1.1 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.

Power electronics deals with the study and design of Thyristorised power controllers for variety of application like Heat control, Light/Illumination control, Motor control - AC/DC motor drives used in industries, High voltage power supplies, Vehicle propulsion systems, High voltage direct current (HVDC) transmission.

the following block diagram shows the components of a Power Electronic system and how they are interlinked.

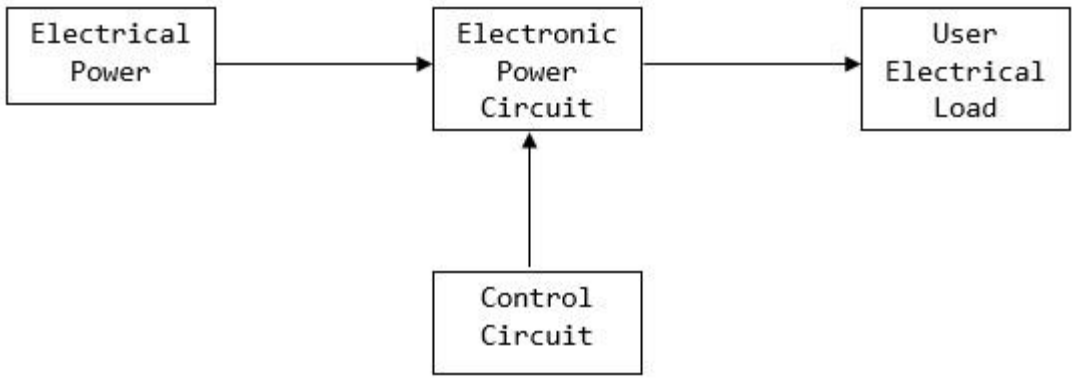

Fig1.1 Power Electronic system

A power electronic system converts electrical energy from one form to another and ensures the following is achieved;

- Maximum efficiency
- Maximum reliability
- Maximum availability
- Minimum cost
- Least weight
- Small size

1.2 Applications of Power Electronics:

Applications of Power Electronics are classified into two types − Static Applications and Drive Applications.

1.2.1 Static Applications

- This utilizes moving and/or rotating mechanical parts such as welding, heating, cooling, and electro-plating and DC power.

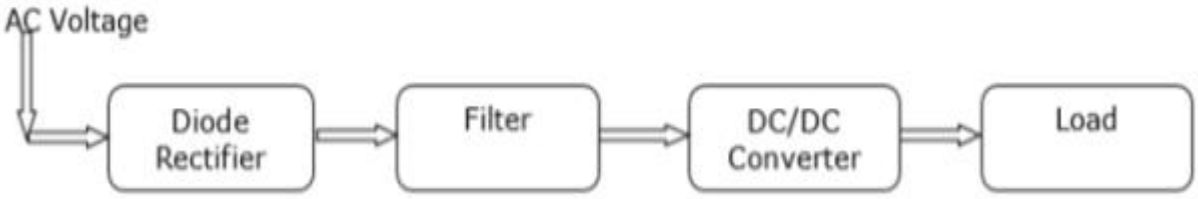

Fig 1.2 DC Power Supply

- Simple Grid-Connected System

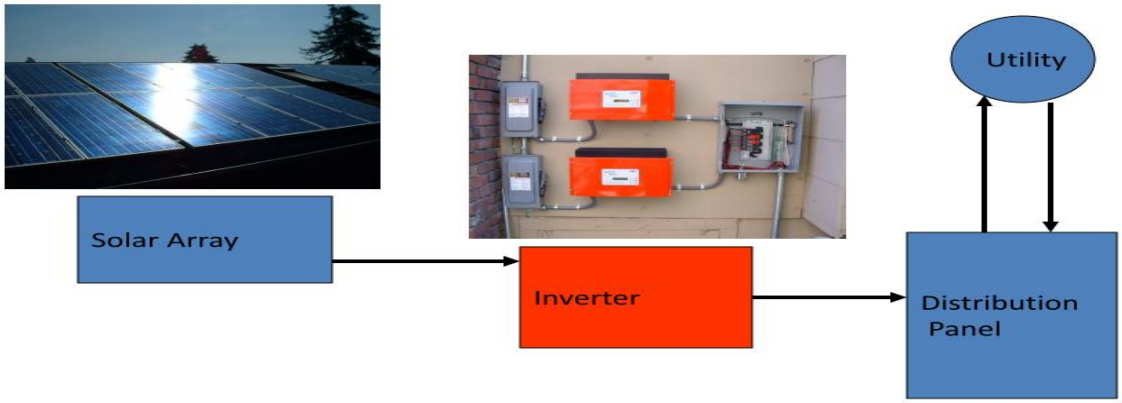

Fig.1.3: Simple Grid-Connected System

- Stand Alone Residential System

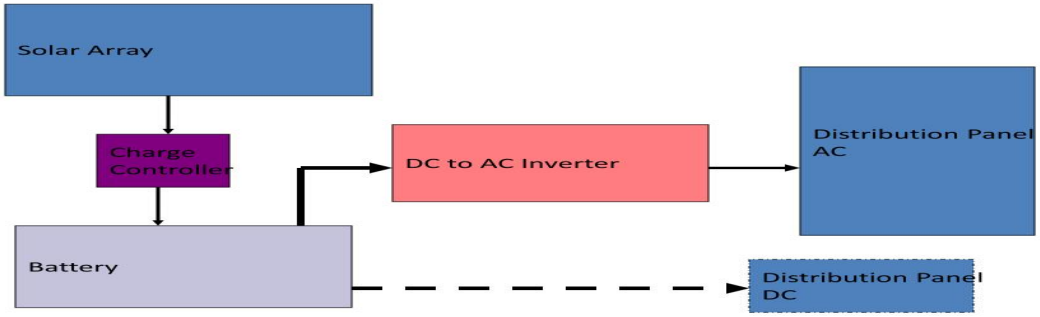

Fig.1.4 Stand Alone Residential System

1.2.2 Drive Applications

Drive applications have rotating parts such as motors. Examples include compressors, pumps, conveyer belts and air conditioning systems.

Air Conditioning System

Power electronics is extensively used in air conditioners to control elements such as compressors. A schematic diagram that shows how power electronics is used in air conditioners is shown below.

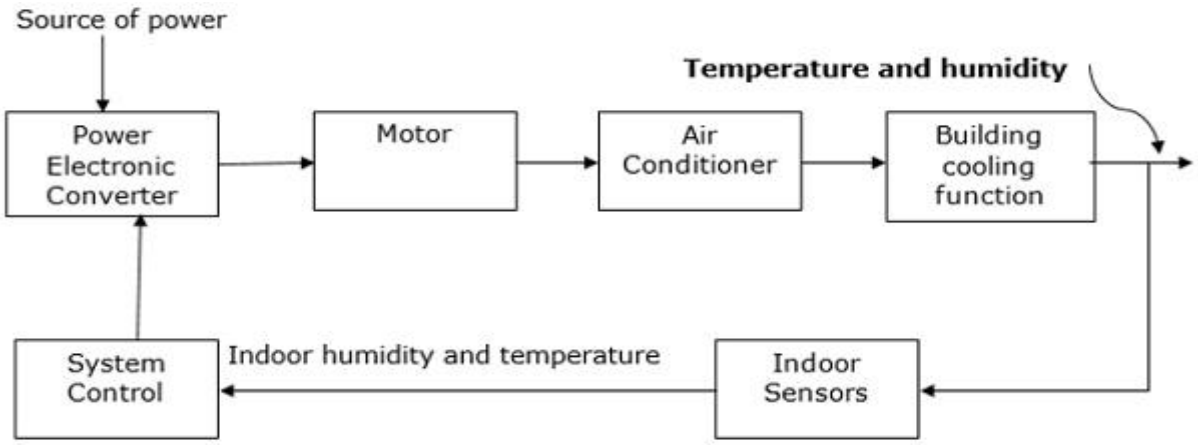

Fig1.5 schematic diagram air conditioners

- **Electric vehicle:**

In Figure 1.6 a configuration of an EV. In this figure it can be seen that the traction motor requires AC input. The main source of electrical power is the battery which is a DC source. The DC output of the battery is bucked or bossted according to the requirement and then converted into AC using a DC-AC inverter. The function of an inverter is to change a dc input voltage to a symmetric ac output voltage of desired magnitude and frequency. The output voltage waveforms of ideal inverters should be sinusoidal. However, the waveforms of practical inverters are non-sinusoidal and contain certain harmonics.

1.3 Functions of Power Electronic Circuits:

Power electronics is defined as the application of solid-state electronics for the control and conversion of electric power. The key element is the switching converter. In general, a switching converter contains power input and control input ports, and a power output port. The raw input power is processed as specified by the control input, yielding the conditioned output power. One of several basic functions can be performed;

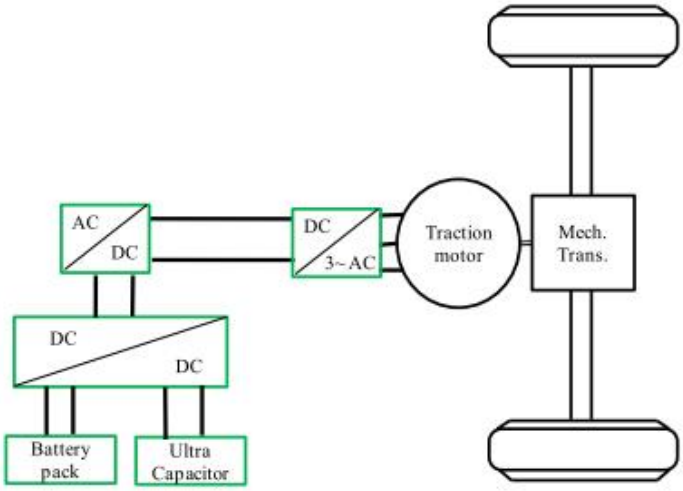

Fig1.6: Configuration of electric vehicle

- In a DC-DC converter, the dc input voltage is converted to a dc output voltage having a larger or smaller magnitude, possibly with opposite polarity or with isolation of the input and output ground references.
- In an AC-DC rectifier, an ac input voltage is rectified, producing a dc output voltage. The dc output voltage and or ac input current waveform may be controlled.
- DC-AC inversion, involves transforming a dc input voltage into an ac output voltage of controllable magnitude and frequency.
- AC-AC cyclo conversion involves converting an ac input voltage to a given ac output voltage of controllable magnitude and frequency.