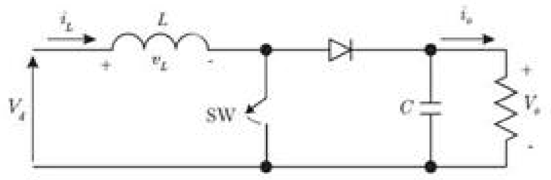
Power Conversion

Many electronics devices need power form ac to dc or dc ac. There are three types of topologies used in power conversion:-

i) **Boost ConverterTopology :-**The boost converter is a DC-to-DC converter that is usually used to boost the source voltage, but it can be adjusted to supply a lower voltage, too.

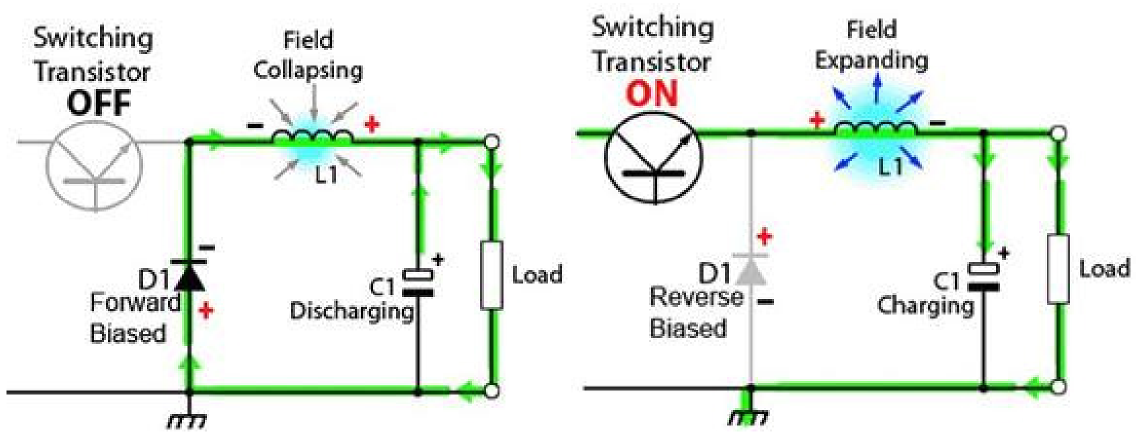


When the MOSFET/TRANSISTOR switch is turned on, the source current builds up a magnetic field in the inductor that opposes it.When the switch is turned off, as before, the voltage switches direction. Now the source voltage, plus the voltage generated by the inductor combine to become more than the source alone. The resulting higher voltage travels through the diode, supplyingVo to charge the capacitor and flowing through the load resistance.

Then, when the switch turns on, the charge stored in the capacitor can't flow through the diode, because the nature of the diode is to pass voltage only one way, so it stays connected only to the load resistance. As before, charge builds up in the inductor, and the cycle repeats itself.

ii) Buck Converter Topology:-

The buck converter is used when a higher DC voltage has to be converted to a lower DC value. It's often used to replace the highly inefficient linear regulator, and modern devices are 95 percent efficient or better.



The diagram above is a highly simplified diagram of a buck converter. When the "switch," usually a power MOSFET/TRANSISTOR, is turned on, voltage in the inductor (L1) is generated that opposes the voltage from the source. Thus, voltage across the load and capacitor (C1) never gets as high as the input voltage from the source.

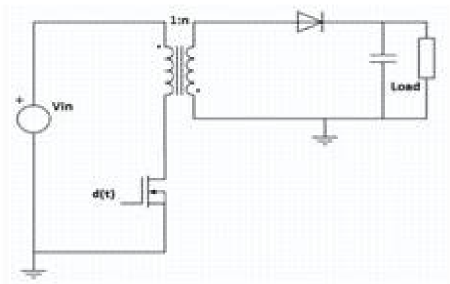
When the switch turns off, the energy still left in the inductor's coil induces a voltage in the opposite direction—the same direction as initially supplied by the source. That voltage, always less than the source's, passes through the load and the capacitor, and the diode turns on, replacing the now-disconnected power source to complete the loop.

Thus, the voltage across the load is always less than that of the voltage source. The capacitor stores power, and as the power stored in the inductor's magnetic field begins to wane, the capacitor's charge will keep current flowing into the load. The MOSFET switches on and off continuously, repeating the cycle. By choosing the correct values of inductor and capacitor, and by providing for the automatic adjustment of the times, within one on/off period, that the switch is closed or open or closed (the duty cycle), remarkable stability and efficiency is achieved.

iii) Fly Back Topology

This type of switcher can operate from AC or DC voltage. Because the source power is switched on and off by the switching MOSFET directly to a transformer, this type of supply has the advantage of providing isolation between the output voltage as well as the ground and the power main. This is vitally important in many applications (see Medical Power Supplies Provide Multiple Levels of Protection).

While the detailed design of flybacks is, as in the case of all SMPS's, quite involved, the basic principles are quite simple.



When the switch, generally a power MOSFET, turns on, the transformer is energized. The relationship of the transformer's input voltage to its output voltage is determined by its windings ratio. The "dots" on the wirings of the transformer indicate that a positive voltage on the input wiring means a negative voltage will appear on the secondary. Thus, the diode will be reverse-biased, so no current flows, but a magnetic field is created in the primary (input) coil's windings.

When the switch is turned off, the magnetic field stored in the primary induces an opposite voltage in the secondary. The diode, now forward-biased, allows the power to flow through the load and the capacitor. When the switch again turns on, the capacitor's stored charge will only be able to discharge through the load, because the diode is, again, reverse-biased. As in the case of the previously described SMTP's, the cycle repeats itself, and through proper choices of the transformer and the capacitor, as well as dynamic monitoring of the duty cycle, the desired output can be maintained in real-world conditions.

For power conversion transformer , basic requirement for ferrite are:-

- Low loss over operating temperature and frequency range
- High flux density

Preferred Material: -

100kHz: -200kHz CF139, CF297

200kHz:-500kHz CF292, CF295

Core Type :-

EE core Cost Effective, Low Shielding, Easy Assembly,

UU core Easy to assemble,handle large power, accommodate more conductor

RM core Good Shielding, Less foot print

Pot Core Excellent Shieling, Size limitation, Heat confined

PQ core Min core size, foot print for given power, less leakage

ER/ETD Sorter path length, handle more power, Shielding is less

EFD core High magnetic path length, can handle more current

Toroids No radiating flux, high input Impedance, core prone to saturate

POWER SUPPLY COMPONENT	**CORE PROPERTIES**
EMI FILTER CMC	High Saturation(Bmax) High Permeability(μ)
PFC	Low loss High Current Handling
Transformer	Low loss over operating frequency range
Magnetic Amplifier	High retention(Br/Bm) with low loss
Inductor	High Saturation Flux Density