AUTOMATIC STAIRCASE LIGHT USING PIR SENSOR

A PROJECT REPORT SUBMITTED TO

SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE

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UNDER THE FACULTY OF SCIENCE

BY

Miss. DARANDALE MADHURI PATILBA
Department of Physics, Arts, Commerce and Science College, Sonai

UNDER THE GUIDANCE OF

Prof. BHAKARE C. H. .
ASSISTANT PROFESSOR *M. Sc SET.*

DEPARTMENT OF PHYSICS,
ARTS, COMMERCE AND SCIENCE COLLEGE, SONAI SONSI-414105

MARCH-2021

Seat No.

SAVITRIBAI PHULE PUNE UNIVERSITY

BONAFIDE CERTIFICATE

This is to certify that the work incorporated in the project report entitled **"Automatic staircase light using PIR sensor"** submitted to Savitribai Phule Pune University, Pune, is benefited work of **Mis. Darandale Madhuri Patilba** of M.Sc. (Physics) during the academic year 2020-21, who carried out the project work under my supervision

Bhakare C.H.

Prof. Bhakare C. H.
Guide
Department of Physics
Arts, Commerce and Science College College,
Sonai-414105
Date-

Dr. Sadekar H.K.
Head
Department of Physics
Arts, Commerce and Science

Sonai-414105

Internal Examiner

Date

External Examiner

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My classmates have been of great help to me the project work. My ideas were shaped and refined progressively through my discussions with them from time to time. I cannot miss to thank them all. There were some persons like **Prof.Virkar A. A. ., Prof. Shelke A.T.** who were directly but indirectly involved in my preparatory/practical work. I appreciate their contribution and thank them too.

Place: Sonai **Signature of Research Student**

Miss .Darandale Madhuri Patilba

MADHURI D.

Date: (M.Sc. Physics)

Chapter 1

Abstract

Presented here is a solution for switching off staircase light even when you are not at there. The light turns on if we situated at there. So that there is no need for manually switching it on/off.

This project is actually based on the working principle of Passive Infrared sensor. A PIR Sensor is a device which detects a motion and infrared radiations of warm bloody body. When it detects motion and IR radiations it feds output as light becomes ON. So automatic switching action can takes place.

Thus automatic staircase light using PIR Sensor project is a power saving project. Because it gives output High only motion and IR radiations detected.

Chapter No. 2

Introduction

Now a day Electronic Science is more popular among the other science. Today, in every field of our life, we see uses of science and electronics, computers, robots, missiles and number of other application.

Presented here is a solution for switching off staircase light even when you are not there. The light turns on if we situated at there

The circuit contains PIR sensor which senses human being and gives corresponding output. If we present in staircases then PIR sensor senses infrared radiations and movement and gives output high or vice versa. From this we can save the power.

Considering the above facts I have tried to conduct a small project on "Automatic Staircase Light Using PIR Sensor".

Chapter No. 3

PIR sensor

- **PIR Sensor Circuit and Module Working**

3.1 Introduction

A sensor is used to detect the changes in quantities or events and generate the respective output signals such as an electrical signal output or optical signal output. The sensors are classified into various types, but, primarily the sensors can be categorized into analog sensor and digital sensor.

3.1.1 Different Types of Sensors:

The various types of sensors include temperature sensors, pressure sensors, gas sensors, fire sensors, piezoelectric sensors, piezoelectric sensors, IR sensors, PIR sensors, and so on. Here, in this article we specially discuss about PIR sensor – circuit – module and it's working.

3.2 PIR Sensor:

3.2.1 Introduction

The electronic sensor used to detect the movement of human being within a certain range of the sensor is called as PIR sensor or passive infrared sensor (approximately have an average value of 10m, but 5m to 12m is the actual detection range of the sensor). Fundamentally, piezoelectric sensors that detect the levels of infrared radiation are used to make PIR sensors. There are different types of sensor and here let us discuss about PIR sensor with dome shaped Fresnel lens.

Diagram: 3.1 Structure of PIR sensor

3.2.2 PIR Sensor Module:

The PIR sensor circuit is used in numerous electronics projects which are used to discover a human being entering or leaving the particular area or room. These passive infrared sensors are flat control, consists of a wide range of lens, and PIR sensors can be easily interfaced with electronic circuit.

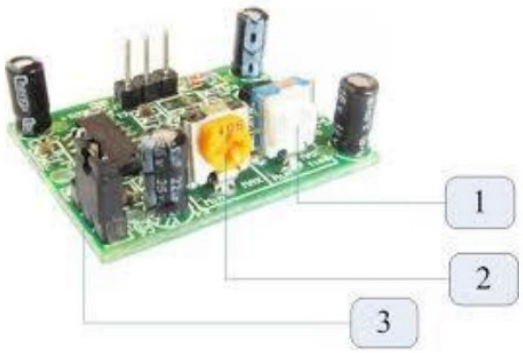


Diagram: 3.2 PIR Sensor Modules

As shown in diagram,

Number 1 indicates- Time delay adjustment

Number 2 indicates- Sensitivity adjustment

Number 3 indicates- Jumper setter

3.2.3 Pin Configuration of PIR' Sensor

The pin configuration of the PIR sensor is shown in the figure. PIR sensor consists of three pins, ground, signal, and power at the side or bottom. Generally, the PIR sensor power is up to 5V, but, the large size PIR modules operate a relay instead of direct output. It is very simple and easy to interface the sensor with a microcontroller. The output of the PIR is (usually digital output) either low or high.

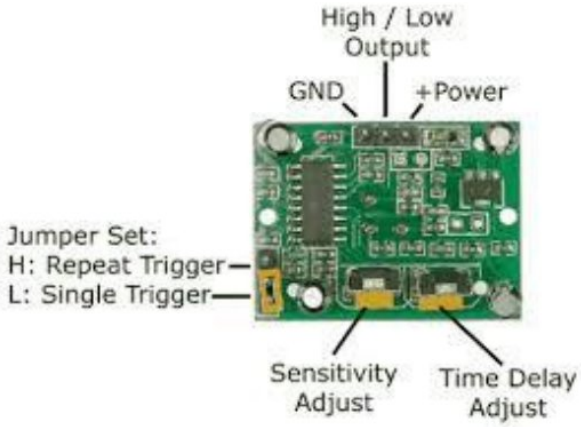


Diagram: 3.3 Pin Configuration of PIR Sensor

3.3 .1PIR Sensor Circuit

The PIR sensor circuit consists of three pins, power supply pin, output signal pin, and ground pin. The PIR sensor circuit is having ceramic substrate and filter window as shown in the figure and also having dome like structure called as Fresnel lens.

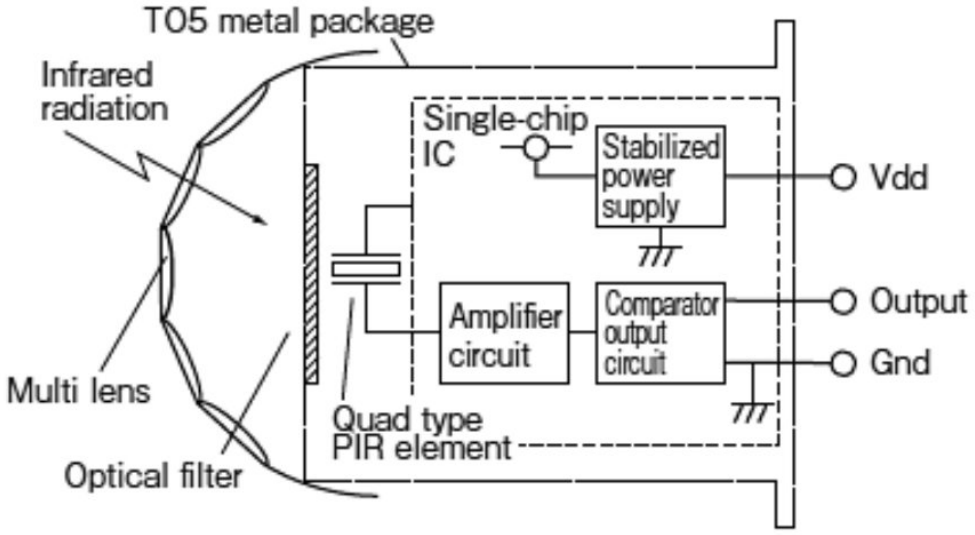


Diagram: 3.4 Circuit Diagram

3.3 PIR Sensor Working

Whenever, human being (even a warm body or object with some temperature) passes through the field of view of PIR sensor, and then it detects the infrared radiation emitted by a hot body motion. Thus, the infrared radiation detected by the sensor generates an electrical signal that can be used to activate an alert system or buzzer or alarm sound. Once it detects the motion, then the output goes high for a couple of seconds and The PIR sensor internally is split into two halves, one half is positive and the other is considered as negative. Thus, one half generates one signal by detecting the motion of a hot body and other half generates another signal. The difference between these two signals is generated as output signal. Primarily, this sensor consists of Fresnel lens which is bifurcated to detect the infrared radiation produced by the motion of hot body over a wide range or specific area.

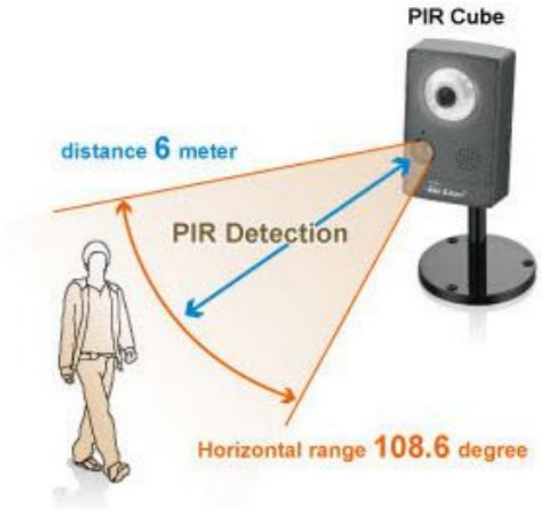


Diagram: 3.5 Range of Sensor

If once the sensor gets warmed up, then the output remains low until it detects motion. If then returns to a normal state or low. This sensor requires settling time, which is characteristically in the range of 10 to 60 seconds.

3.3.3Multi Lens used in PIR Sensor

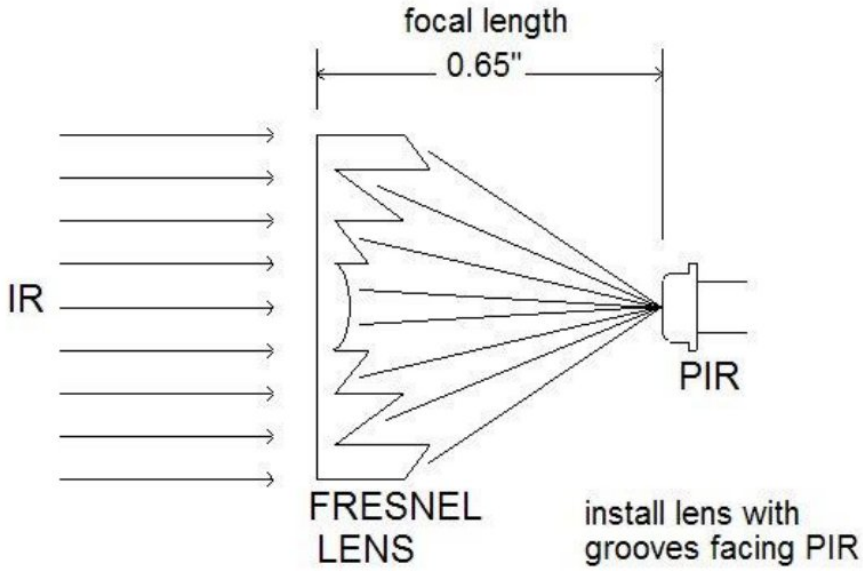


Diagram: 3.6 Fresnel Lens

PIR sensors are rather generic and for the most part vary only in price and sensitivity. Most of the real magic happens with the optics. This is a pretty good idea for manufacturing: the PIR sensor and circuitry is fixed and costs a few dollars. The lens costs only a few cents and can change the breadth, range, sensing pattern, very easily.

In the diagram up top, the lens is just a piece of plastic, but that means that the detection area is just two rectangles. Usually we'd like to have a detection area that is much larger. To do that, we use a simple sensor such as those found in a camera: they condenses a large area (such as a landscape) into a small one (on film or a CCD sensor). For reasons that will be apparent soon, we would like to make the PIR lenses small and thin and moldable from cheap plastic, even

though it may add distortion. For this reason the sensors are actually Fresnel Lenses.

3.4 Applications of PIR Sensors:

PIR sensors have numerous applications in different fields such as automatic switching operation of outdoor lights, lift lobby, common staircases, and automatic switching operation of garden lights based on the presence of a human being, for covered parking area, automatic door operating system in shopping malls, and so on. Let us discuss about a few innovative electronic projects designed using a PIR sensor circuit.

3.4.1 Automatic door opening system using PIR Sensor

Thus, the motor driver controls the motor interfaced to it and fixed to the door. Hence, if the circuit detects any human passing in its region will enable the motor to operate the door automatically.

3.4.2 Security Alarm system

This project is intended to use in the places such as banks and other security intended places. This circuit is interfaced with the alarm system that includes IC UM3561. The UM3561 is an integrated circuit that takes digital input and generates multi tones such as an ambulance or fire engine or police sirens. Thus, if a human being is detected by the PIR sensor circuit, then the digital output is generated by it. This digital output is fed to the IC UM3561 that generates the siren or alarm.

3.4.3 Automatic Staircase Light

This application is used in places such as common staircases and other multi-apartment buildings. This circuit includes PIR sensor, which senses IR radiations and motion of a human being and gives output HIGH. This project saves energy.

Chapter 4

Transformer

4.1 Introduction:

The transformer is a device that takes AC at one voltage and transforms it into another voltage either higher or lower than the original voltage. Alternatively, a transformer can be used to do the same thing with current. Transformers only work with AC (and they do not work with DC) because they work on the principle of Faraday's law of induction which involves time varying magnetic flux. Transformers are useful in electronics because (for example) the voltage supplied by the electric utility is 110-120 voltages while the voltage used by transistors and integrated circuits is typically a much lower (say 10-12 volts).

Diagram: 4.1 transformers

Examining a very unusual transformer will show power is transferred through the use of electromagnetic induction. This direct current transformer will demonstrate the actions of a step-up transformer and provide stop-action analysis of the moving magnetic field.

Diagram: 4.2shows a one-line diagram of the primary and secondary automobile ignition system. The primary circuit, or power source side, includes the battery positive terminal, the ignition switch, the primary winding to the ignition points, and the battery negative terminal. The secondary circuit starts with the secondary winding wire and connects the distributor rotor and the spark plug.

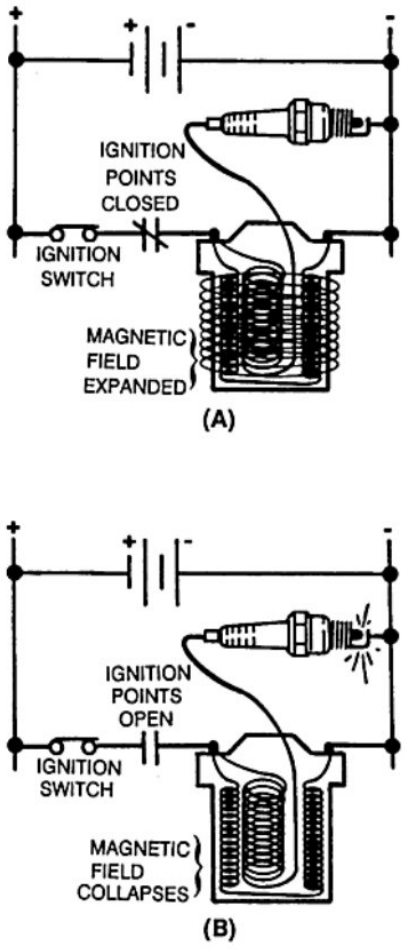


FIGURE 8-1. Automobile Step-Up Transformer.

When both the ignition switch and the points are closed, there is a complete circuit through the 12-volt battery terminals and the primary windings. As a current initially moves through the conductor, an expanding magnetic field is created. As the magnetic field from the primary winding expands across the secondary windings, a type of generator is created which produces an EMF in the secondary
Windings. Through electromagnetic induction, the secondary winding has all the necessities for generating an EMF a conductor (the secondary winding), the magnetic field (from the current flow through the primary winding), and the relative motion between the expanding magnetic field and the secondary winding.
As the contact points open, the primary field collapses. With this collapse, there is again relative motion between the magnetic field and the secondary windings. This motion and the increased number of conductors in the secondary windings allow the coil to step up voltage from the original 12 volts to the 20,000 volts necessary to fire this type of ignition system.

The distributor, ignition points, and condenser that comprise this DC switching device are very costly. It is not very practical to use DC to step up voltage. AC has certain advantages over DC because it changes direction readily and has a constantly moving magnetic field. One important advantage is that when AC is used, the voltage and current levels can be increased or decreased by means of a transformer.

4.2 Transformer Components:

The principle parts of a transformer and their functions are --

- The core, which provides a path for the magnetic lines of flux.
- The primary winding, this receives power from the AC power source.
- The secondary winding, which receives power from the primary winding and Delivers it to the load.

4.3 Core characteristics

The composition of a transformer core depends on such factors as voltage, current, and frequency. Size limitations and construction costs are also factors to be considered. Commonly used core materials are air, soft iron, and steel. Each of these materials is suitable for particular applications and unsuitable for others. Generally, air-core transformers are used when the voltage source has a high frequency (above 20 kHz). Iron-core transformers are usually used when the source frequency is low (below 20 kHz). A soft-iron-core transformer is useful when the transformer must be physically small, yet efficient. The iron-core transformer provides better power transfer than does the air-core transformer. A transformer whose core is constructed of laminated sheets of steel dissipates heat readily, providing efficient transfer of power. Most transformers in the Army marine field contain laminated steel cores. These steel laminations are insulated with a non conducting material, such as varnish, and then formed into a core. It takes about 50 such laminations to make a core an inch thick.

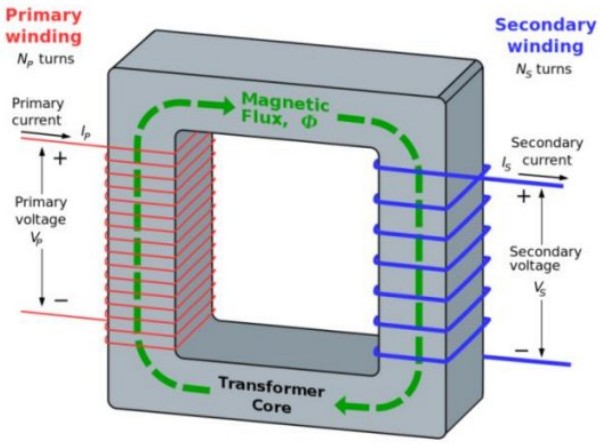


Diagram4. 3 Transformer core

The laminations reduce certain losses which will be discussed later. The most effective transformer core is one that offers the best path for the most lines of flux with the least magnetic and electrical energy loss.

Two main shapes of cores are used in laminated steel-core transformers: the hollow core and the shell core. The hollow core is shaped with a square through the center. The core is made up of many laminations of steel. Diagram4.4 shows how the transformer windings are wrapped around both sides of the core.

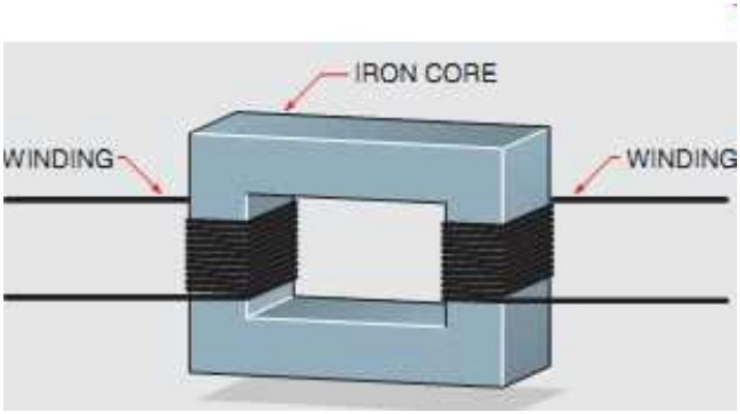


Diagram4.4 Winding wrapped around lamination .

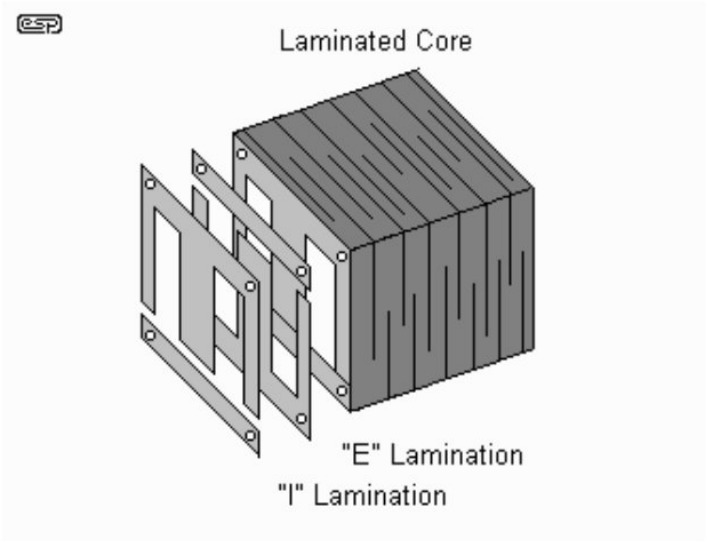


Diagram4.5 Shell – type core construction

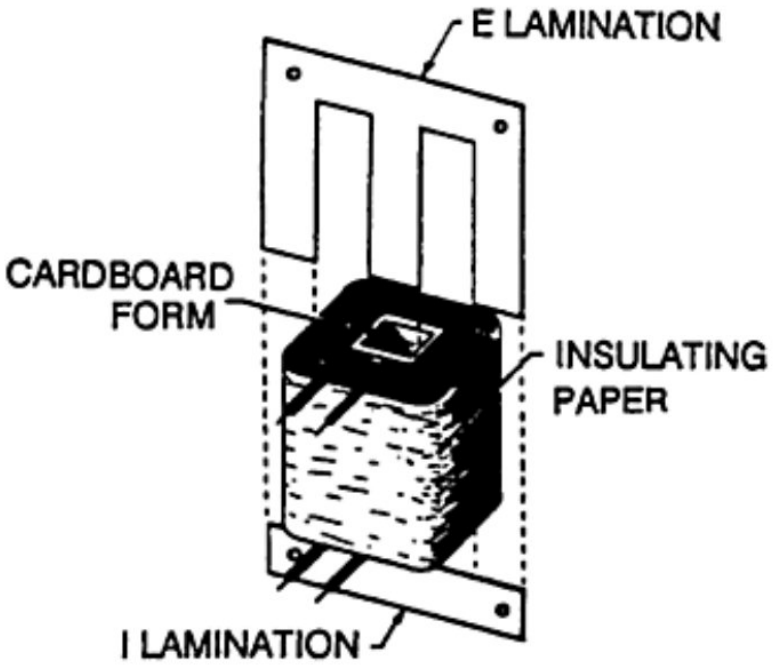


FIGURE 8-6. Exploded View of Shell-Type Transformer Construction.

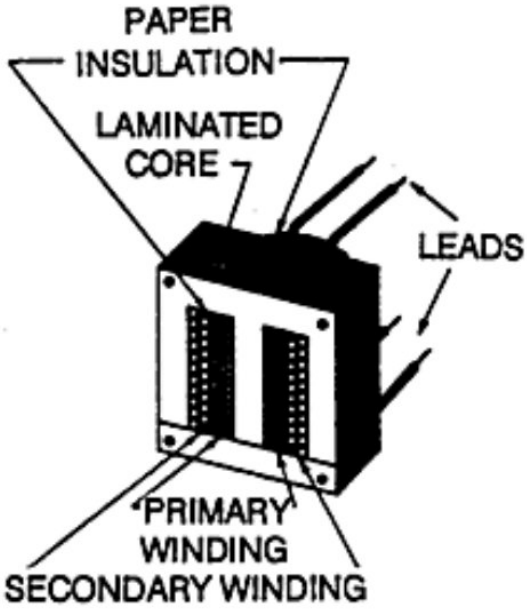


FIGURE 8-7. Cutaway View of Shell-Type Core With Windings.

As shown, each layer of the core consists of E- and I-shaped sections of metal. These sections are butted together to form laminations. The laminations are insulated from each other and then pressed together to form a core.

Chapter 6

Rectifier

6.1 Define:

Rectifier is a circuit which converts an alternating (or bidirectional) voltage into direct (or unidirectional) voltage.

Classification of Rectifiers:

1. Half wave Rectifier (HWR)
2. Full Wave Rectifier (FWR)

Types of Full Wave Rectifier:

1. FWR With Centre Tapped Transformer
2. FWR With Bridge Rectifier

6.2 Bridge Rectifier Circuit with Working Operation and Types

6.2.1 Bridge Rectifier:

A bridge rectifier circuit is a common part of the electronic power supplies. Many electronic circuits require rectified DC power supply for powering the various electronic basic components from available AC mains supply. We can find this rectifier in a wide variety of electronic AC power devices like home appliances, motor controllers, modulation process, welding applications, etc.

6.2.2 What is a Bridge Rectifier?

Define:

A Bridge rectifier is an Alternating Current (AC) to Direct Current (DC) converter that rectifies mains AC input to DC output. Bridge Rectifiers are widely used in power supplies that provide necessary DC voltage for the electronic components or devices. They can be constructed with four or more diodes or any switches.

Depending on the load current requirements, a proper bridge rectifier is selected. Components' ratings and specifications, breakdown voltage, temperature ranges, transient current rating, forward current rating, mounting requirements and other considerations are taken into account while selecting a rectifier power supply for an appropriate electronic circuit's application.

6.2.3 Types of Bridge Rectifiers

Bridge rectifiers are classified into several types based on these factors: type of supply, controlling capability, bride circuit's configurations, etc. Bridge rectifiers are mainly classified into single and three phase rectifiers. Both these types are further classified into uncontrolled, half controlled and full controlled rectifiers. Some of these types of rectifiers are described below.

1. **Single phase and three phase rectifiers**

The nature of supply, i.e., a single phase or three-phase supply decides these rectifiers. The Single phase bridge rectifier consists of four diodes for converting AC into DC, whereas a three phase rectifier uses six diodes, as shown in the figure. These can be again uncontrolled or controlled rectifiers depending on the circuit components such as diodes, thrusters, and so on.

2. **Uncontrolled Bridge Rectifiers:**

This bridge rectifier uses diodes for rectifying the input as shown in the figure. Since the diode is a unidirectional device that allows the current flow in one direction only. With this configuration of diodes in the rectifier, it doesn't allow the power to vary depending on the load requirement. So this type of rectifier is used in constant or fixed power supplies.

3. **Controlled Bridge Rectifier:**

In this type of rectifier, AC/DC converter or rectifier – instead of uncontrolled controlled solid state devices like SCR's, MO.

In SFET's, IGBT's, etc. are used to vary the output power at different voltages. By triggering these devices at various instants, the output power at the load is appropriately changed.

6.3 Bridge Rectifier Circuit Diagram

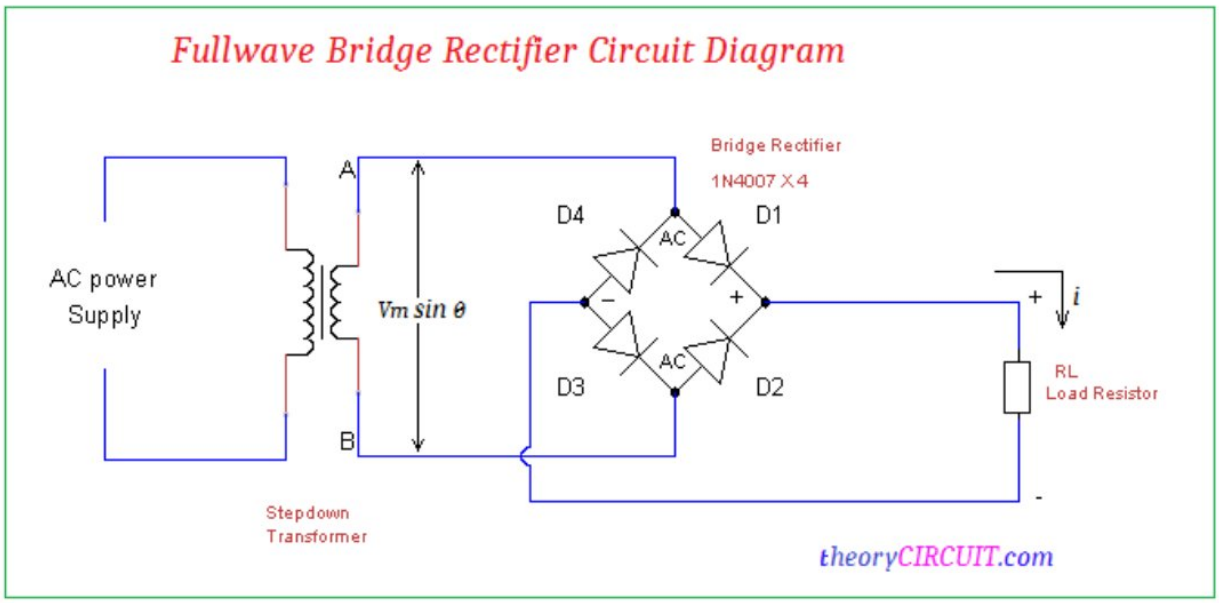


Diagram: 6.1 Full wave Bridge Rectifier Circuit Diagram

The main advantage of bridge rectifier is that it produces almost double the output voltage as with the case of a full wave rectifier using center-tapped transformer. But this circuit doesn't need center tapped transformer so it resembles low-cost rectifier.

The bridge rectifier circuit diagram consists of various stages of devices like transformer, Diode Bridge, filtering and regulators. Generally all these blocks combination is called as regulated DC power supply that powers various electronic appliances.

The first stage of the circuit is a transformer which is a step-down type that changes the amplitude of the input voltage. Most of the electronic uses 230/12V transformer to step-down the AC mains 230V to 12V AC supply.

Next stage is a diode-bridge rectifier which uses four or more diodes depending on the type of bridge rectifier. Choosing a particular diode or any other switching device for a corresponding rectifier needs some considerations of the device like Peak Inverse Voltage (PIV), forward current If, voltage ratings, etc. It is responsible for producing unidirectional or DC current at the load by conducting a set of diodes for every half cycle of the input signal.

Since the output after the diode bridge rectifiers is of pulsating nature, and for producing it as a pure DC, filtering is necessary. Filtering is normally performed with one or more capacitors attached across the load, as you can observe in the below figure wherein smoothing of wave is performed. This capacitor rating also depends on the output voltage.

The last stage of this regulated DC supply is a voltage regulator that maintains the output voltage to a constant level. Suppose the microcontroller at 5V DC, but the output after the bridge rectifier is around 16V, so to reduce this voltage, and to maintain a constant level – no matter voltage changes in input side – a voltage regulator is necessary.

6.4 Bridge Rectifier Operation:

As we discussed above, a single-phase bridge rectifier consists of four diodes and this configuration is connected across the load. For understanding the bridge rectifier's working principle, we have to consider the below circuit for demonstration purpose.

During the Positive half cycle of the input AC waveform diodes D1 and D2 are forward biased and D3 and D4 are reverse biased. When the voltage, more than the threshold level of the diodes D1 and D2, starts conducting – the load current starts flowing through it, as shown as red lines path in the diagram below.

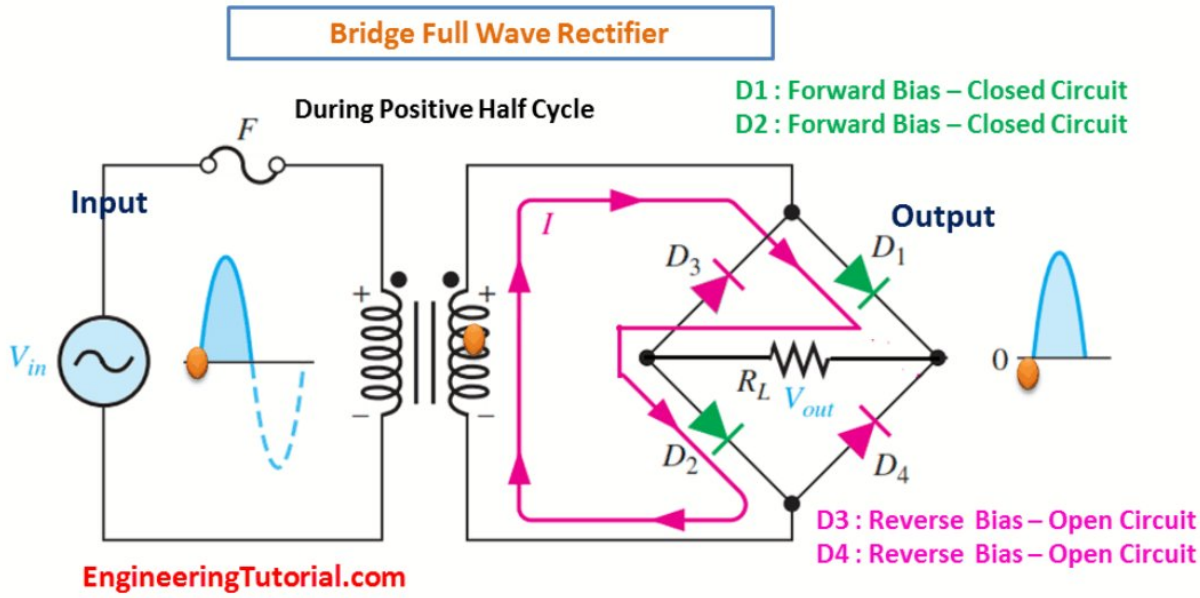


Diagram: 6.2 Bridge rectifier operations

During the negative half cycle of the input AC waveform, the diodes D3 and D4 are forward biased, and D1 and D2 are reverse biased. Load current starts flowing through the D3 and D4 diodes when these diodes starts conducting as shown in the figure.

We can observe that in both the cases, the load current direction is same, i.e., up to down as shown in the figure – so unidirectional, which means DC current. Thus, by the usage of a bridge rectifier, the input AC current is converted into a DC current. The output at the load with this bridge wave rectifier is pulsating in nature, but for producing a pure DC requires additional filter like capacitor. The same operation is applicable for different bridge rectifiers, but in case of controlled rectifiers triggering is necessary to drive the current to load.

This is all about the bridge rectifier theory its types, circuit and working principles. We hope that this wholesome matter about this topic will be helpful in building students' electronics or electrical projects as well as in observing various electronic devices or appliances. We appreciate you for your keen attention component ratings in this bridge rectifier for your application and for any other technical guidance.

Chapter 7

Integrated circuit 7805

7.1 Introduction

In this chapter we will see about one of the most commonly used regulator IC's, the 7805 Voltage Regulator IC. A regulated power supply is very much essential for several electronic devices due to the semiconductor material employed in them have a fixed rate of current as well as voltage. The device may get damaged if there is any deviation from the fixed rate.

One of the important sources of DC Supply is Batteries. But using batteries in sensitive electronic circuits is not a good idea as batteries eventually drain out and lose their potential over time.

Also, the voltage provided by batteries is typically 1.2V, 3.7V, 9V and 12V. This is good for circuits whose voltage requirements are in that range. But, most of the TTL IC's work on 5V logic and hence we need a mechanism to provide a consistent 5V Supply.

Here comes the 7805 Voltage Regulator IC to the rescue. It is an IC in the 78XX family of linear voltage regulators that produce a regulated 5V as output.

7.1.1 7805 Voltage Regulator

7805 is a three terminal linear voltage regulator IC with a fixed output voltage of 5V which is useful in a wide range of applications. Currently, the 7805 Voltage Regulator IC is manufactured by Texas Instruments, ON Semiconductor, STMicroelectronics, Diodes incorporated, Infineon Technologies, etc.

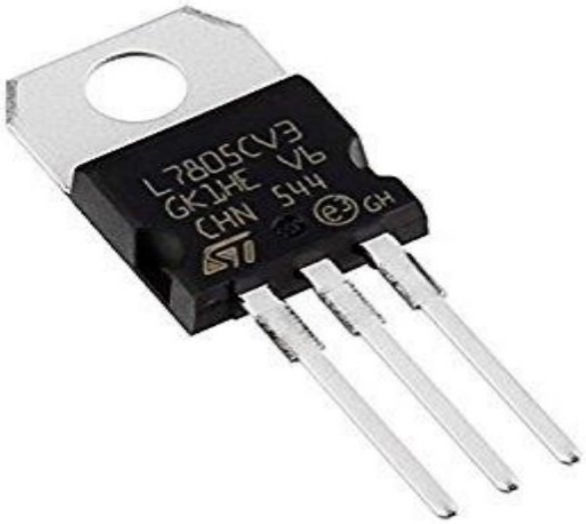


Diagram: 7.1 IC7805 Voltage regulators

They are available in several IC Packages like TO-220, SOT-223, TO-263 and TO-3. Out of these, the TO-220 Package is the most commonly used one (it is the one shown in the above image).

7.3 Some of the important features of the 7805 IC are as follows:

- It can deliver up to 1.5 A of current (with heat sink).
- Has both internal current limiting and thermal shutdown features.
- Requires very minimum external components to fully function.

7.4 Pin Diagram of 7805 Voltage Regulator IC

As mentioned earlier, 7805 is a three terminal device with the three pins being 1. INPUT, 2. OUTPUT, 3.GROUND. The following image shows the pins on a typical 7805 IC in To-220 Package.

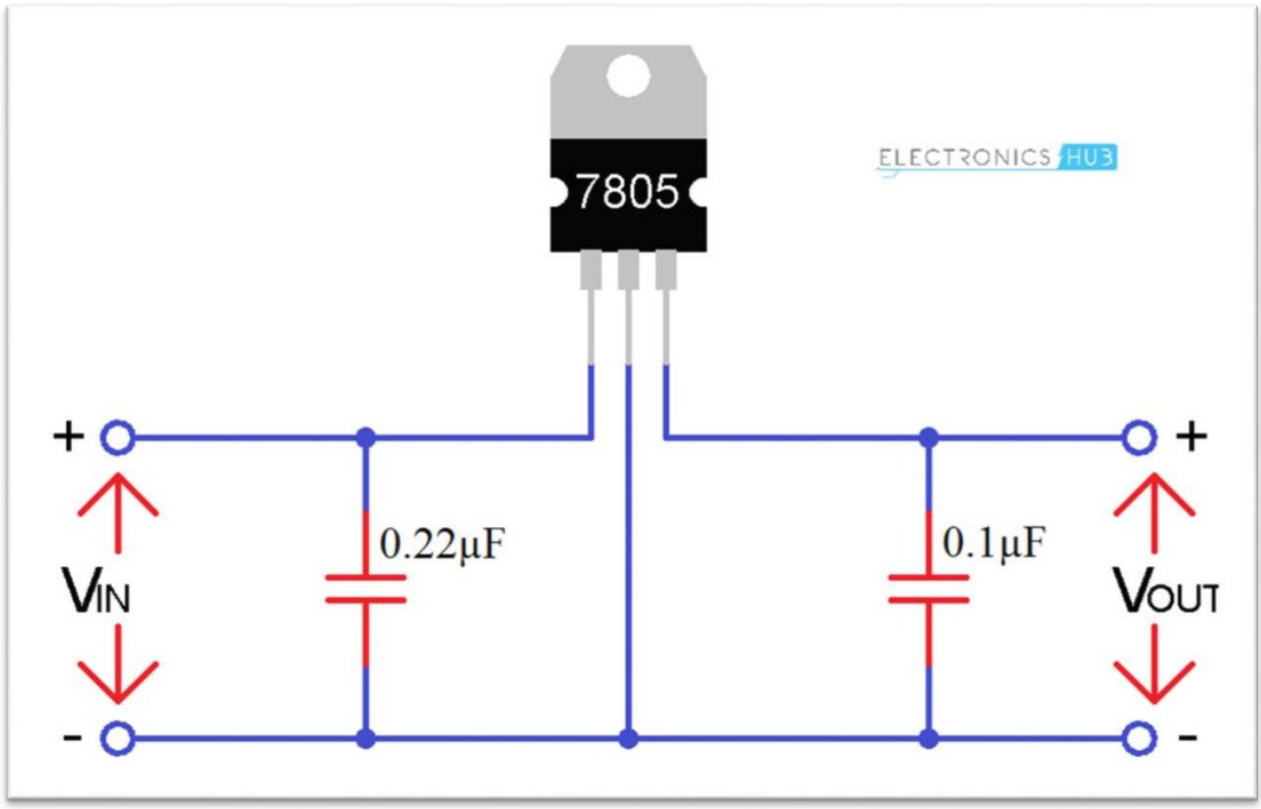


Diagram: Pin Diagram Of IC7805

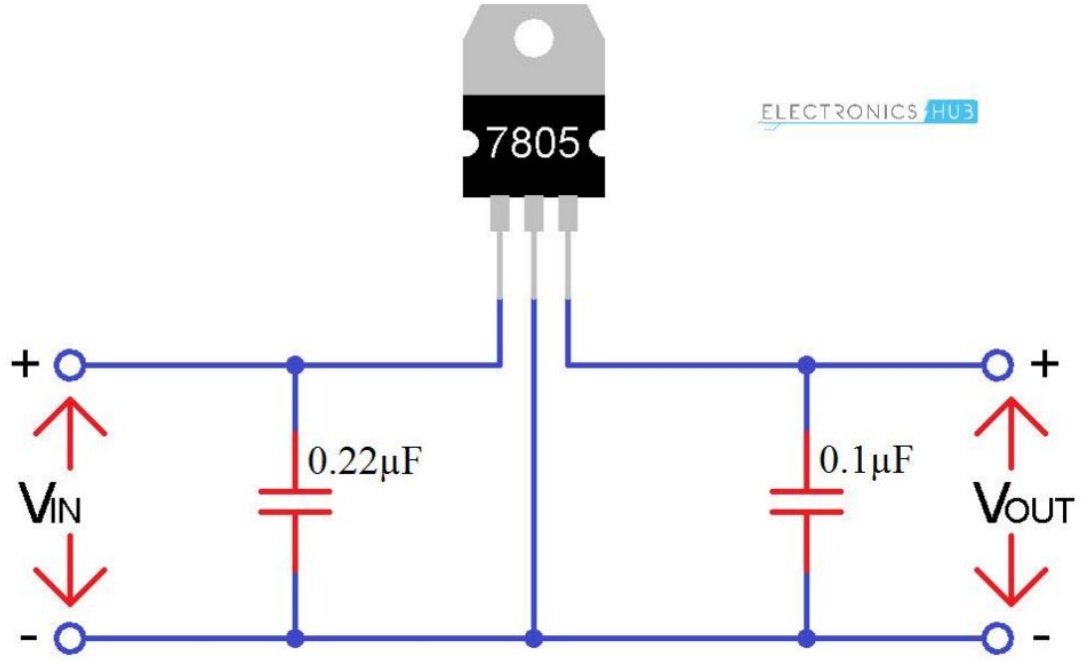
The pin description of the 7805 is described in the following table:

1	INPUT	Pin 1 is the INPUT Pin. A positive unregulated voltage is given as input to this pin.
2	GROUND	Pin 2 is the GROUND Pin. It is common to both Input and Output.
3	OUTPUT	Pin 3 is the OUTPUT Pin. The output regulated 5V is taken at this pin of the IC.

7.5 Basic Circuit of 7805

We know that regulated power supply as a device that works on DC voltages and it can uphold its output accurately at a fixed voltage all the time even if there is a significant alteration in the DC input voltage.

As per the datasheets of 7805 IC, the basic circuit required for 7805 to work as a complete regulator is very simple. In fact, if the input supply is an unregulated DC Voltage, then all you need are two capacitor (even those are not mandatory depending on the implementation).



The above circuit shows all the components required for a 7805 IC to work properly. The 0.22µF Capacitor near the input is required only if the distance between the regulator IC and the power supply filter is high. Also, the 0.1µF Capacitor near the output is optional and if used, it helps in the transient response.

In this circuit, VIN is the input voltage to the 7805 IC and the source can be from either a battery of an unregulated DC. VOUT is the output of the 7805 IC, which is a Regulated 5V.

7.6 How to Get Constant DC Power Supply from AC?

Although batteries can be used as input to the 7805 Voltage Regulator IC, we face certain bumps like frequent discharge of batteries and reduction of battery voltage levels over a period of time.

The best alternative to using Batteries is to provide an unregulated but rectified DC Voltage from an AC Source. Since AC Source is easily available as mains supply, we can design a circuit to convert AC Mains to DC and provide it as input to the 7805 Voltage regulator IC.

.7.8 Components Required

- 230V-12V Step Down Transformer
- Bridge Rectifier (or 4 PN Diodes – 1N4007)
- 1A Fuse
- 1000µF Capacitor
- 7805 Voltage Regulator IC
- 0.22µF Capacitor
- 0.1µF Capacitor
- 1N4007 Diode

7.9 Working

The AC power supply from mains first gets converted into and unregulated DC and then into a constant regulated DC with the help of this circuit. The circuit is made up of transformer, bridge rectifier made up from diodes, linear voltage regulator 7805 and capacitors.

The working of the circuit can be divided into two parts. In the first part, the AC Mains is converted into unregulated DC and in the second part, this unregulated DC is converted into regulated 5V DC. So, let us start discussing the working with this in mind.

Initially, a 230V to 12V Step down transformer is taken and its primary is connected to mains supply. The secondary of the transformer is connected to Bridge rectifier (either a dedicated IC or a combination of 4 1N4007 Diodes can be used).

A 1A fuse is placed between the transformer and the bridge rectifier. This will limit the current drawn by the circuit to 1A. The rectified DC from the bridge rectifier is smoothened out with the help of 1000µF Capacitor.

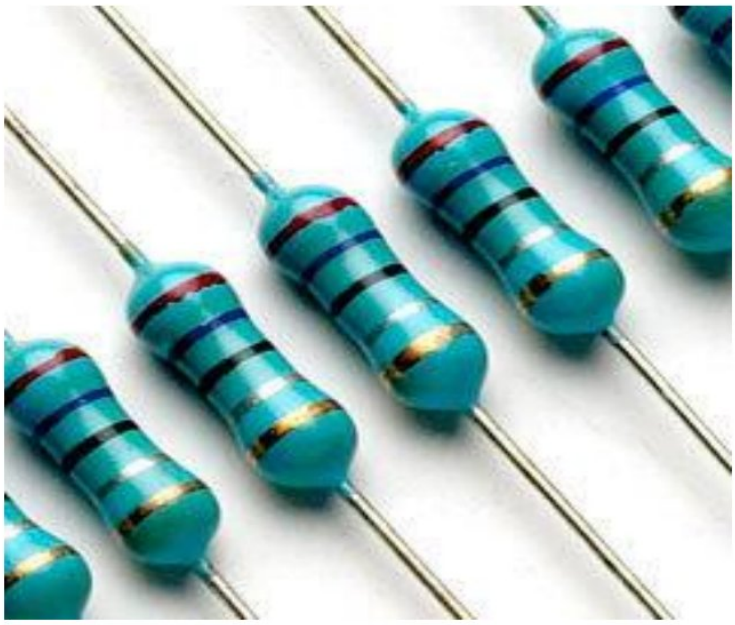
So, the output across the 1000µF Capacitor is unregulated 12V DC. This is given as an input to the 7805 Voltage Regulator IC. 7805 IC then converts this to a regulated 5V DC and the output can be obtained at its output terminals.

7.10 Important Points on 7805 Voltage Regulator IC

- The first important point to note is that the input voltage should always be greater than the output voltage (at least by 2.5V).
- The input current and output current are almost identical. This means that when a 7.5V 1A supply is given at input, the output will be 5V 1A.
- The remaining power is dissipated as heat and hence a heat sink like the one shown below must be used with 7805 IC.

Chapter 8

Resistor



8.1 Introduction

Resistors are the most commonly used component in electronics and their purpose is to create specified values of current and voltage in a circuit. The resistors are on millimeter paper, with 1cm spacing to give some idea of the dimensions.

A **resistor** is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at the same time, act to lower voltage levels within circuits. In electronic circuits, resistors are used to limit current flow, to adjust signal levels, bias active elements, and terminate transmission lines among other uses. High-power resistors, that can dissipate many watts of electrical power as heat, may be used as part of motor controls, in power distribution systems, or as test loads for generators.

Fixed resistors have resistances that only change slightly with temperature, time or operating voltage.

Resistors are common elements of electrical network and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms.

The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance will fall within a manufacturing tolerance.

8.2 Ohm's law

The behavior of an ideal resistor is dictated by the relationship specified by Ohm's law:

$$V = I \cdot R.$$

Ohm's law states that the voltage (V) across a resistor is proportional to the current (I), where the constant of proportionality is the resistance (R). For example, if a 300 ohm resistor is attached across the terminals of a 12 volt battery, then a current of 12 / 300 = 0.04 amperes flows through that resistor. Practical resistors also have some inductance and capacitance which will also affect the relation between voltage and current in alternating current circuits.

The ohm (symbol: Ω) is the SI unit of electrical resistance, named after Georg Simon Ohm. An ohm is equivalent to a volt per ampere. Since resistors are specified and manufactured over a very large range of values, the derived units of milliohm (1 m Ω = 10^{-3} Ω), kilo ohm (1 k Ω = 10^{3} Ω).

8.3 Types of Resistors

The first major categories into which the different types of resistor can be fitted is into whether they are fixed or variable. These different resistor types are used for different applications:

1. **Fixed resistors:**

Fixed resistors are by far the most widely used type of resistor. They are used in electronics circuits to set the right conditions in a circuit. Their values are determined during the design phase of the circuit, and they should never need to be changed to "adjust" the circuit. There are many different types of resistor which can be used in different circumstances and these different types of resistor are described in further detail below.

2. **Variable resistors:**

These resistors consist of a fixed resistor element and a slider which taps onto the main resistor element. This gives three connections to the component: two connected to the fixed element, and the third is the slider. In this way the component acts as a variable potential divider if all three connections are used. It is possible to connect to the slider and one end to provide a resistor with variable resistance.

1.1 Fixed resistor types

There are a number of different types of fixed resistor:

- **Carbon composition:**
- **Carbon film:**
- **Metal oxide film:**
- **Metal film:**
- **Thin film:**

8.4 Resistor Color Code

Components and wires are coded are with colors to identify their value and function.

Table1: Resistor Color Code

Color	Digit	Multiplier	Tolerance (%)
Black	0	10^0 (1)	
Brown	1	10^1	1
Red	2	10^2	2
Orange	3	10^3	
Yellow	4	10^4	
Green	5	10^5	0.5
Blue	6	10^6	0.25
Violet	7	10^7	0.1
Grey	8	10^8	
White	9	10^9	
Gold		10^{-1}	5
Silver		10^{-2}	10
(none)			20

The colors brown, red, green, blue, and violet are used as tolerance codes on 5-band resistors only. All 5-band resistors use a colored tolerance band. The blank (20%) "Band" is only used with the "4-band" code (3 colored bands + a blank "band").

Chapter 9

Capacitor

Diagram9.1: Capacitors

9.1 Introduction

A capacitor (originally known as a condenser) is a passive two terminal electrical component used to store electrical energy temporarily in an electric field. The forms of practical capacitors vary widely, but all contain at least two electrical conductors (plates) separated by a dielectric (i.e. an insulator that can store energy by becoming polarized). The conductors can be thin films, foils or sintered beads of metal or conductive electrolyte, etc. The non-conducting dielectric acts to increase the capacitor's charge capacity. Unlike a resistor, an ideal capacitor does not dissipate energy. Instead, a capacitor stores energy in the form of an electrostatic field between its plates.

9.2 Define

Capacitance is defined as the ratio of the electric charge Q on each conductor to the potential difference V between them. The SI unit of capacitance is the farad (F), which is equal to one coulomb per volt (1 C/V).

9.2 Types of Capacitors

Practical capacitors are available commercially in many different forms. The type of internal dielectric, the structure of the plates and the device packaging all strongly affect the characteristics of the capacitor, and its applications.

1. Dielectric materials.

Most types of capacitor include a dielectric spacer, which increases their capacitance. These dielectrics are most often insulators. However, low capacitance devices are available with a vacuum between their plates, which allows extremely high voltage operation and low losses

2. Polymer capacitors

(OS-CON, OC-CON, KO, and AO) use solid conductive polymer (or polymerized organic semiconductor) as electrolyte and offer longer life and lower ESR at higher cost than standard electrolytic capacitors.

3. Voltage Dependent Capacitors

The dielectric constant for a number of very useful dielectrics changes as a function of the applied electrical field, for example ferroelectric materials, so the capacitance for these devices is more complex.

4. Frequency-dependent capacitors

If a capacitor is driven with a time-varying voltage that changes rapidly enough, at some frequency the polarization of the dielectric cannot follow the voltage.

Chapter 12

Transistor NPN 2N2219a

12.1Introduction

- **2n2219** is an NPN bipolar junction transistor which is mainly used for small signal general purpose amplification and switching applications.
- It mainly consists of three terminals called emitter, base, and collector. And the base is positive with respect to the emitter.
- It is termed as bipolar junction transistor because conduction is carried out by both charges carriers i.e. electrons and holes but majority charge carriers are electrons.
- Movement of electrons plays an important role in defining the conducting behavior of this NPN transistor.
- This NPN transistor can be configured with three configurations named as a common collector, common base, and common emitter configuration.
- 2n2219 is a current controlled device where small current at the base side is used to control large current at the emitter and collector side.
- When positive voltage is applied at the base side, electrons start to flow from emitter to collector and base is used to control the number of electrons.

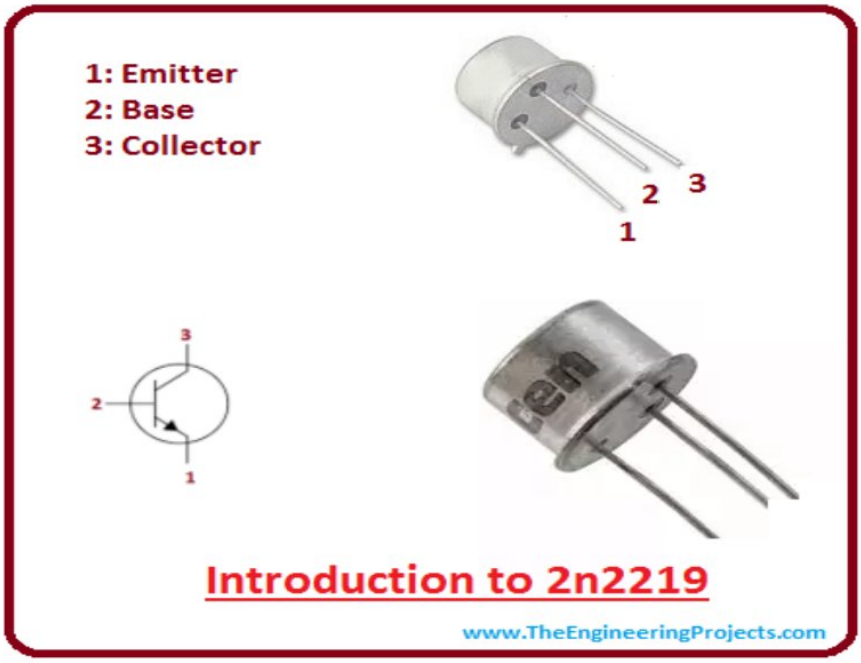


Diagram: 12.1 Introductions to 2N2219a

12.2 Pin Configuration of Transistor npn 2N2219a

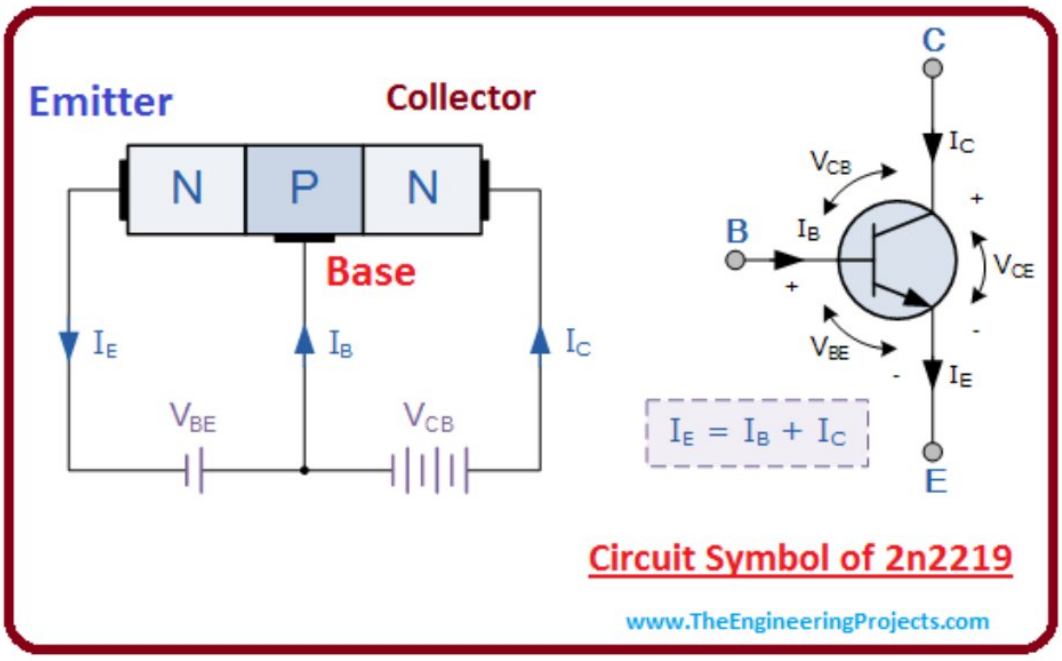
It mainly consists of three terminals which determine the overall nature of the transistor.

1. **Emitter**
2. **Base**
3. **Collector**

- When a small voltage is applied at the base side, it gets biased and allows the small current at the base side to control the large current at the emitter and collector side.
- Conduction is carried out by the movement of electrons from the emitter to collector and base is used to control the number of electrons.

12.3 Circuit Diagram of 2N2219a Transistor

- The circuit symbol of 2n2219 is shown.



This NPN silicon transistor exhibits positive base side and negative emitter side.

- Similarly, a voltage at the collector side is more than the voltage at the base side.
- This transistor can be configured into three main configurations called common emitter configuration common base configuration. Common emitter configuration is mainly used for amplification purpose because it features the exact voltage and power gain required for amplification purpose.

- This common emitter configuration allows the input to increase by 20dB which is 100 times more than the input signal.

- Collector and emitter are slightly different in terms of their size and doping concentrations. A collector is lightly doped while the emitter is highly doped.
- This NPN transistor is a bipolar current controlled device which is different than MOSFET that is unipolar voltage controlled device.
- Forward current gain is an important feature that is mainly used for determining the amplification capacity of the transistor. Forward current gain is called beta, usually denoted by β and is a ratio between collector current to the base current. It is called amplification factor which is a measure of current being amplified. Beta value ranges between 20 to 1000 but its standard value is 200. Beta is a ratio of two current so it has no unit.
- The current gain of this transistor is represented by alpha α which is a ratio between collector current and emitter current. Alpha value ranges between 0.95 to 0.99 and most of the times its value is considered as a unity.
- Both NPN and PNP transistors are different in terms of charge carriers. Electrons are major carriers in NPN transistors while holes are major carriers in PNP transistors.

13.4 Applications

It exhibits high current and low voltage which makes it an ideal choice for high-speed switching.

- The ability of a base terminal to control the number of electrons is mainly used for amplification purpose.

Chapter 13

Details of PCB

13.1 Introduction

It is electronic circuit, mounted on a base material. The circuit made of copper foil, is so thin that it need a base to support it. The name printed on the base. The unwanted copper can be etching process.

13.2 Layout work/Art work

While drawing layout, the size and shape of components, IC's, pin number, transistors etc should be kept in mind. The power supply lines should not touch and cross each other .Each line must have minimum thickness. The distance between two holes must be 2.5mm.

13.3 Etching process

Various solutions can be used for this purpose namely chromic acid, cupric solution, ferric chloride. The most commonly used in industries are .fecl3.It included tray rocking, tank etching, spray etching. The tray rocking is sample one. In this process put copper clad in fecl3 solution for 3 or 4 hours .The wanted copper once completed removed then wash clad by alcohol solution to remove the painted color which save the copper behind it. Hence PCB relay for mounting.

13.4 Cleaning of PCB

The cleaning of PCB can be done by using organic solvents.

Chemical mostly used in the cleaning media are:

1. Acetone
2. Aromatic hydrocarbons
3. Fluorinated hydrocarbon
4. Alcohols

13.5 Mounting and Soldering

Now the components by drilling holes at proper places on copper clad. It is necessary to components to increase the show of designing. By using proper soldering material and gun solder the components. Solder is an alloy of tin for fusing metals at relatively low temperature at about 500-600 degree Celsius.

13.6 Advantages of PCB

1) All wire replaces by printed wire track there for circuit every small size
2) Uniformly components assembly is possible which most suitable in mass production of equipment is.
3) Servicing of board is easy
4) Easy to Solder and disorder component

Chapter 14

Project Name: Automatic Staircase Light Using PIR Sensor

14.1Circuit Diagram:

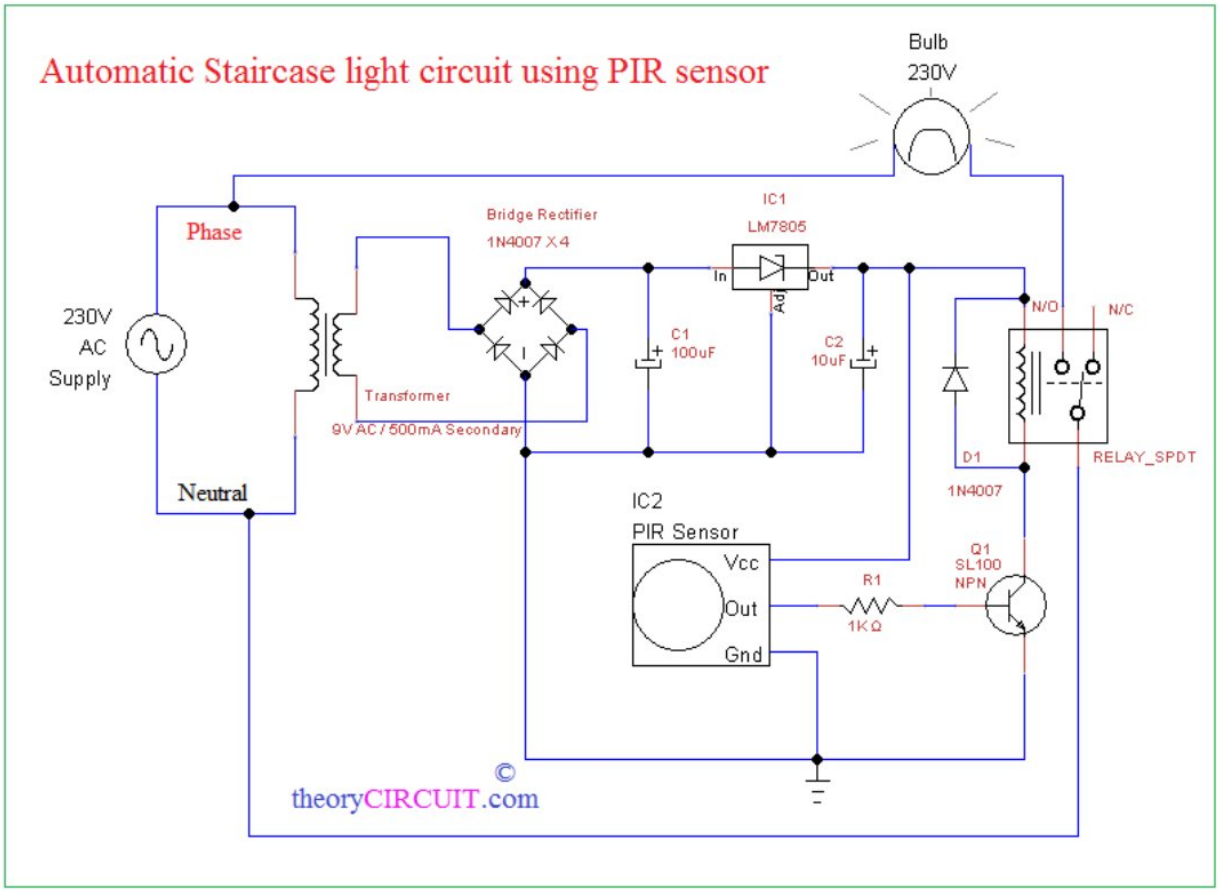


Diagram:14.1 Circuit for Automatic Staircase Light Using PIR Sensor

14.2 Component List: Part list for automatic staircase light using PIR sensor

Sr. No.	Label	Description
1	C1	100µf capacitor
2	C2	10µf capacitor
3	IC1	LM 7805
4	D1	Diode 1N4007
5	R1	1kΩ resistor
6	Q1	2N2219A NPN transistor
7	Transformer	9VAC/500mA
8	Rectifier	Bridge rectifier(1N4007*4)
9	Relay	SPDT

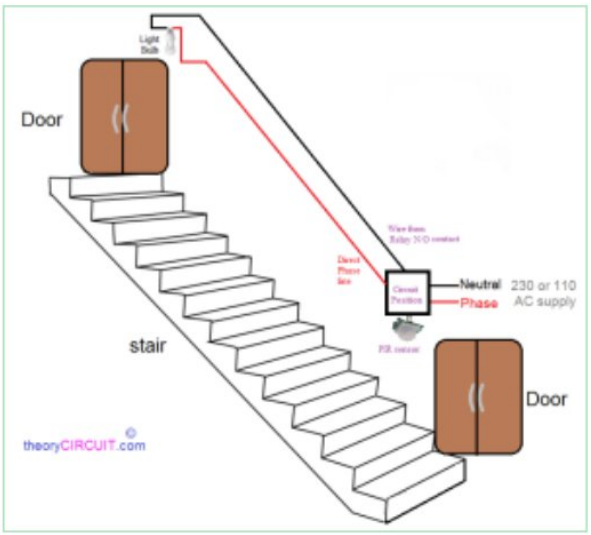
14.3 Construction and Working:

This circuit diagram m constructed by using simple and easily available components. The PIR sensor HC-SR501 connected with bias and output terminal is connected to the switching transistor SL100 through R1 Resistor. The SPDT (Single Pole Double Throw) Relay coil is connected between Vic and Q1 transistor's collector, when the transistor ON then relay gets energized otherwise relay stay opened. Bias for the whole circuit is comes from bridge rectifier and IC 7805 positive DC regulator; it gives constant 5V DC supply.

The bulb is connected between phase line and relay N/O contact, the Pole terminal of relay is connected to the Neutral line of AC supply. Here 230V AC primary to 9V AC 500mA secondary step-down transformer is used.

PIR sensor takes some duration to become stabilize during that time output changes randomly for about 10 to 50 seconds then becomes normal and starts sense motion.

Prototype



Here is the example prototype given, fix PIR sensor plastic cap faced towards the staircase steps, and then check the output & change time delay depends on the requirement of light duration then fix it, now your stair case light becomes automatic.

As shown in circuit diagram, 230V AC primary to 9V 500 mA secondary steps- down transformer is used. Bridge rectifier converts 9V AC to DC voltage. IC LM7805 is used to taken regulated output i.e. +5 volt. This regulated output is given to the VCC terminal of PIR sensor. When PIR senses motion and infrared radiation it feds output to the 2N2219A NPN transistor then transistor become ON. Then relay SPDT have N/C situation mode, therefore the bulb becomes ON.

Advantages, Applications and Disadvantages Of Project:

Advantages:

1. Detect s motion reliably in indoors as well as in day or dark.
2. It consumes less energy.
3. Complete with PIR, Motion Detection.
4. Dual element sensors with low noise and high sensitivity.
5. Supply voltage-5v.
6. Standard TTL output.

Applications:

1. Lift lobby.
2. Multi apartment complexes.
3. Common staircases.
4. For basement or covered parking area.
5. Shopping Malls.

Disadvantages:

1. PIR sensor has lower sensitivity less coverage as compare to microwave sensor.
2. It does not operate greater than 35 degree celsius.
3. PIR sensor works effectively in LOS (Line Of Sight) and will have problems in the corner region.
4. PIR sensor insensitive to very slow motion of the objects.
5. Snoozing is another problem with PIR sensors. PIR sensors may turn off even if there is very little movement in occupied floors.

Chapter 15

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