

INTRODUCTION TO POWER ELECTRONICS

Power Electronics is a field which combines Power (electric power), Electronics and Control systems.

Power engineering deals with the static and rotating power equipment for the generation, transmission and distribution of electric power.

Electronics deals with the study of solid state semiconductor power devices and circuits for Power conversion to meet the desired control objectives (to control the output voltage and output power).

Power electronics may be defined as the subject of applications of solid state power semiconductor devices (Thyristors) for the control and conversion of electric power.

1.1 Brief History of Power Electronics

The first Power Electronic Device developed was the Mercury Arc Rectifier during the year 1900. Then the other Power devices like metal tank rectifier, grid controlled vacuum tube rectifier, ignitron, phanotron, thyatron and magnetic amplifier, were developed & used gradually for power control applications until 1950.

The first SCR (silicon controlled rectifier) or Thyristor was invented and developed by Bell Lab's in 1956 which was the first PNP triggering transistor.

The second electronic revolution began in the year 1958 with the development of the commercial grade Thyristor by the General Electric Company (GE). Thus the new era of power electronics was born. After that many different types of power semiconductor devices & power conversion techniques have been introduced. The power electronics revolution is giving us the ability to convert, shape and control large amounts of power.

1.2 Power Electronic Applications

1. COMMERCIAL APPLICATIONS

Heating Systems Ventilating, Air Conditioners, Central Refrigeration, Lighting, Computers and Office equipments, Uninterruptible Power Supplies (UPS), Elevators, and Emergency Lamps.

2. DOMESTIC APPLICATIONS

Cooking Equipments, Lighting, Heating, Air Conditioners, Refrigerators & Freezers, Personal Computers, Entertainment Equipments, UPS.

3. INDUSTRIAL APPLICATIONS

Pumps, compressors, blowers and fans. Machine tools, arc furnaces, induction furnaces, lighting control circuits, industrial lasers, induction heating, welding equipments.

4. AEROSPACE APPLICATIONS

Space shuttle power supply systems, satellite power systems, aircraft power systems.

5. TELECOMMUNICATIONS

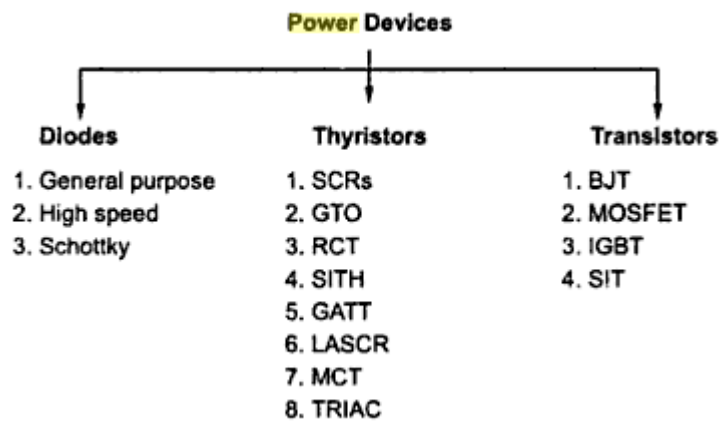
Battery chargers, power supplies (DC and UPS), mobile cell phone battery chargers.

6. TRANSPORTATION

Traction control of electric vehicles, battery chargers for electric vehicles, electric locomotives, street cars, trolley buses, automobile electronics including engine controls.

1.3 POWER SEMICONDUCTOR DEVICES

The power semiconductor devices are used as on/off switches in power control circuit. These devices are classified as follows.



A. POWER DIODES

Power diodes are made of silicon p-n junction with two terminals, anode and cathode. Diode is forward biased when anode is made positive with respect to the cathode. Diode conducts fully when the diode voltage is more than the cut-in voltage (0.7 V for Si). Conducting diode will have a small voltage drop across it.

Diode is reverse biased when cathode is made positive with respect to anode. When reverse biased, a small reverse current known as leakage current flows. This leakage current increases with increase in magnitude of reverse voltage until avalanche voltage is reached (breakdown voltage).

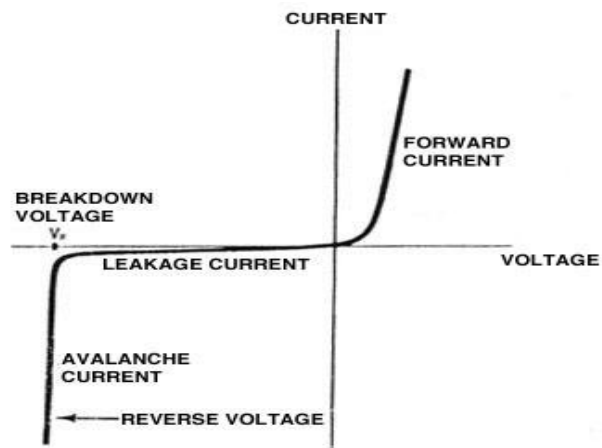


Fig.1.1 V-I Characteristics of diode.

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