



SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF COMPUTER SCIENCE AND DESIGN

COURSE NAME : 19EE01 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

I YEAR /II SEMESTER - COMPUTER SCIENCE AND DESIGN

Unit 4 – ANALOG ELECTRONICS

Topic 9 : UPS



Uninterrupted Power Supply

Uninterruptible power supply (UPS) is a type of power supply system that provide interrupts (Power outage, power blackout, Brownout, surge, spike, sag) free power supply to the load. An Uninterruptible Power Supply system generally offers multiple outlets, allowing to maintain battery back-up power to more than one device and will also include additional outlets for surge protection.

Important Interrupts

- i. Surges:- Oversupply of voltage from the electrical supply voltage (or current or both) for a very short period (less than a second) from power grids
- ii. Spike:- Electrical spike is increase in the electrical supply voltage (or current or both) for a very short period (less than a second),. Another name for an electrical spike is an electrical surge.
- iii. Power outage:- (also called a power cut, a power blackout, power failure or a Brownout) is a short-term or a long-term loss of the electric power to a particular area. There are many causes of power failures in an electricity network. Blackouts is due caused by bad weather. Brownouts is due to an overloaded power grid.
- iv. Voltage Sag:- A voltage sag is a short duration reduction in r. m. s. voltage which can be caused by a short circuit, overload or starting of electric motors.



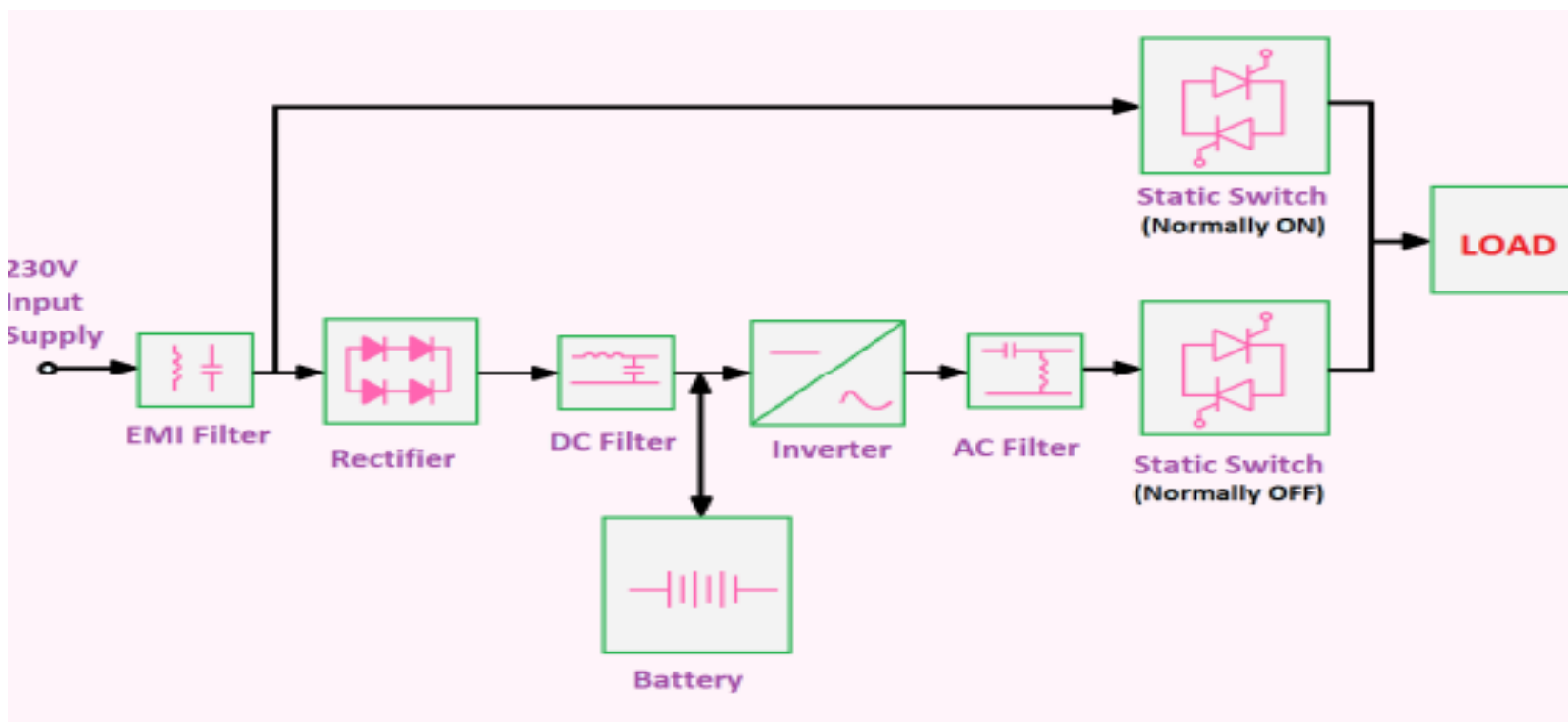
Types of UPS

There are three types of UPS

- i. OFF Line UPS
- ii. Online UPS
- iii. Line Interactive UPS

OFF Line UPS:

OFF-Line UPS are those UPS which passes the AC Mains Supply directly to the output load if the AC Mains Supply is present. Only in the case of power failure, it switches to inverter within few milliseconds to give power to load until mains supply returns. The off line UPS is also called as standby Uninterruptible Power.





1. EMI Filter: It is made using inductors and capacitor. The main function of this EMI filter circuit is to reduce or filter the electromagnetic interferences.
2. Rectifier Circuit: The rectifier circuit is used to convert AC to DC. As the UPS has the battery inside it, and the battery can store only DC that is why we need to convert input AC supply into DC.
3. DC Filter Circuit: The DC filter circuit is used to filter the impure DC comes from the rectifier circuit. The DC output from the rectifier has some AC component. So the filter circuit is used to remove those AC components from the DC supply.
4. Battery: The battery is connected with the output of the DC filter circuit. When the UPS is connected to the power supply the battery will charge.
5. Inverter Circuit: Now we have DC supply but, we need AC supply as output to drive the load. So the inverter circuit is used to convert the DC to AC. The inverter Circuit is made high-speed solid state switches such as MOSFET, SCR, etc. If your load required DC supply then the Inverter Circuit is not required
6. AC Filter Circuit: The AC filter circuit is used to filter the impure AC coming from the inverter circuit.
7. Static Switch: A static switch is connected between the AC filter Circuit and the Critical Load. Which allow or disallow the power flow from the UPS to load according to the given condition.



Another static switch is connected between the critical load and the main power supply after the EMI filter Supply. This switch allows or disallows the power flow from the main supply to the load.

In the case of Offline UPS, the upper static switch is normally ON and lower static switch is normally OFF. So in normal condition, the power directly flows from the main supply to the load. At the same time, the battery will charge. When the main power supply is not available, the upper static switch will be OFF and the lower static switch will be ON. So the load takes power from the battery. This kind of UPS system offers a small size, high degree of efficiency, & pretty low costs, making of this UPS is easy.

Advantages of Offline UPS: i. Offline UPS has high efficiencies, since charger is not continuously on. ii. The power handling capacity of charger is reduced. iii. Cost of Offline UPS is low.. iv. Internal control is simpler in offline UPS. v. Operation of Off-Line UPS is Silent when in standby mode.

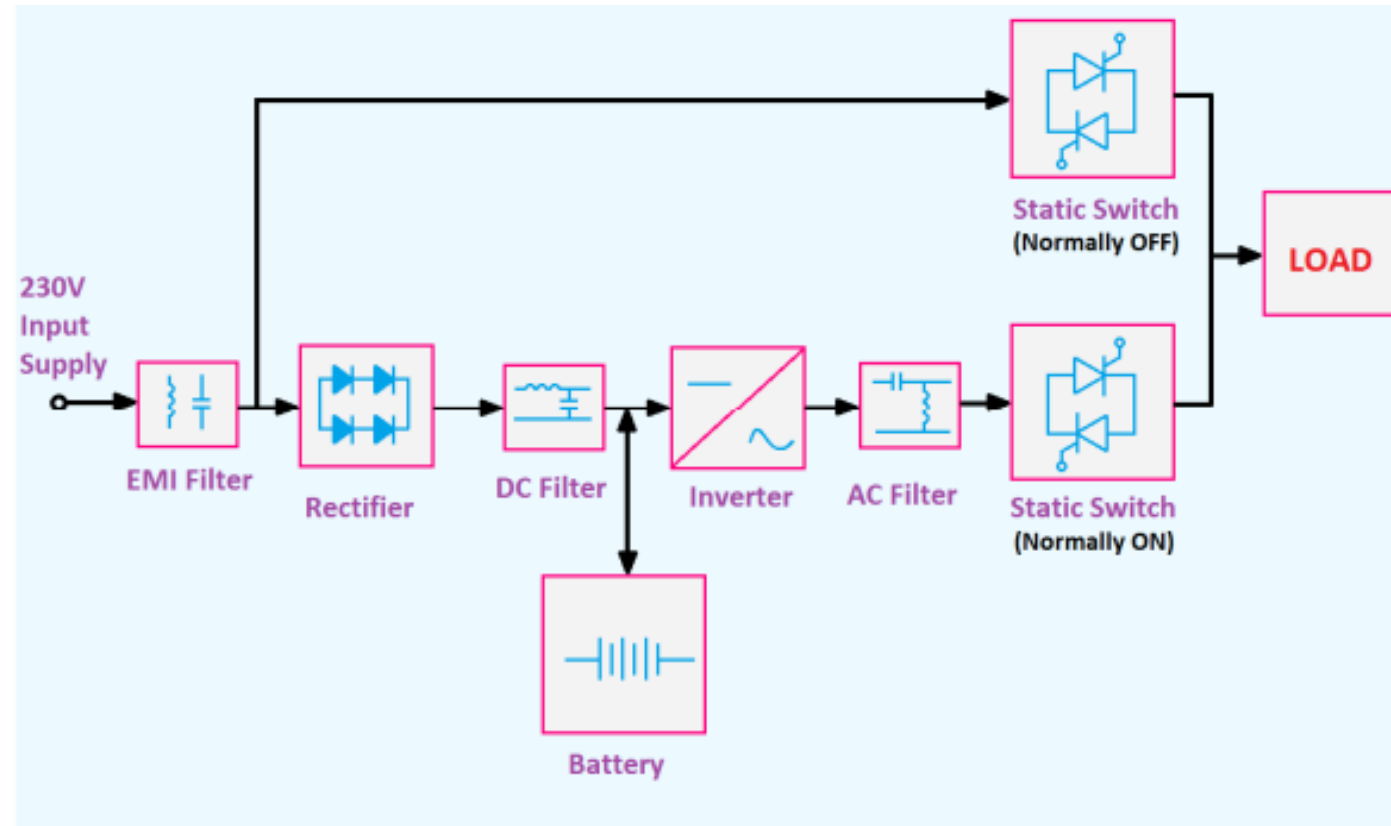
Disadvantages of OFF-Line UPS: i. Since offline UPS provides mains supply when it is present, the output contains voltage spikes, brownouts, blackouts. ii. There is finite transfer time from mains to inverter when mains supply fails. iii. Output of offline Uninterruptible Power Supply is not perfectly reliable. iv. Minimal power protection - only protects against a small percentage of problems. v. Output voltage regulation is poor- sags and surges will be passed straight to the load.

Applications of OFF-Line UPS: i. Off-Line UPS are used in Computers, printers, scanners etc. ii. Off-Line UPS are used in Emergency power supplies, EPABX.

ON-Line UPS:

ON-Line UPS are those UPS which supplies power to load via the inverter. Even if the mains supply fails, there is no interruption to the output load at all and always charges battery from incoming AC mains supply.

In this UPS, the total load power flow through both the inverter and the battery charger, resulting in reduced efficiency with its associated increased heat generation. The block diagram of ON-Line UPS is shown below :-





Advantages of Online UPS:

i. It provides isolation between main supply and load. ii. Since inverter is always ON, the quality of load voltage is free from distortion. iii. All the disturbances of supply such as blackout, brownouts, spikes etc are absent in the output. iv. Voltage regulation of On-Line UPS is better. v. Transfer time is practically zero since inverter is always ON.

Disadvantages of Online UPS:

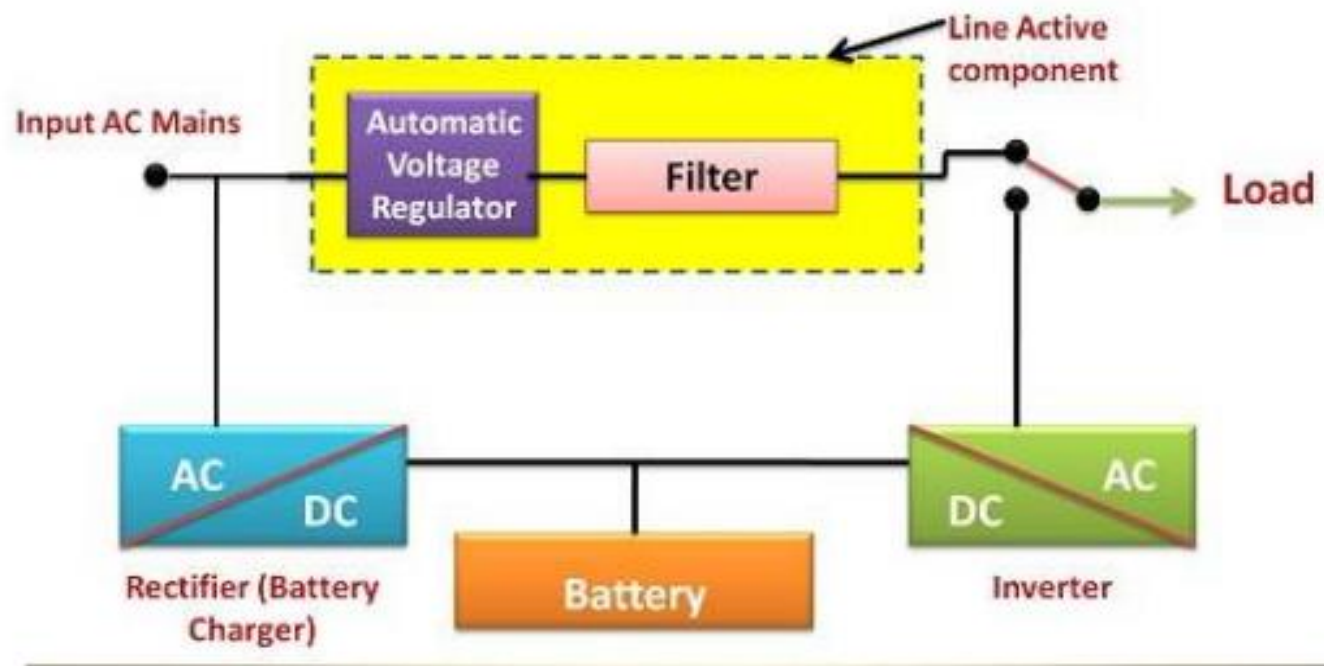
i. Overall efficiency of UPS is reduced since inverter is always ON. ii. The wattage of the rectifier is increased since it has to supply power to inverter as well as charge battery. iii. Online UPS is costlier than other Uninterruptible Power Supply Systems.

Applications of Online UPS:

i. ON-Line UPS are used in Induction motor drives and similar other motor control applications. ii. ON-Line UPS are used in Intensive care units, medical equipments. iii. ON-Line UPS are used in Computers, Data Centres, Server rooms, Search Data Centres iv. ON-Line UPS are used in Network Operation Centres v. ON-Line UPS are used in Process Industries

Line Interactive UPS :

Line-interactive UPS is one type of Uninterruptible Power Source that can regulate voltage automatically. Line-Interactive technology is an incorporates technology that allows the UPS to correct minor power fluctuations (under and over voltages) without switching to battery. Line Interactive UPSs provide full protection from major power problems, such as surges, spikes, sags, blackouts and brownouts..





Advantages:

i. The cost of Line interactive UPS is lower than online UPS ii. It gives better protection than offline UPS. iii. The operation of Line Interactive UPS is Silent when in standby mode.

Disadvantages:

i. In Line Interactive UPS, Fluctuations, such as spikes, can still be passed straight to the load ii. There is finite transfer time from mains to inverter when mains supply fails iii. Line Interactive UPS has No failsafe - UPS will drop the load if there is a high start-up current, overload or inverter failure. Simply put, an on-line UPS offers a higher level of protection than a line interactive at a higher cost.



Comparison between Online, Offline UPS and Line-interactive UPS

Sr. No	Parameter	Online UPS	Offline UPS	Line-interactive UPS
1	Inverter	Always ON	Turned On when mains fails	Turned On when mains fails
2	Rectifier cum charger	Supplies power to inverter as well as charges battery	Charges only battery	Charges only battery
3	Output waveform	Sine wave	Quasi square wave	Sine wave & Quasi square wave
4	Harmonic distortion	Low	High	Low
5	Efficiency	Low	High	High
6	Load	Isolated from supply	Not isolated from Supply	Not isolated from Supply but regulated by AVR
7	Cost	High	Low	Medium



REFERENCES

1. Bhattacharya. S.K, “Basic Electrical and Electronics Engineering”, Pearson Education , (2017)
2. Muthu Subramanian R, Salivahanan S,“ Basic Electrical and Electronics Engineering”, Tata McGraw Hill Publishers, (2009)
3. V.Mittle“ Basic Electrical Engineering”, Tata McGraw Hill Publishers, (2017)
4. Nagrath. I.J, “Electronics: Analog and Digital”, Prentice Hall India Pvt. Ltd., (2013)

THANK YOU