



School of Science and Technology

Computer Science

– Embedded Systems Architecture –

MSc in Computer Science (LM-18)

Lecture #10

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Semiconductor diodes

Diode characteristic curve

The lower left quadrant of the graph represents the reverse-biased condition. As the reverse voltage (V_R) increases to the left, the current remains near zero until the breakdown voltage (V_{BR}) is reached. When breakdown occurs, there is a large reverse current which, if not limited, can destroy the diode. Typically, the breakdown voltage is greater than 50 V for most rectifier diodes. Remember that most diodes should not be operated in reverse breakdown.



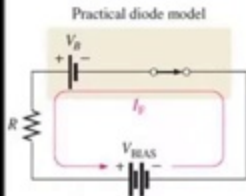
Semiconductor diodes

Diode approximation – Practical model

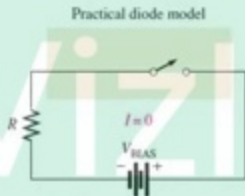
In this approximation, the forward-biased diode is represented as a closed switch in series with a small “battery” equal to the barrier potential (0.7 V for Si).

The positive end of the battery is toward the anode.

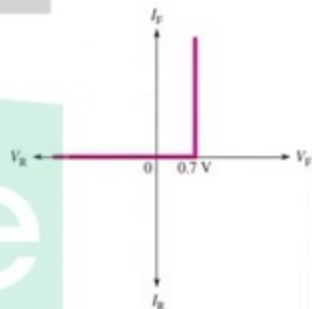
The reverse-biased diode is represented by an open switch, as in the ideal case, because the barrier potential does not affect reverse bias.



(a) Forward bias



(b) Reverse bias



(c) V-I characteristic curve

Semiconductor diodes

Diode rectifier – The half-wave rectifier

The net result is that only the positive half-cycles of the ac input voltage appear across the load. Since the output does not change polarity, it is a pulsating dc voltage

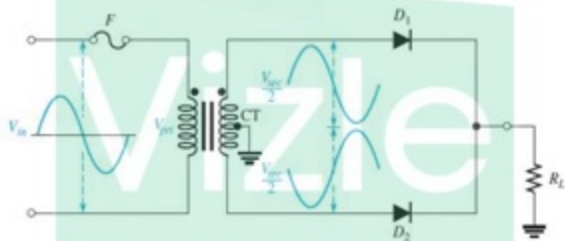


Half-wave output voltage for three input cycles

Semiconductor diodes

Center tapped full-wave rectifier

The center-tapped (CT) full-wave rectifier uses two diodes connected to the secondary of a center-tapped transformer.

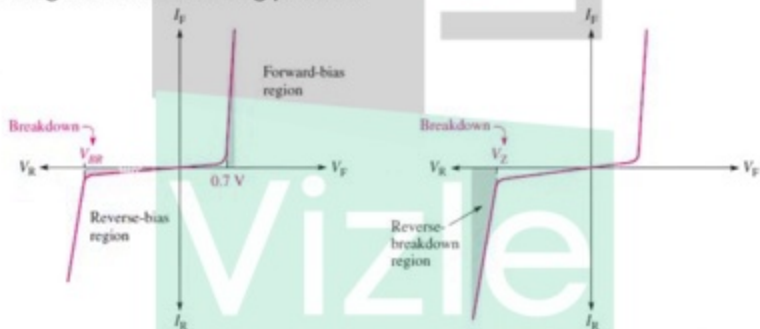


Semiconductor diodes

The Zener diode

A major application for the zener diode is to provide an output reference voltage that is stable despite changes in input voltage. Reference voltages are used in power supplies, voltmeters, and many other instruments.

The breakdown voltage of a zener diode is set by carefully controlling the doping level during the manufacturing process.



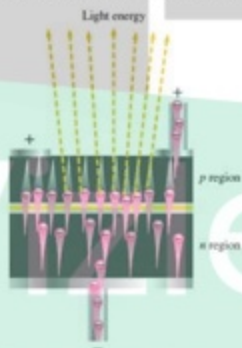
(a) The normal operating regions for a rectifier diode are shown as shaded areas.

(b) The normal operating region for a zener diode is shaded.

Semiconductor diodes

The light emitting diode (LED)

The basic operation of an **LED** (light-emitting diode) is as follows: When the device is forward-biased, electrons cross from cathode to anode recombining with positive particles. When recombination takes place, the recombining electrons release energy in the form of heat and **light** (*electroluminescence*). A large exposed surface area on one layer of the semiconductor permits the photons to be emitted as visible light.





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