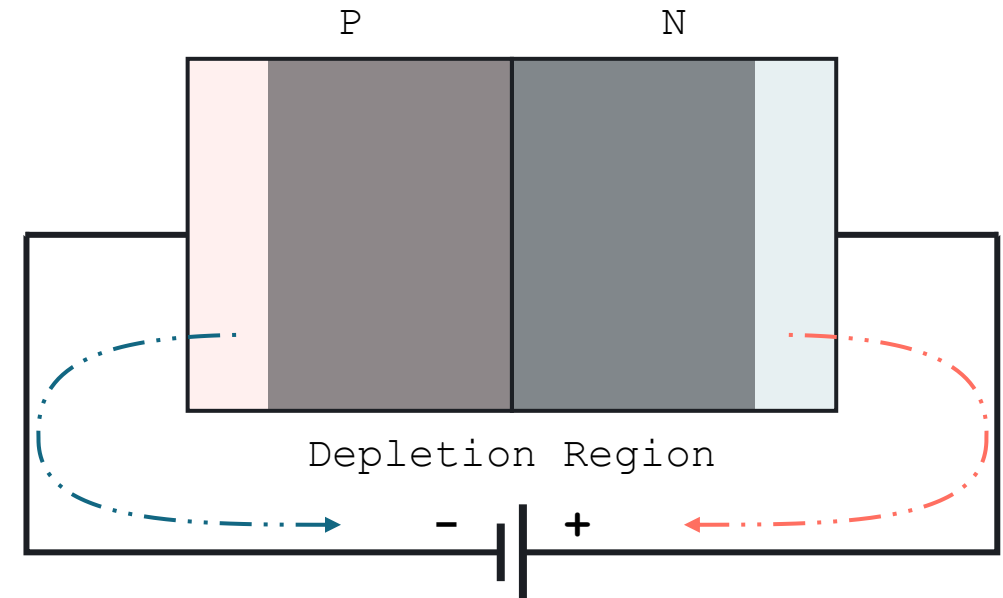
SURFACE-LEAKAGE CURRENT

Surface-leakage current is the unwanted current that flows along the surface of a semiconductor device due to impurities and imperfections in the crystal structure.



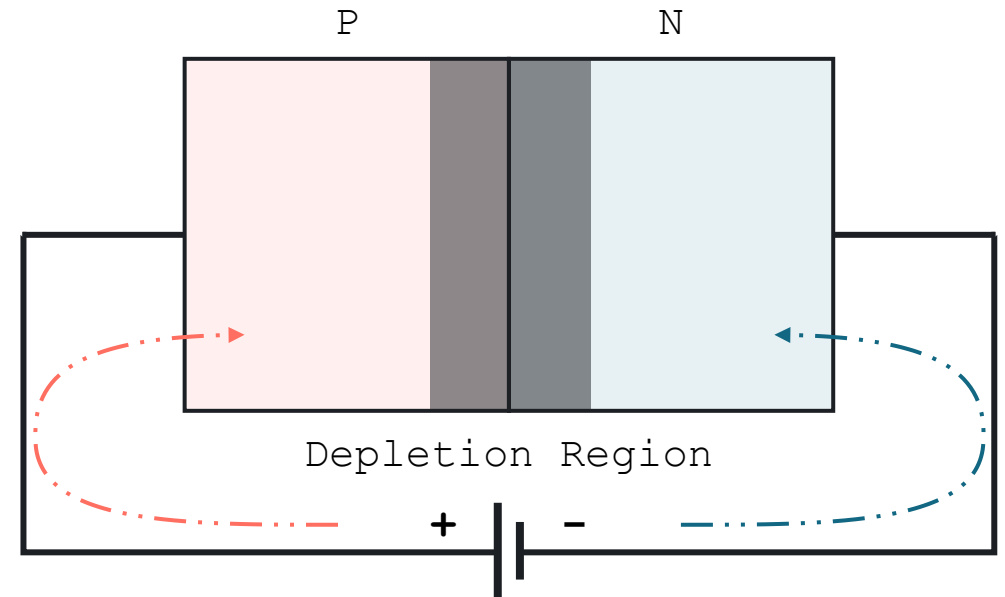
BREAKDOWN VOLTAGE

Breakdown voltage is the highest reverse voltage a diode can withstand without breaking down or being **damaged** – typically around 50V for standard small-signal diodes.



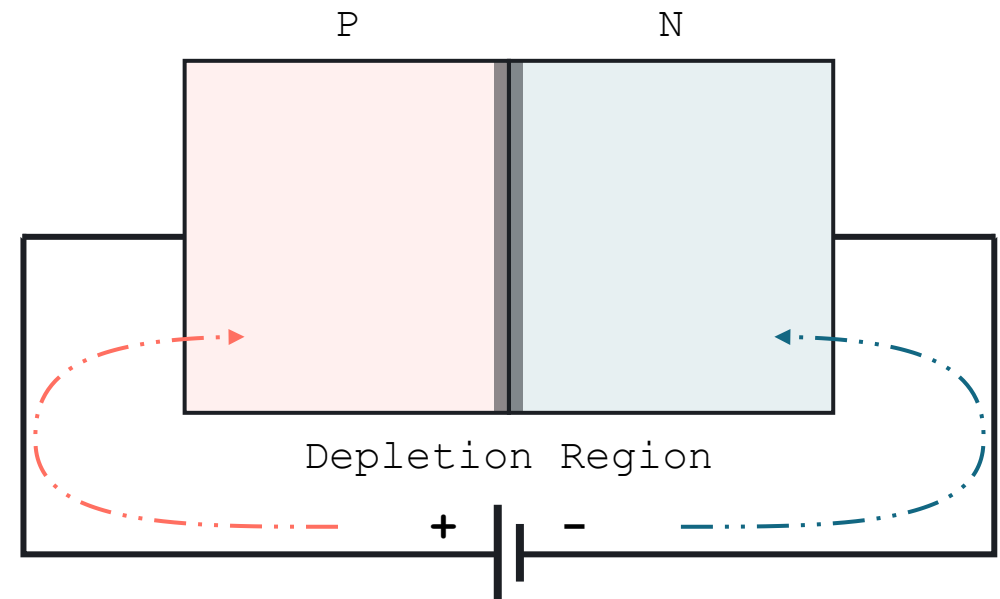
FORWARD BIAS

Forward bias decreases the depletion region and allows current to flow in a PN junction.



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TEMPERATURE DEPENDENCE OF DIODE VOLTAGE

The forward voltage drop across a diode decreases as the junction temperature increases.

Formula

$$\frac{\Delta V}{\Delta T} = -2\text{mV}/^{\circ}\text{C}$$

For every 1°C increase in junction temperature, the forward voltage drops by about 2mV.

This is due to increased carrier activity at higher temperature, which makes it easier for current to flow.



EXERCISE

Assuming a barrier potential of 0.7V at an ambient temperature of 25°C. Determine the barrier potential of a silicon diode when the junction temperature is

- 100°C
- 0°C
- 50°C

Solution



LABORATORY

