

Power Electronics

Power Electronics

Date _____
Page _____

power electronics :- power electronics is a subject that connects with the application of electronic principles into situations that are rated at power level rather than signal level. ~~rather than signal level.~~

It may also be defined as a subject that deals with apparatus and equipment working on the principle of electronics but rated at power level rather than signal level.

For ex: semiconductor power switches such as thyristor, GTO etc.

Application:

There are following applications of power electronics

- i) **Aerospace:** space shuttle power supplies, satellite power supplies.
- ii) **Commercial:** Advertising, heating, air conditioning, etc.
- iii) **Residential:** Air conditioner, cooking, lighting etc.
- iv) **Telecommunications:** Battery charger, power supplies (dc and ups).
- v) **Transportation:** Battery charger, electric locomotive, street cars, etc.
- vi) **Utility System:** High voltage dc transmission (HVDC) excitation system, VAR compensation, etc.

Advantages and disadvantages of power electronic converters.

The advantages of power electronic system are as under.

- i) High efficiency due to low loss in power semiconductor devices.
- ii) High reliability of power-electronic converter system.

- iii) Long life and less maintenance due to the absence of any moving parts.
- iv) Fast ~~life~~ dynamic response of the power electronic system as compared to electromechanical converter system.
- v) Small size and less weight result in less floor space and therefore lower installation cost.
- vi) Mass production of power semiconductor devices has resulted in lower cost of the converter equipment.

Disadvantages:

→ power electronics converter circuit have a tendency to generate harmonics in the supply system as well as in the load circuit.

In the load circuit, the performance of the load is influenced. For example a high harmonic content in the load circuit causes commutation problem in DC machines, increased motor heating and more acoustic noise in both dc and ac machines. So steps must be taken to filter these out from the output side of a converter.

In the supply system, the harmonics distort the ~~output~~ voltage waveform and ~~seriously~~ ~~distort~~ influence the performance of the equipment connected to the same supply line.

In addition, the harmonics in the supply line can also cause interference in audio and video equipment (radio interference) so it is necessary.

Necessarily to insert filter on the input side of a converter.

- ii) A.C to D.C and a.c to a.c converters operate at a low input power factor under certain operating conditions. In order to avoid a low pf, some special power measures have to be adopted.
- iii) power electronic controllers have low overload capacity. These converters must therefore be rated for taking momentary overloads. As such regeneration of power is difficult in power electronic converters system.
- iv)

POWER ELECTRONICS SYSTEM.

The major componts of a power electronics are shown in the form block diagram.

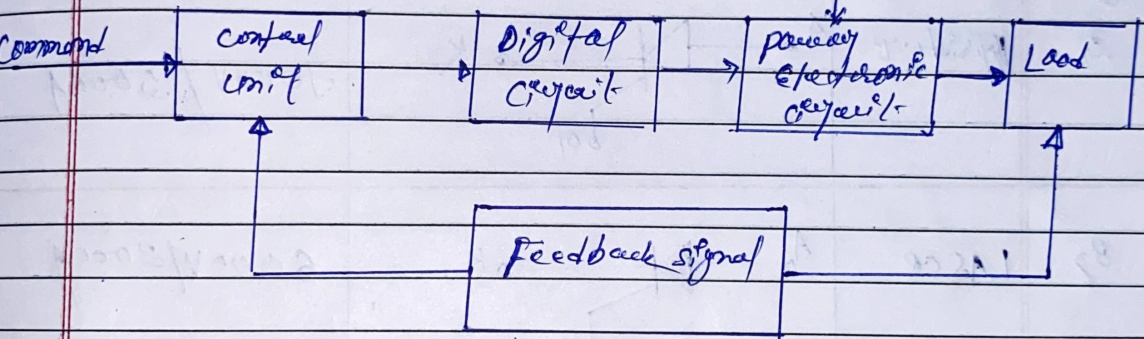


Fig: Block diagram of a typical power electronic system.

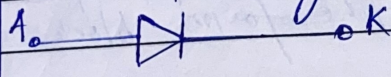
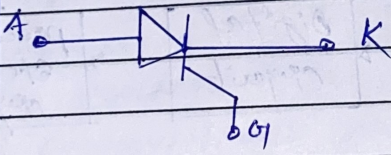
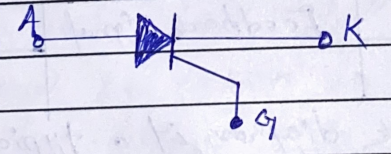
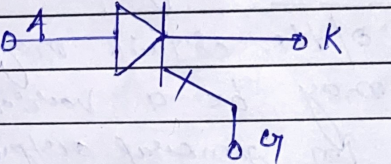
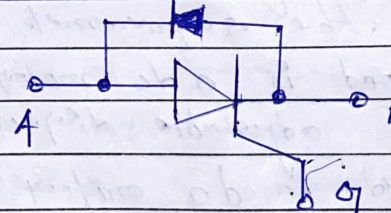
The output ~~from~~ of the circuits may be d.c, or a.c voltage or it may be a variable voltage ~~and~~ and frequency. In general output of the circuit depends upon the requirement of load.

E.g. If the load is a d.c motor, the converter output must be adjustable direct voltage.

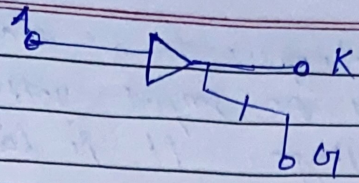
If the load is d.c motor the converter

output must be adjustable direct voltage. If the load is 3-phase induction motor, the converter output is adjustable voltage and frequency. The feedback component measure of ω parameter of load, (say speed) in case of rotating machine and it compares with command. The difference of the two, through the digital comparators controls the instants turn on ~~time~~ of the semiconductor devices forming the solid state-power converter system. In this way behaviour of load circuit controlled.

power semiconductor devices:

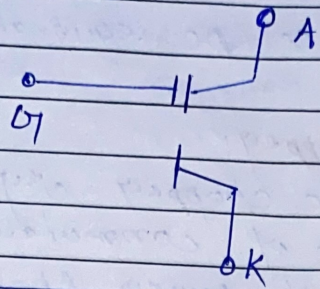
Sr NO	Device	Circuit symbol	Voltage / current rating
1.	Diode		5000V / 5000A
2.	Thyristor		7000V / 5000A
3.	LSCR		6000V / 3000A
4.	GTO		5000V / 3000A
5.	ASCR / RCT		2500V / 400A

6 ITH



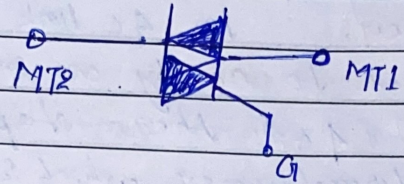
2500V/500A

7 MCT

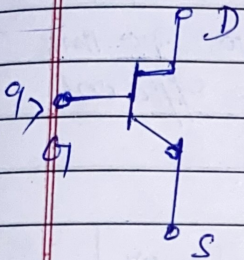


2000V/40A

8 TRIC



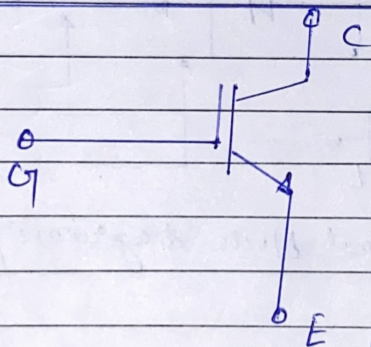
1200V/1000A



SIT

2000V/300A

10 IGBT



1200V/500A