UNINTERRUPTIBLE POWER SUPPLY (UPS)

UPS:

- An uninterruptible power supply (UPS) or uninterruptible power source is a type of continual power system that provides automated backup electric power to a load when the input power source or mains power fails.
- An uninterruptible power supply (UPS) is a device that provides emergency power to electrical devices when the main power source fails or experiences disruptions. It acts as a backup power source, allowing connected devices to continue running or be shut down gracefully during power outages

THE UPS CONSISTS OF THREE PRIMARY COMPONENTS:

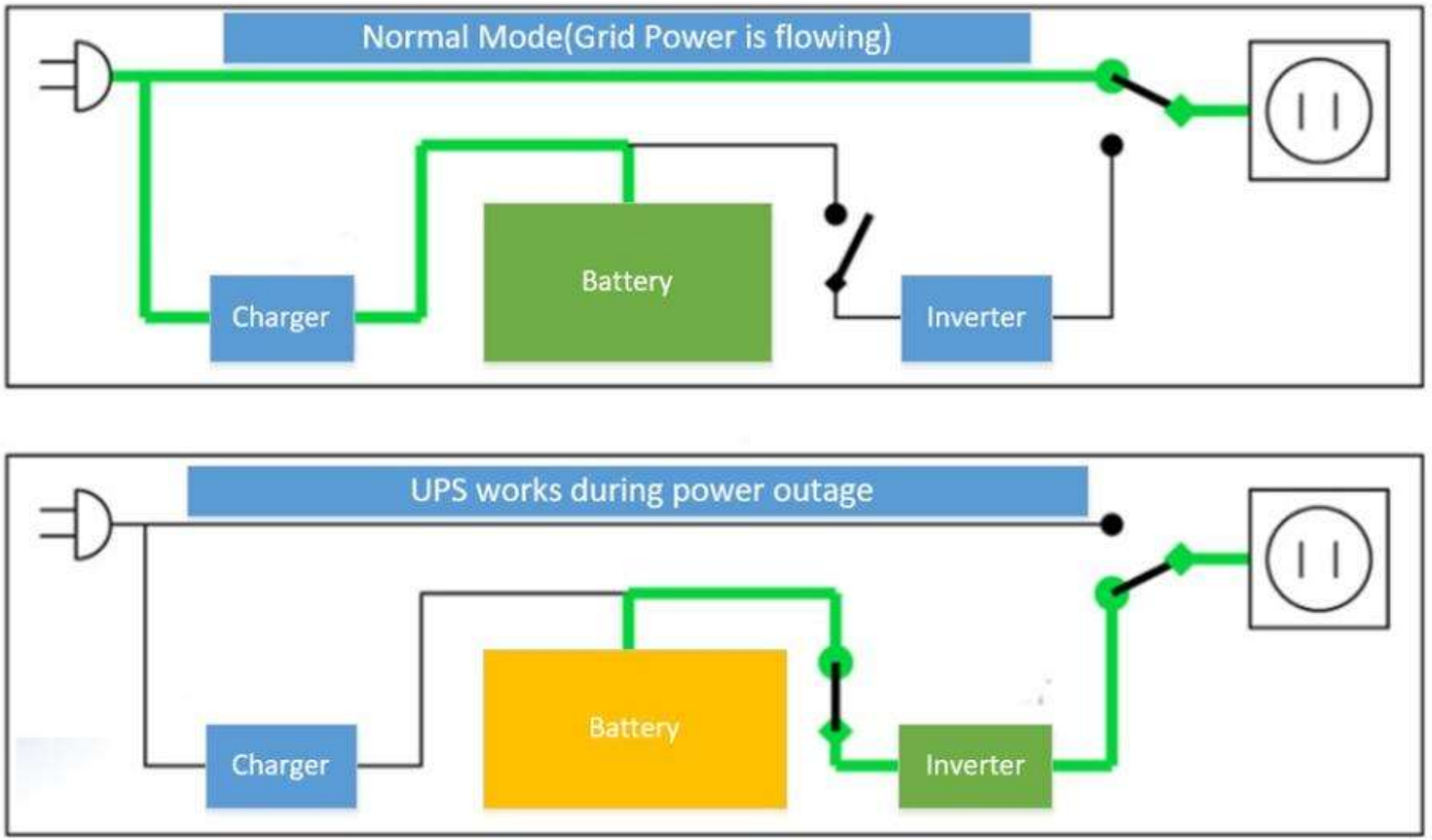
1. Battery: The battery is a crucial part of a UPS. It stores electrical energy and provides power when the main power supply is interrupted. The capacity of the battery determines how long the UPS can sustain power to connected devices.
2. Inverter: The inverter converts the direct current (DC) power from the battery into alternating current (AC) power, which is compatible with most electrical devices. The inverter ensures a smooth and stable power supply during power outages.
3. Charger: The charger is responsible for replenishing the battery's charge when the main power supply is available. It keeps the battery charged and ready to provide backup power when needed.

PRIMARY FUNCTION OF A UPS

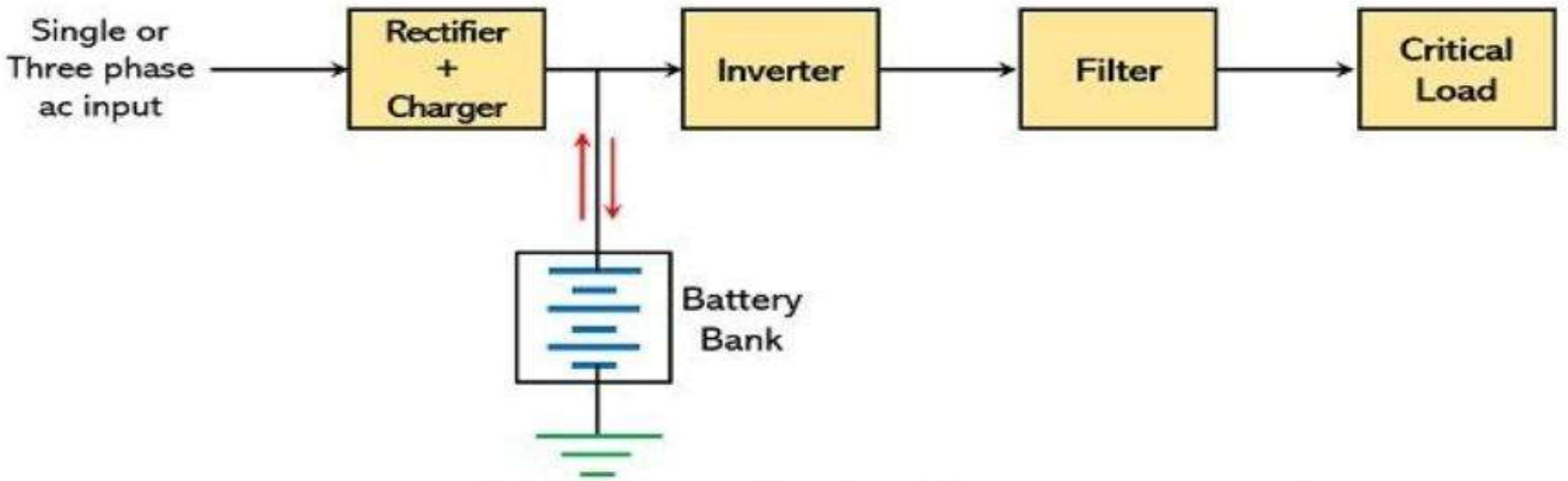
- When there is any failure in the main power supply from the utility, the UPS supplies emergency power to the load for a short duration of time. This is the primary function of a UPS. Modern UPSs can also provide protection against electrical faults such as short-circuit, voltage fluctuations, low voltage, instability of mains frequency, etc.

HOW DOES AN UPS WORK?

- In the simplest form, UPS is a supply system that offers uninterrupted power to the AC load by converting DC into AC. UPS differs from an emergency power supply system or a standby generator, as it can protect devices from power outages by one or more connected batteries. The battery run time is relatively short, typically 5 to 15 minutes, but it is long enough to bring the auxiliary power supply online or protect devices from shutting down.
- In normal operating conditions, the current is drawn from the AC main power supply or grid, while UPS provides load current in case of a power outage. Here the battery is used as the backup source to deliver power to the load in case of power failure


Normal Mode(Grid Power is flowing)
Charger
Battery
Inverter
UPS works during power outage
Charger
Battery
Inverter

UPS BLOCK DIAGRAM:

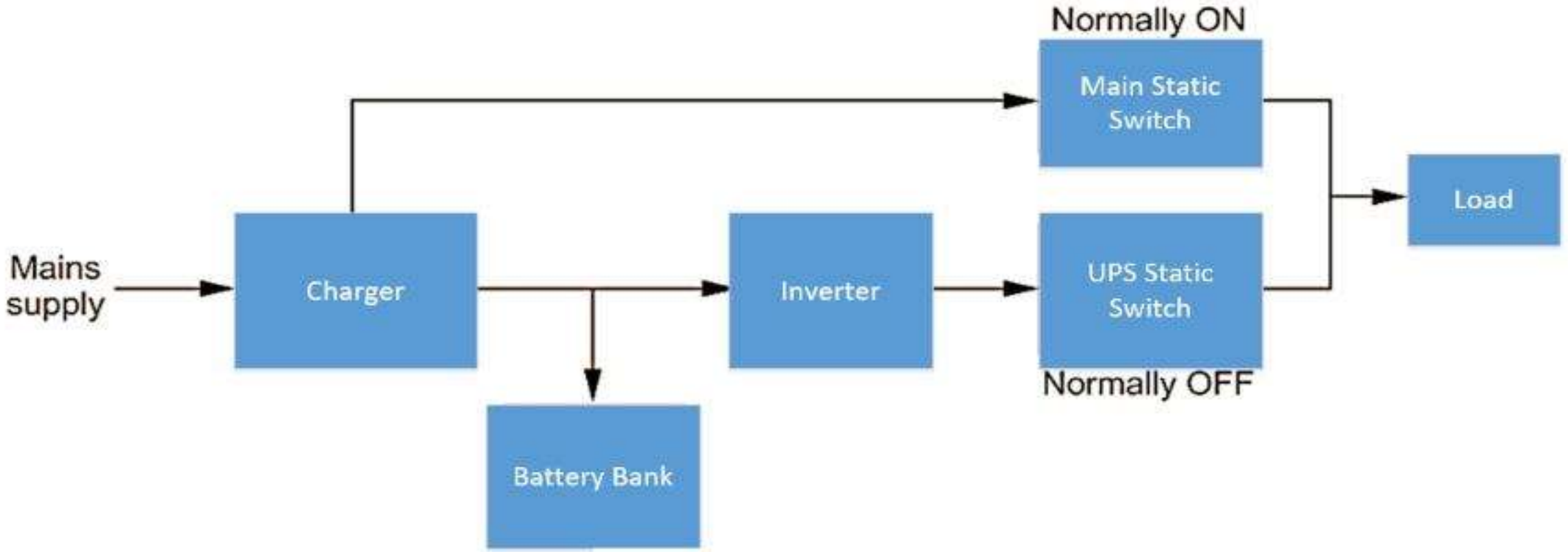


Block Diagram of typical UPS System

UPS TYPES:

1. **Offline UPS:** Offline: Offline UPS types are activated only when the main power is gone. In this type, the UPS is connected directly to the consumer load. However, the offline type does not have an acceptable quality for the output power, and its maximum power is limited.
2. **Online UPS:** If you also want the proper and suitable output power, the online type can be a good option for you. In online types, the inverter can charge batteries and provide output power simultaneously. It means the grid power is converted into direct current by a rectifier. Then it is converted into alternating current by the inverter section and is ready to use by consumer loads. This conversion can protect consumer devices from volatile grid voltage.
3. **Line interactive UPS:** In this type, the inverter always charges the battery in the normal voltage range. Nevertheless, as soon as the input voltage goes beyond or below the normal range, UPS is activated, and supplies the consumer load from the batteries and prevents damage to connected devices. The interactive line type is mostly used in network equipment.

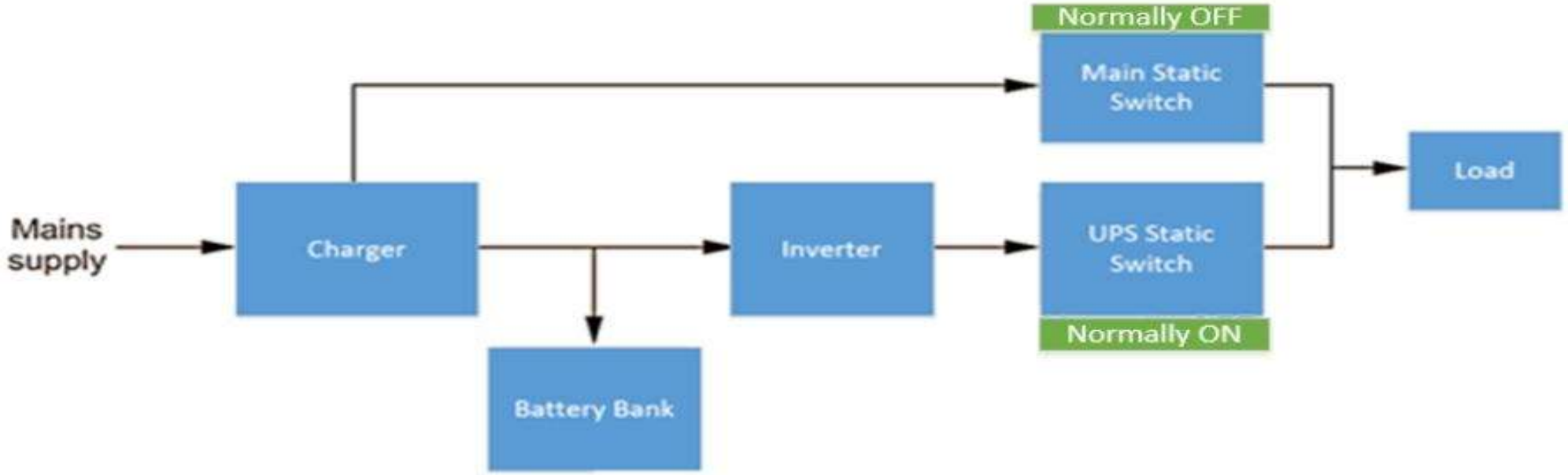
OFFLINE UPS BLOCK DIAGRAM:



- Charger: This block rectifies the input AC and charges the batteries. The charger block unit involves an EMI filter, rectifier, and DC filter.
- Rectifier: this unit converts AC current to DC current.
- DC filter: The rectifier's needed output voltage is unidirectional and does not change concerning time. It has an average or DC value on which AC components of different frequencies are superimposed (mixed). These undesired AC components mixed in DC are called Ripples. Therefore, filter circuits are necessary for DC Regulation. Thus, this part task reduces the negative ripple effect and makes the output current much more in DC shape.
- Static switch: Static Switches are designed to connect or disconnect the load to or from the supply, respectively, without the existence of moving parts
- Inverter: DC to AC inverters are designed to change a DC (direct current) power supply to an AC (alternating current) power supply.
- Battery bank: An assemblage of one or more individual batteries used to store energy in electrochemical form is referred to as a battery bank.
- Load: sensitive and critical loads selected by the user

ONLINE UPS BLOCK DIAGRAM:

In online UPS, the load draws power from the battery bank and main power supply simultaneously. Because the load initially receives electricity from the main power supply but switches seamlessly to the battery backup in the event of a power outage, the supply delivered to the load is uninterruptible. This is the difference between online and offline UPSs.



ADVANTAGES & DISADVANTAGES:

- Advantages of On-line UP

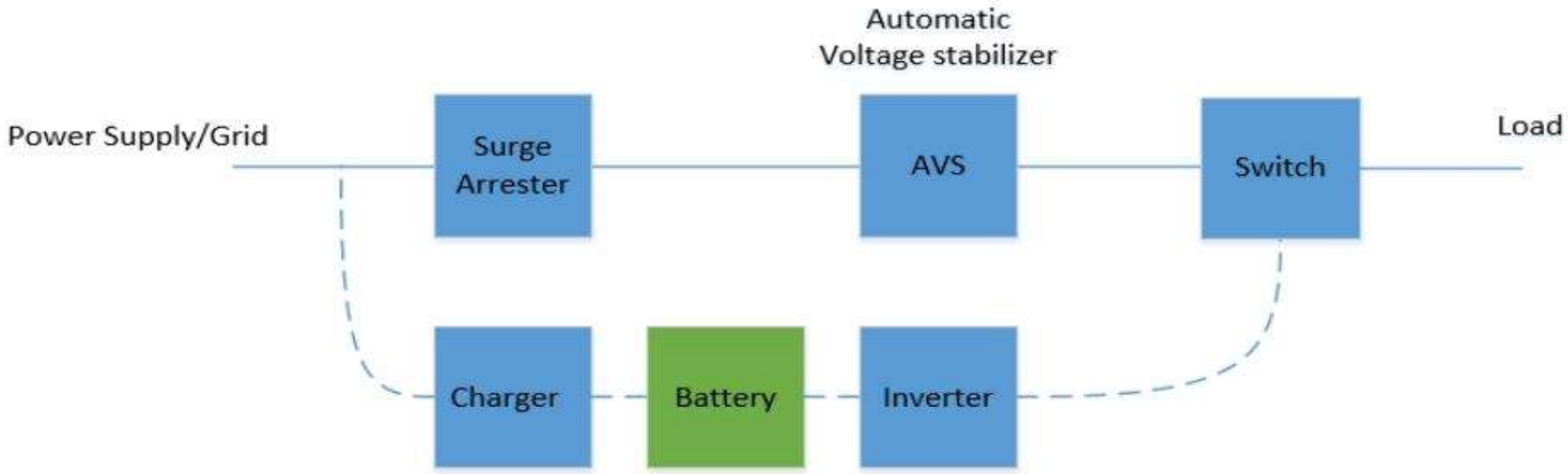
1. It offers continuous power flow with complete isolation from the main power supply or grid ac input to the end user,
2. Constantly uninterrupted electricity is given to the load,
3. Main power supply failure (outage) cannot change the operation mode,
4. The transfer time is negligible due to the always-on condition,
5. Wide range of input voltage

- Disadvantages of On-line UPS

1. Due to Continuous on-mode, it generates more heat. Hence, a large heat sink is required.
2. It has a Complex design.
3. It is much more expensive than offline UPS.
4. Higher power loss (since the inverter is always on, the overall efficiency of the device is reduced).

LINE INTERACTIVE UPS BLOCK DIAGRAM:

Line interactive technology UPSs are being used in places where we have sensitive and expensive devices and equipment because electrical fluctuations will lead Sensitive electrical devices to fail. Thus, they should not be subject to fluctuations or noises. Line interactive UPSs are usually used for network equipment. For instance, line interactive UPS is utilized for departmental servers, websites, and small company servers. The line interactive design is a combination of offline & online schematic. In line with interactive design, the inverter plays a dual role. First, it charges the battery when the main power supply is flowing. Second, it regulates the output voltage and works as a normal inverter in the absence of the main power supply.



ADVANTAGES & DISADVANTAGES:

- Advantages of Line-interactive UPS

1. High reliability and high efficiency,
2. Lower costs than On-line UPS,
3. High power supply,
4. Noise and fluctuation filtering
5. Better protection than Offline UPS.

- Disadvantages of Line-interactive UPS

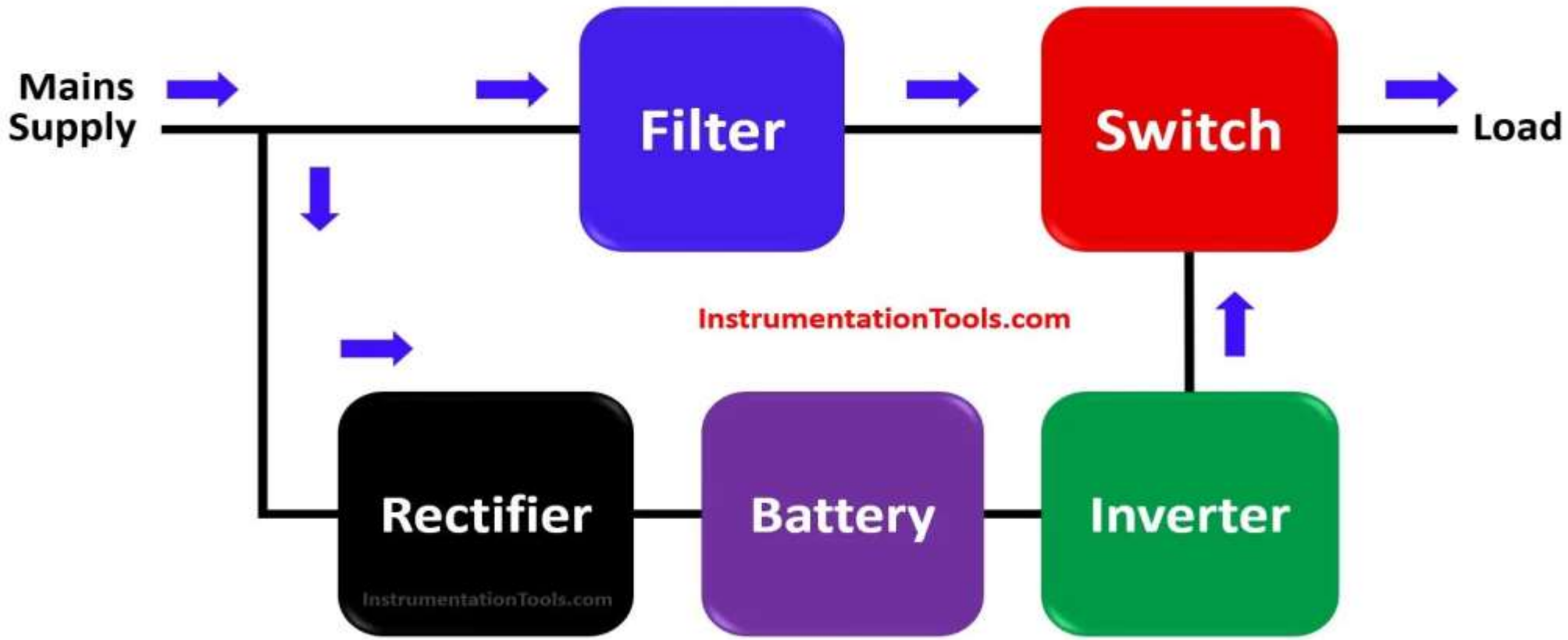
1. Line interactive UPS cannot fully filter noise and fluctuation with low power demands (like 5KA and below),
2. Output frequency depends on the input frequency.
3. Line interactive UPS has not power factor correction circuit.

WORKING OF UPS:

A UPS takes AC supply, stores it in batteries and these batteries then feed the power back to the load device in case of mains power failure. This is the basic working of UPS.

Every UPS has a semiconductor static switch, which is used to switch power between the main AC supply and batteries to the load. Failure of this switch can cause the UPS to be worthless because it will damage the working of UPS.

The basic components of UPS are – a rectifier (conversion of AC to DC for feeding batteries), inverter (conversion of DC to AC for feeding load), battery (for providing DC power to the inverter), and a semiconductor switch for switching load transfer between mains AC supply and inverter supply


Mains Supply
Filter
Switch
Load
InstrumentationTools.com
Rectifier
Battery
Inverter
InstrumentationTools.com

WORKING OF UPS IN METROS:

In the context of metros, UPS (Uninterruptible Power Supply) systems play a crucial role in providing backup power in case of electrical disruptions. Here's an overview of how UPS systems work in metros:

1. Power Source: The primary power source for a metro system is the electrical grid. The grid supplies electricity to the metro's traction system, including the trains, signaling systems, lighting, and other electrical components.
2. UPS Components: UPS systems in metros consist of several key components:

- Rectifier/Charger: This component converts the incoming AC power from the grid into DC power to charge the UPS batteries.
- Batteries: UPS systems employ large batteries to store electrical energy. These batteries provide backup power during outages or disruptions in the main power supply.
- Inverter: The inverter converts the DC power from the batteries back into AC power, which is then supplied to the critical systems in the metro.

- Normal Operation: During normal operation, when the main power supply from the grid is available and stable, the UPS system primarily serves as a charger for the batteries. The rectifier converts the AC power from the grid into DC power, which charges the batteries. At the same time, the inverter provides a clean and stable AC power supply to the metro systems.
- Power Disruption: In the event of a power disruption or outage, the UPS system detects the loss of grid power. It immediately switches to battery power to provide uninterrupted electricity supply to critical systems such as train control systems, signaling, emergency lighting, and ventilation.
- Battery Runtime: The battery runtime of a UPS system in a metro is designed to provide backup power for a specific duration. The runtime depends on factors such as the capacity of the batteries, power consumption of critical systems, and the expected time needed for power restoration. Metro operators carefully determine the required battery capacity to ensure the essential systems remain operational until the main power supply is restored or alternate measures are taken.
- Power Restoration: Once the main power supply is restored, the UPS system switches back to the grid power source. The rectifier resumes its role of charging the batteries while supplying power to the metro systems. The

ADVANTAGES OF UNINTERRUPTIBLE POWER SUPPLIES :

- Emergency power supply
- Maintain battery life
- Provide surge protection
- Protect some uncertain data loss
- Use gives a huge power back in the industries
- Reliable power source
- Trusted power solution provider
- Uncertain data loss can be prevented
- Protect the voltage-sensitive device from bad electricity

DISADVANTAGES OF UNINTERRUPTIBLE POWER SUPPLIES :

- Maintain cost is difficult
- The startup cost is too much high
- Commercial uses require a large number of batteries

Thank you