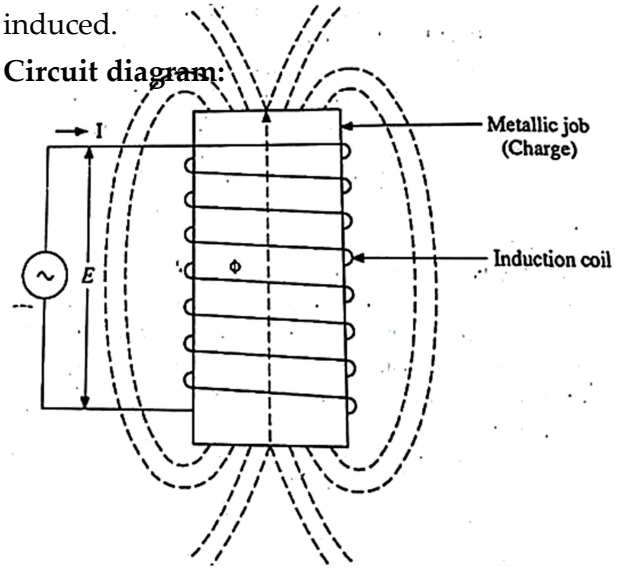
Induction heating

Induction heating is known as eddy current heating because the heat is produced due to the eddy current losses taking place in the system

Principle:

Whenever a conductor is placed in a moving magnetic field, an EMF is induced.

Circuit diagram:



Description:

The metallic job called charge is kept within alternating magnetic field. When alternating voltage (E) is supplied across the job coil, current (I) starts flowing in the coil. This current produces an alternating magnetic field. The metallic job placed in this field cuts the alternating magnetic flux and produce an induced emf is given by

$$e = \{-N \, d\Phi/dt\}$$

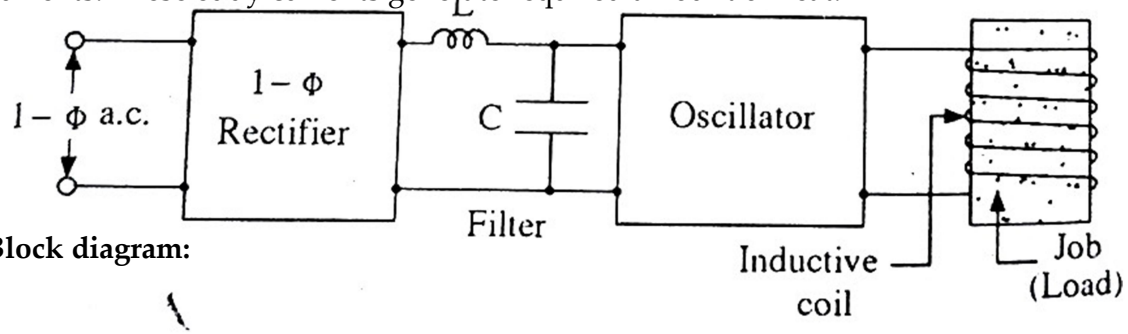
N -> Number of turns in the coil

Φ -> Magnetic flux

dΦ/dt -> Rate of change of flux

The alternating currents produced by the induced emf are known as eddy currents. These eddy currents generate required amount of heat.

Block diagram:



Description:

1-Φ Rectifier:

Rectifier converts ac into dc. Here 1-Φ Bridge rectifier is used to convert dc.

Filter:

Filter is used to remove unwanted noise. Here LC filter is filtered to reduce unwanted ripples.

Oscillator:

The ripple free dc is fed to oscillator circuit to produce high frequency power at the oscillator output. The type of oscillator used depends on the value of frequency which is required for the heating.

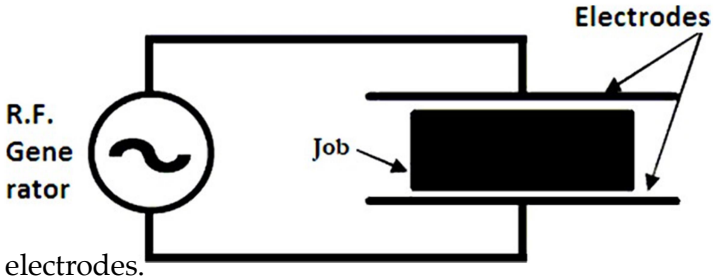
Job:

Job acts as the Load. High frequency power output of the oscillator circuit is supplied to the job for heating it.

Dielectric heating

Dielectric heating is also known as radio frequency heating. A non-conducting material is subjected to an alternating electric field, the dielectric loss occurs in it. This loss appears in the form of heat in dielectric heating.

Circuit diagram:

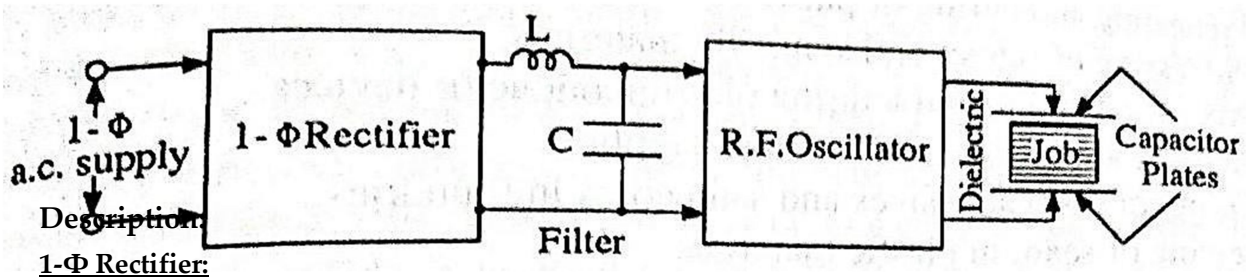


electrodes.

Description:

A Capacitor is formed between the two electrodes and the job. The two electrodes acts as the two plates of the capacitor and the job acts as the diectric material between two

Block diagram:



Description:

1-Φ Rectifier:

Rectifier converts ac into dc. Here 1-Φ Bridge rectifier is used to convert dc.

Filter:

Filter is used to remove unwanted noise. Here LC filter is filtered to reduce unwanted ripples in dc.

RF Oscillator:

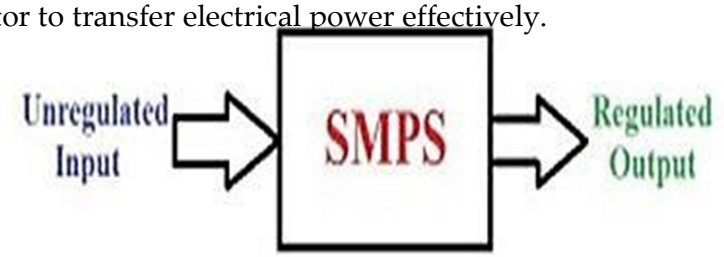
The ripple free dc is fed to oscillator circuit to produce high frequency power at the oscillator output. The type of oscillator used depends on the value of frequency which is required for the heating.

Job:

The very high frequency supply is connected across the two electrodes between which the job is kept as dielectric medium.

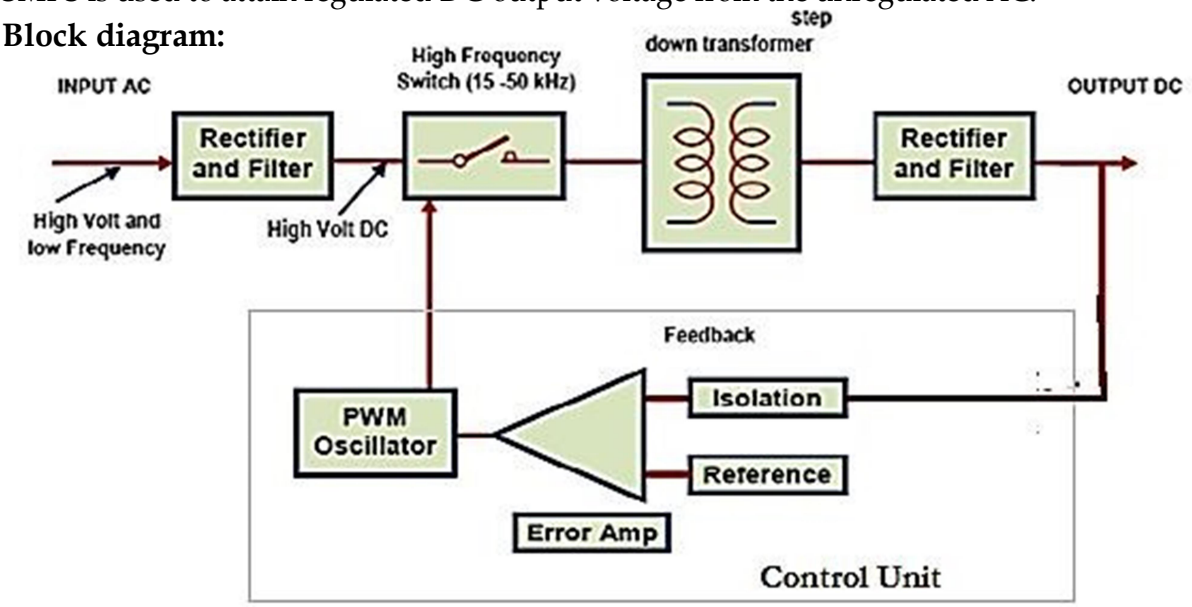
SMPS

SMPS is Switched Mode Power Supply also known as Switching Mode Power Supply. SMPS is an electronic power supply system that makes use of a switching regulator to transfer electrical power effectively.



SMPS is used to attain regulated DC output voltage from the unregulated AC.

Block diagram:



Description:-

Rectifier & Filter:

The Bridge rectifier is used to convert the high voltage AC to DC voltage. Filter is used to remove unwanted noise from dc. Here LC filter is used.

High frequency Switch:

High-frequency switch is used to convert high voltage DC to very high-frequency square wave. The switch is controlled by the feedback and control circuit.

Step down transformer:

The high-frequency AC is step down into low voltage by a fly back high-frequency transformer.

Rectifier & Filter:

Again a rectifier circuit is used to convert the low voltage AC to DC and Filter is used to filter the dc.

Control Unit:

Control unit has high-frequency oscillator, pulse width modulation, and Error amplifier. It is used to control the output DC supply.

Isolation:

The output of rectifier and filter are isolated from the High-Frequency switch by a high-frequency transformer, and voltage control feedback.

Error amplifier:

Error amplifier acts as a comparator. It compares the reference voltage with the output voltage.

PWM oscillator:

The switching-power supply output is regulated by using Pulse Width Modulation. High frequency switch is driven by the PWM oscillator.

UPS: (Uninterrupted Power Supply)

Uninterruptible Power Supply (UPS) is designed to supply continuous power to loads that must run without interruption. UPS system continues its operation even during a power outage, suppresses line transients, and harmonic distortions in the power supply.

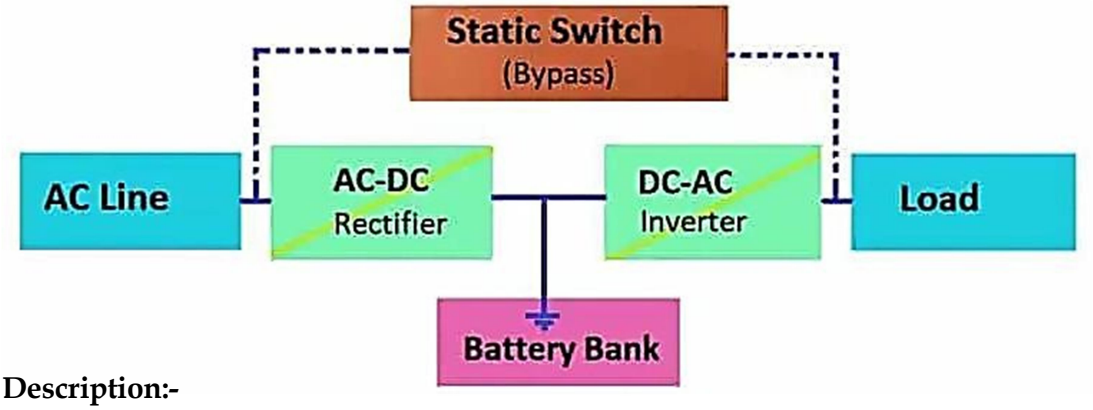
Types:-

1. Online UPS
2. Offline UPS

Online UPS:-

Online UPSs are used to provide uninterrupted power. The on-line ups is also called double conversion system because the AC input is converted to DC by the rectifier, and then back to AC by the inverter.

Block diagram:-



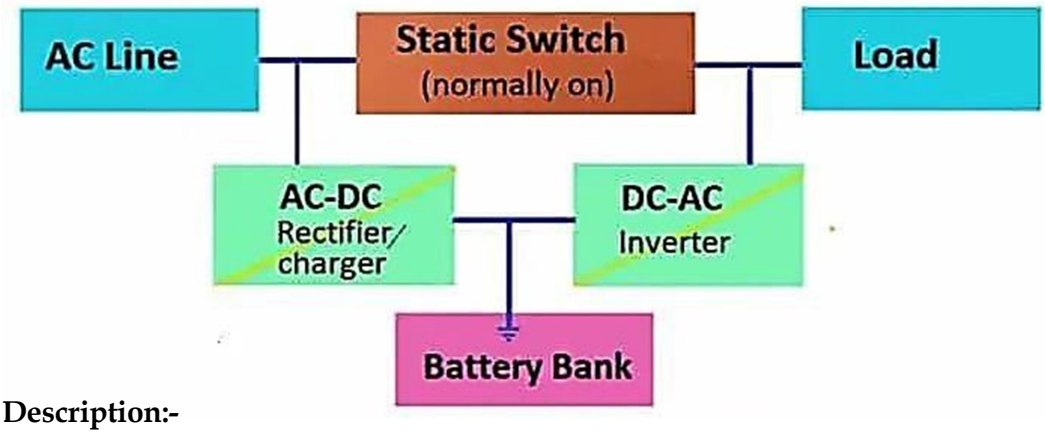
Description:-

The AC supply is used to charge the battery bank through a rectifier, as well as supply DC power to the inverter and given to the load which it is connected. When the main supply fails, the battery will automatically supply power to the inverter. The rectifier will be bypassed in this case. One more added feature is the addition of a static bypass switch. When the UPS fails, this switch is turned on which supplies direct AC power to the load

Offline UPS:-

The Off-Line UPS is also Stand-By because the inverter is off, "waiting" for it to be required to turn on.

Block diagram:-



Description:-

The ac input signal from the supply mains is fed to the rectifier circuit which converts the applied ac input into rectified dc output. The rectifier acts as a battery

charger. The battery is used to feed DC power to the inverter; for converting it to AC supply and given to the load or equipment which it is connected.

When the mains supply fails, the static switch disconnects the main power to the load and supply power to the load from the inverter circuit. Thus, even after supply failure, the load will get the power to continue the operation.

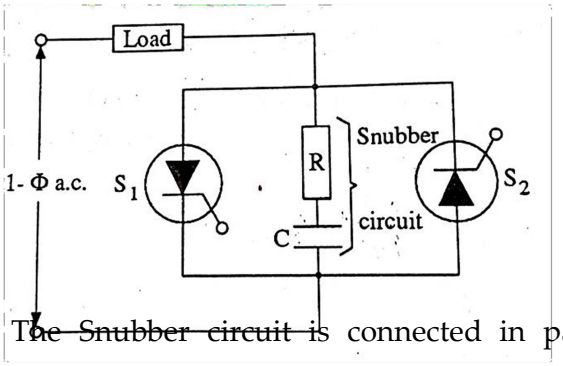
Static Switch

SCR is a bistable solid state device because its non-conducting state and conducting state are stable. These are equivalent to the OFF and ON states respectively of a switch. Hence the SCR switch is called as the static switch.

a) Static switch using Inverse parallel connection of two SCRs:

The circuit is a single phase full wave converter circuit. It uses two SCRs and Snubber circuit.

Circuit diagram:



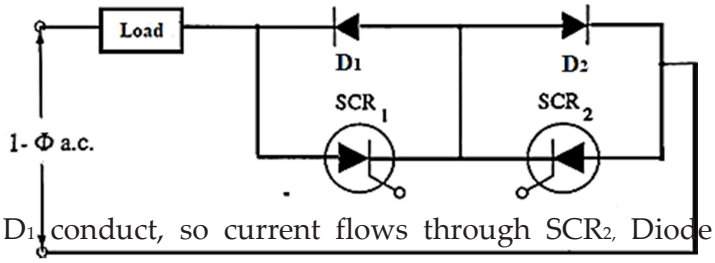
Description:

The two SCRs S_1 and S_2 are connected in parallel but in opposite mode. It is also known as antiparallel connection of two SCRs. The SCRs S_1 and S_2 will conduct in either half of the a.c. cycle. SCR S_1 will conduct in the positive half cycle and SCR S_2 will conduct in the negative half cycle. The RC network acts as Snubber circuit. The Snubber circuit is connected in parallel with the two SCRs. It is used to overcome the effects of transients in the a.c. supply.

b) Static switch using SCR-Diode combination:

A pair of SCRs (1 & 2) has been used with a pair of diodes D_1 and D_2 in the circuit.

Circuit diagram:



Description:

In the positive half cycle SCR_1 and Diode D_2 conduct, so current flows through the Load, SCR_1 and Diode D_2. In the negative half cycle SCR_2 and Diode D_1 conduct, so current flows through SCR_2, Diode D_2, and the Load. Hence the current flowing through the Load is alternating in nature.

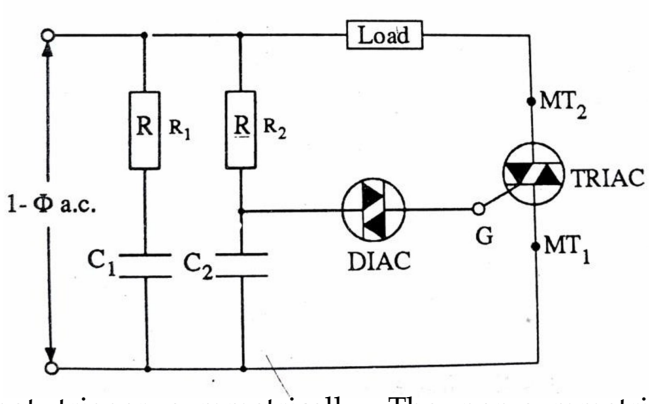
Fan regulator using Triac

A Fan Regulator regulates or controls the speed of the fan motor. The motor used in a household ceiling fan is a Single Phase squirrel cage type induction motor.

Principle:

The basic principle of Fan regulator using Triac is to change the firing angle of the TRIAC in order to change the voltage across the fan.

Circuit diagram:



Construction:

The **DIAC** stands for the **DI**ode **AC** switch. It is also known as bidirectional Thyristor diode. Diac is a Bidirectional device hence it starts conducting in both the directions. It does not have any control terminal. A Diac is a Symmetrical device. TRIACs do not trigger symmetrically. The non-symmetrical triggering of Triac generates unwanted harmonics. To overcome the problem, a DIAC is connected in series with the TRIAC. Hence the Diac is used as triggering device for the Triac and it provides trigger signal for Triac. The TRIAC stands for the TRIode AC switch. It is also known as Bidirectional Triode Thyristors. It is also a Bidirectional device hence it starts conducting in both the directions. The RC network (R_1 C_1) acts as Snubber network. RC triggering by means of a R_2 C_2 network is used for triggering Diac.

Description:

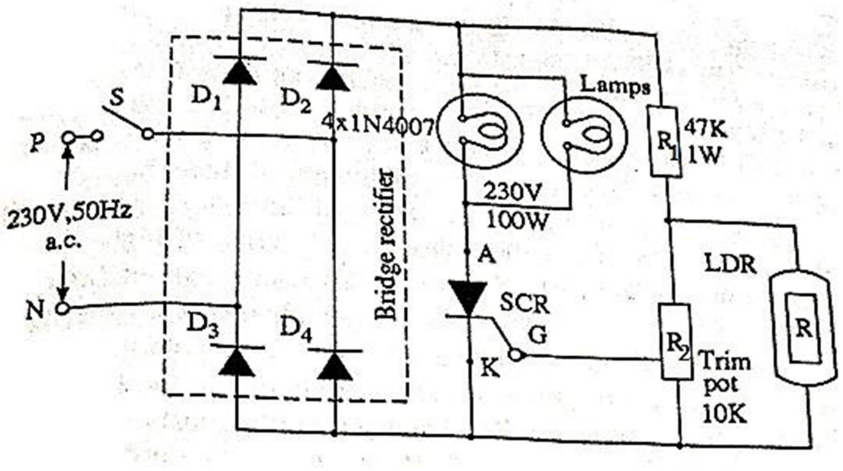
The Snubber network is used to reduce the noise due to transients in ac supply. Voltage across C_2 (V_{C2}) depends on the value of R_2. Hence Voltage across capacitor C_2 (V_{C2}) can be controlled by Variable resistor R_2. The Diac starts conducting when voltage across capacitor C_2 (V_{C2}) becomes equal to or more than the Break over voltage (V_{BO}) of the Diac. When the Diac starts conducting, it sends a triggering signal to the gate of Triac. The Variable resistor R_2 indirectly controls the firing angle of Triac. The Triac gets triggered and it turns on. Hence it energizes the Load. Here fan is used as a Load. Hence Triac controls the speed of the Fan.

Automatic Street light Controller

Introduction:

Automatic Street light controller is basically a switch which automatically provides a supply to the lamp when kept in darkness. Change of resistance of the Light Dependent Resistor (LDR) acts as an automatic switch.

Circuit diagram:



Description:

Full Wave Bridge Rectifier converts ac supply into dc. A part of this rectified d.c. voltage is fed to the gate of the SCR by potential divider arrangement R_1 & R_2. To limit the gate current, a R_2 pot has been used.

During the day when the LDR receives enough light, its resistance becomes very low. In this condition, the current flows through the R_1 resistor, LDR. Under such conditions no signal will be available at the gate of the SCR and the SCR will remain in the OFF state. The lamps connected in the circuit will not be energised. On the other hand, towards evening, when the quantity of light falling on the LDR reduces, its resistance will increase gradually and become very high. Current will flow through the R_1 resistor and R_2 pot. As soon as the current starts flowing through the R_2 pot, the signal will be available at the gate of the SCR. This would enable the SCR to trigger immediately. The moment, the SCR would start conducting the lamps will get energised and start glowing.

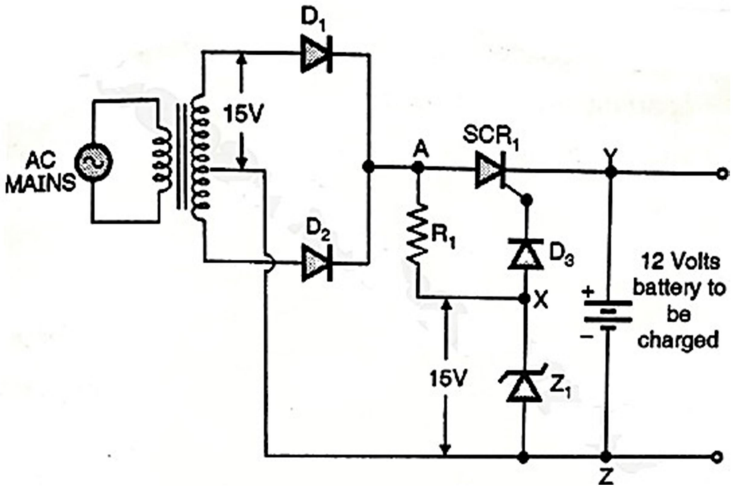
The R_2 pot can be adjusted to switch ON the SCR at a predetermined Illumination level. The LDR works as a triggering agent for the SCR which in turn acts as an automatic switch for the lamp. While installing this device, care should be taken to mount the LDR in such a position that no shadow is cast on its surface during the day time. A Proper heat sink should be used for mounting the SCR.

Automatic Battery charger

Introduction:

A small amount of dc or ac voltage is required to charge the battery. An SCR-based battery charger uses switching principle of the thyristor in order to get the specific output. Here, an ac voltage signal of value 230 V, 50 Hz is applied as input and the load is a 12 V battery that is required to be charged.

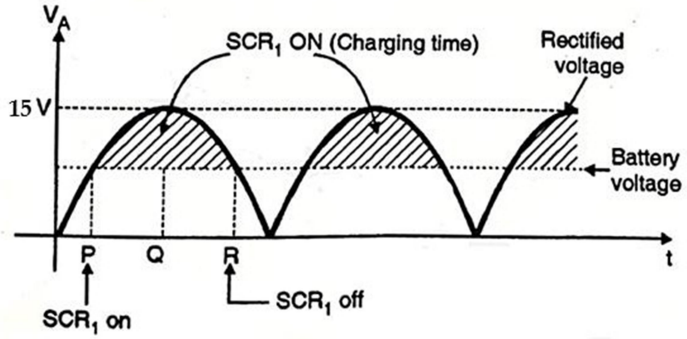
Circuit diagram:



Description:

An Automatic battery charger consists of transformer, rectifier, SCR, Zener diode and Battery to be charged. Initially, ac supply is provided to the step-down transformer which reduces the 230V ac mains into 15V. The full wave rectifier converts the secondary voltage 15V into an ac. The Zener diode maintains a constant voltage of 15V at a point "X"

Rectified voltage waveform at A:



Description:

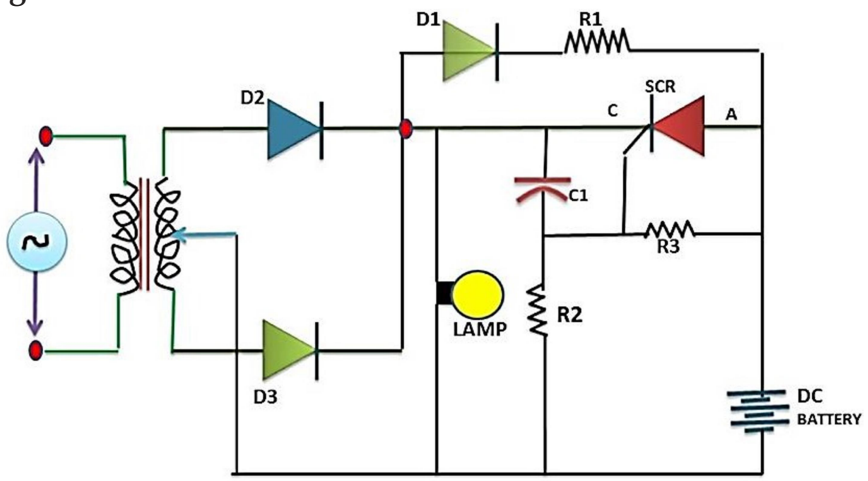
The dotted line in the waveform indicates the battery voltage. When voltage at point A is greater than the battery voltage the SCR_1, is forward biased and can conduct if the gate junction is also forward based. Thus SCR_1 conducts from point P to R and charges the 12 Volts battery connected in the circuit. When the battery is fully charged upto 14 Volts, the cathode of SCR_1 is at 14 Volts and the gate is at 14.3 Volts. This difference of 0.3 Volts between the gate and cathode cannot forward bias the gate junction and hence cannot turn on the SCR_1. Thus the battery is cut off from the supply and charging will stop automatically.

Emergency light

Introduction:

Emergency lighting is used in an urgent situation like when the main supply is disconnected or regular electrical light fails. So the sudden electricity loss could result in a fire otherwise a power cut. The emergency lighting system includes the facility to charge the 6 volt battery and switches automatically from ther AC supply failure takes place.

Circuit diagram:



Description:

Mode I (when AC supply is on):

Initially the input 230v AC supply is stepped down to 6-0-6 V by step down transformer. The full wave rectifier (D_2 and D_3) provides 6V supply to the lamp. It keeps the lamp in ON state. Diode D_1 and R_1 supply the battery charging current which can be varied by R_1. SCR Cathode voltage increases. Therefore as long as the AC supply is ON the SCR remains reverse biased.

Mode 2 (when AC supply is OFF)

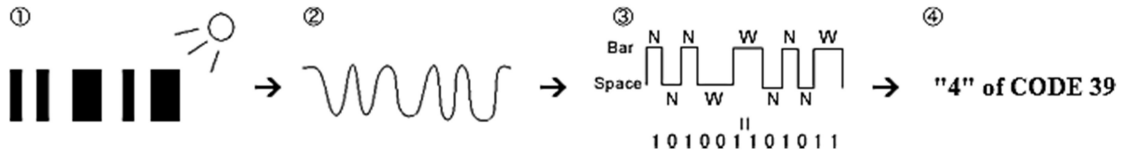
When the AC supply is OFF, the output of the rectifier (D_2 and D_3) goes to zero. The SCR cathode voltage falls below battery voltage. The gate current is supplied to SCR through R_3 and the SCR is triggered and turned on. When this battery potential is applied across the lamp, then the lamp will get ON.

Bar Code Reader

Introduction:

A barcode reader is an input device that uses light beams to scan and digitally convert printed barcodes. Bar code reader is also known as Bar code scanner or digital scanner or optical scanner.

Principles of Barcode Reading:



Description:

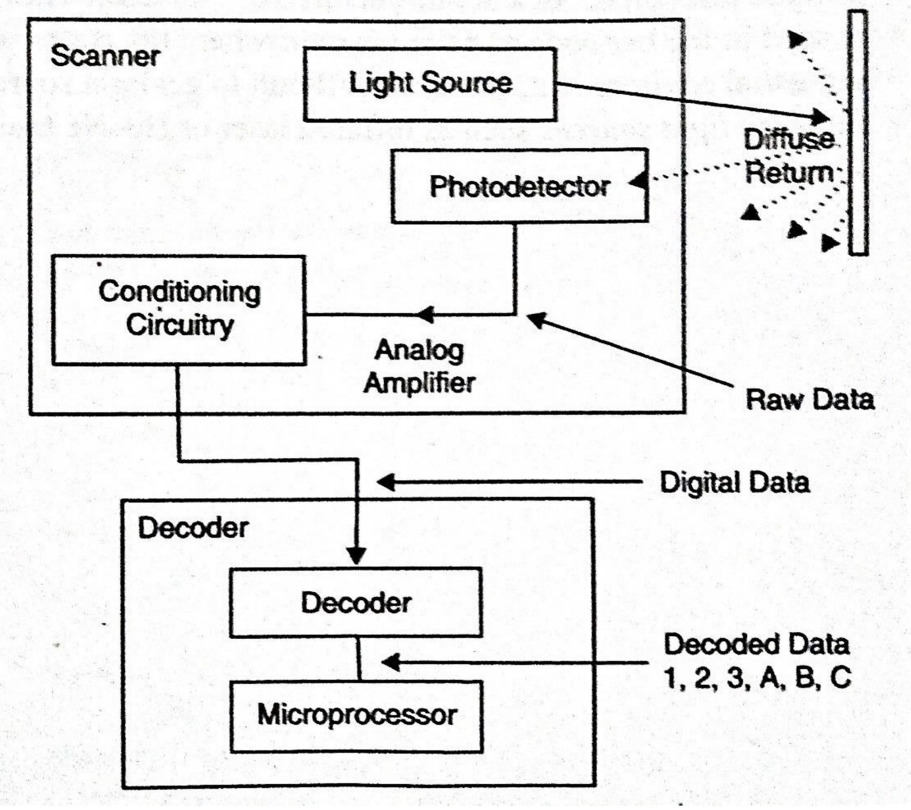
➨ A bar code consists of white and black bars of varying width. Data retrieval is achieved when bar code scanners shine a light at a bar code, capture the reflected light and replace the black and white bars with binary digital signals.

➨ A sensor receives reflections to obtain analog waveforms.

➨The analog signal is converted into a digital signal via an A/D converter.

➨Data retrieval is achieved when a code system is determined from the digital signal obtained. (Decoding process)

Block diagram:



Description:

Bar code Reader consists of two units.

➡Scanner unit ➡Decoder Unit

Scanner unit:

Scanner unit consists of Light source, Photo detector, Analog amplifier and Conditioning circuitry. The **Light Source** focused on the bar code. This light must be reflected back to the **photo detector**. The reflected light must be aligned correctly so that scanner can read the code. After the signal received, it is amplified by an **Analog amplifier** and the analog signal is converted into a digital signal via **conditioning circuitry** and then passed to the Decoder unit.

Decoder unit:

Decoder unit consists of Decoder and Multiplexer. The **Decoder** is used to decode the data and **Microprocessor** is used to compare the decoded data into data in the database. The decoded data can be stored or displayed so that the system can read the data.