5. APPLICATIONS OF POWER DEVICES

Now – a - day's high quality, regular and uninterrupted power supply is a basic requirement of all types of power consumers. But the power quality deteriorates and the supply is affected due to power blackouts and power failures. Because of poor maintenance of power distribution companies the power outage and blackout are becoming very common.

Critical loads such as computers, hospital equipment's including pre and post- surgery medical care systems, processing control system in industries and communication systems requires a continuous and quality power otherwise a major losses will occur in computers and some times of life of human beings may also get affected in operation theatres due to power failure for that purpose *uninterruptible power supply (UPS).*

TYPES OF DISTURBANCES IN COMMERCIAL POWER SUPPLY:

1. **Voltage Deviations**
   Low voltage problem:
   - May arise during peak load hours.

   Over voltage problem:
   - The supply voltage is higher than the rated voltage.
2. **Frequency Deviation**
   The supply system frequency is not maintained within a permissible limit of +/-5% ,then the performance of the motor get affected badly.
3. **Voltage spike**
   It is a sharp rising voltage pulse superimposed over the main supply voltage waveform.
4. **Harmonics**
   Developed due to usage of non-linear loads, SMPS, electronic ballast circuits in vapor lamps and CFL (Compact Fluorescent Lamp).
5. **Chopped distorted voltage**
   It is a deviation of voltage waveform from pure sinusoidal waveform.
6. **Power outage and blackout**
   It is a failure/disconnection of power for a short period of time without prior notice to the customer.

DEVICES USED TO SUPPRESS THE SPIKES IN SUPPLY VOLTAGE:

1. Isolation transformers.
2. Selenium diodes and metal oxide varistors.
3. Snubber circuit (RC type).
4. Transformers of voltage regulators.

SMPS (SWITCHE MODE POWER SUPPLY):

SMPS works on the principle of D.C chopper. By operating ON/OFF switch very rapidly, ac ripple frequency rises which can be easily filtered by using L and C filter circuits.

ADVANTAGES OF SMPS:

- High efficiency.
- Compact in size and light in weight.
- Noiseless output.
- Electrical isolation (using transformers).
- Ripple free output.
- Less sensitive to input voltage variations.
- Less heat dissipation.
- Provide the user with a means to vary the output.
- Can get constant output at variable input

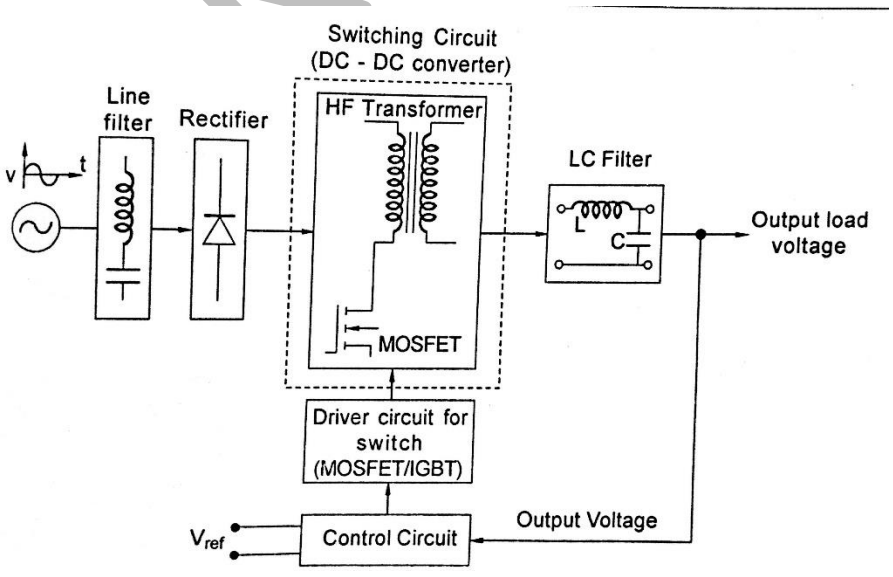
DISADVANTAGES OF SMPS:

- Produces RF Interference
- Requires EMI filters in both input and output
- Complex circuitry

BLOCK DIAGRAM OF SMPS:

The block diagram of SMPS. It consists of line filters, Rectifier, Chopper, LC filter, control circuit and driver circuit. The input to the switching device is unregulated dc, which may be available from AC-DC rectifier and filter circuit. This d.c voltage is chopper at high frequency inorder to withstand the fluctuations in the input voltage or the load conditions.

The output voltage is fed to the chopper circuit using a control circuit & divider circuit. The main function of control circuit is to sense the output voltage and to decide about the duty ration of mosfet. The driver circuit will functions as a switching device. By adjusting the duty ration of chopper. The output voltage is maintained constant and it is then filtered by using LC filter supply the ripple free output voltage to the load.



UNITERRUPTED POWER SUPPLIES (UPS):

- Critical loads like computers , servers , Telephone Exchanges cannot tolerate power line disturbances
- They require continuous and constant mains supply for their proper functioning
- Any power disturbance may cause severe damage and loss

UPS Types:

- **Offline UPS:**

  The load gets the power from mains supply under normal conditions. The Inverter is off when the mains supply is ON. The Inverter turns on only when the mains supply fails and connects to the load through a change over switch. Useful for less critical applications

- **Online UPS:**

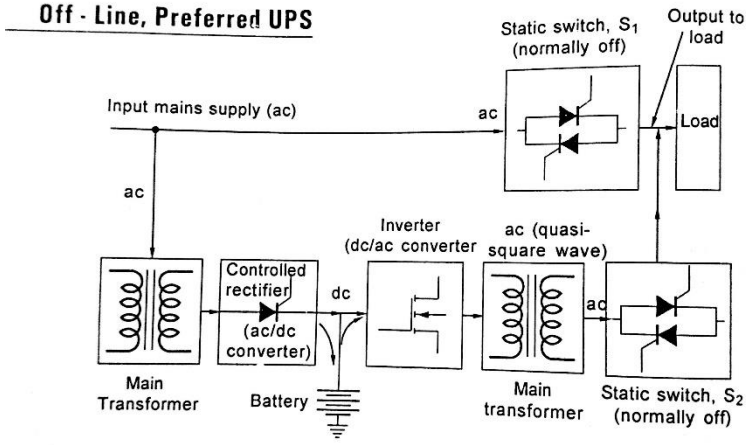
  The load always gets the power from the inverter under both normal conditions and during power failure. No change over therefore no supply interruptions to the load. Suitable for critical applications like Servers and Communication networks.

OFF - LINE UPS:

The functional block diagram of off - line. It consists of independent battery charging circuit, load circuit which is supplied through static transfer switched (S1) during main power ON and through battery, inverter, static switch S2 during power failure.

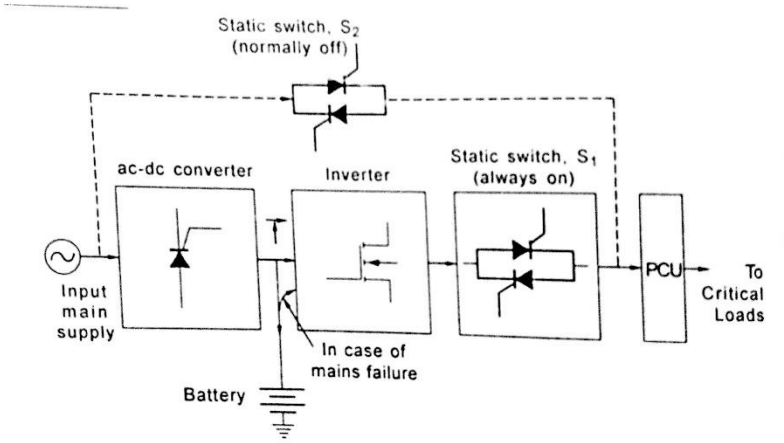
During normal mode the battery is charged through AC – DC converter and a charge controller and the load supplied through switch S1.

During Power failure, static switch S2 operates and battery supplies power to the load through invertor. The backup duration depends on the capacity or rating of the battery and its charge capacity prior to the power failure.



ON - LINE UPS:

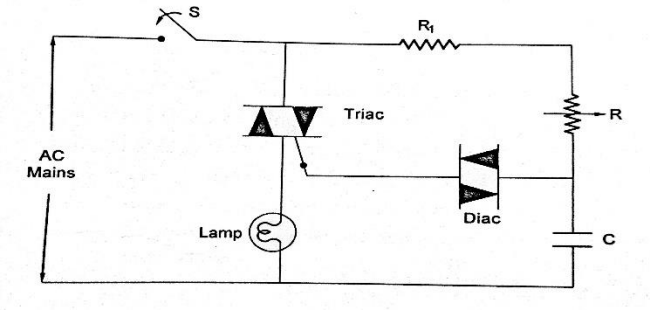
The ON – LINE ups during main supply is available, the main supply is fed to the load through converter, inverter, static switch S1 and PCU.



When the main power supply fails, the battery instantly supplies the power to the load through inverter, static switch S_1 and PCU. Hence power supply to the load continues without any interruption.

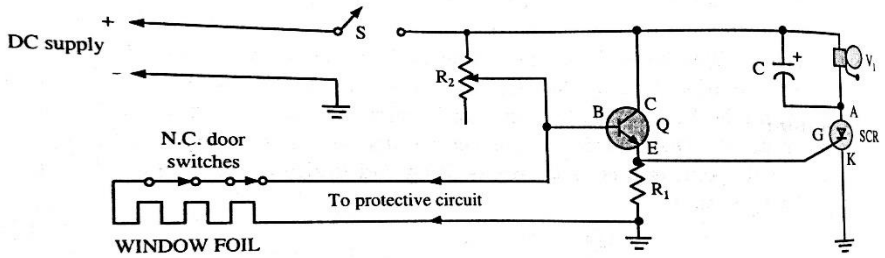
In this method, in the event of failure of inverter, the main can be delivered to the load through the static switch (S2) and its direction is represented by dotted line. Instead of using SCR bridge

LIGHT DIMMER CIRCUIT USING *DIAC* AND *TRIAC*:



- The light dimmer circuit to control illumination level of lamp using DIAC and TRIAC. The R – C circuit forms the triggering circuit for DIAC.
- The gate current flows through the TRIAC when Capacitor (C) is to cause conduction of DIAC.
- The TRIAC starts conducting and the lamp glows.
- Changing resistance R causes change in firing angle of *TRIAC* and voltage applied to the lamp illumination changes.

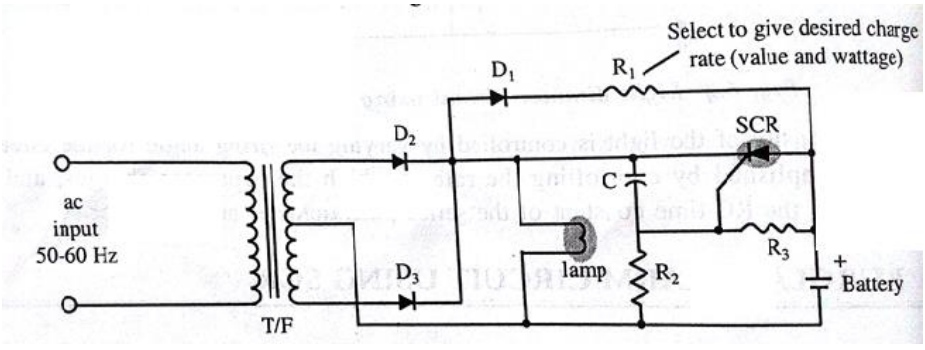
BURGLAR ALARM CIRCUIT USING SCR:



- The circuit consist of transistor, an alarm working of 6V DC and a SCR.
  The transistor is biased in voltage divider mode.
- The output is taken from the emitter which is given to the SCR.
- Initially the transistor is in cutoff region which makes the transistor open circuit.
- When the protective circuit is opened of cut because of breaking of security, all the input voltage falls on the base of the transistor.
- Transistor conducts and triggers the SCR.
- The alarm is in series with the SCR. It starts ringing, there is no other way to stop the alarm even in connecting the broken foil as the before.
- The commutation of SCR is possible only if there is an additional commutation circuitry or by master switch (S).

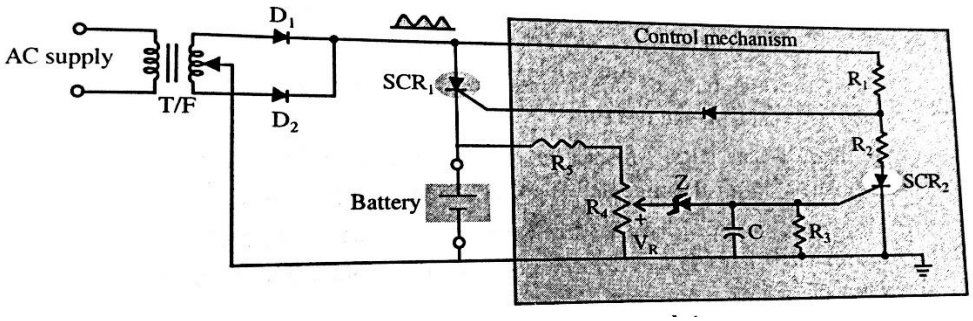
EMERGENCY LAMP CIRCUIT USING SCR:

A DC energy is given to the bulb if there is a power shortage by a emergency lamp circuit.
The capacitor C will charge to a voltage slightly less than a DC voltage across R_2
The cathode of SCR is higher than the anode and the SCR is non conducting. The battery is being charged through R_1 and D_1 at a rate determined by R_1. Charging only take place when the anode of D1 is more positive than its cathode. The dc voltage of the full – wave – rectifier will lit the bulb when the power is ON. If the power fails, the capacitor C will discharge through D_1, R1 and R3, until the cathode of SCR is less positive than the anode. At the same time the junction of R2 and R3 will become positive and establish discharge through the SCR and energize the lamp and maintain its illumination. Once power is restored, the capacitor C will recharge.



BATTERY – CHARGER CIRCUIT USING SCR:

The fundamental components of the circuit are shown in Fig.



D_1 and D_2 establish a full wave rectifier signal across SCR_1 and the battery to be charged. When the full wave rectifier input is sufficiently large to produce the required turn on gate current SCR_1 will turn ON and charging of the battery will commence. At the start of charging, the low battery voltage will result a low voltage V_R and voltage V_R is turn too small to cause zener conduction. In the "off" state, the current is zero. The capacitor C is included to prevent any voltage transients in the circuit from accidental turning on the SCR_2. As charging continues, the battery voltage rises to a point where V_R is sufficiently high to both turn on the zener and fire SCR_2 has fired, the short – circuit representation for SCR_2 will result in a voltage divider circuit determined by R1 and R2 that will maintain V_2 at a level too small to turn SCR_1 ON. When this occurs, the battery is full charged and the open circuit state of SCR_1 will cut off the charging current. Thus, the regulator recharges the battery whenever the voltage drops and prevents over charging when fully charged.