MALLAREDDY ENGINEERING COLLEGE & MANAGEMENT SCIENCES
(Approved by the AICTE, New Delhi and affiliated to JNTU,Hyderabad)
Kistapur Hamlet of Medchal, Hyderabad, Medchal .Dist. - 501401

Department of Electrical & Electronics Engineering

LABORATORY MANUAL
OF

ELECTRICAL & ELECTRONICS DESIGN LAB

IV B.Tech : I–SEM (EEE)

Lab code : EE701PC

TABLE OF CONTENTS

VISION OF THE EEE-DEPARTMENT

The aspiration is to produce competent Electrical and Electronics Engineering Graduates capable ofmaking valuable contributions in the field of Electrical and Electronics Engineering.
Mission of the Department:

MD-1:

Student Support Systems:

To equip students with advanced learning skills in Electrical and Electronics Engineering, while providing themwith the necessary professional competencies to overcome future challenges.

MD-2:

Training the students as per the industry needs:

To facilitate the students to acquire interdisciplinary skills inrenewable energy, electric vehicles, and power electronics applications through practical knowledge and innovative techniques to meet evolving global challenges.

MD-3:

Educating the students, the needs of society:

To develop professional ethics, self-confidence, and leadership qualities among students.

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

Program Educational Objectives (PEOs):

PEO 1: MREM B.Tech EEE graduates shall be able to apply technical knowledge in Electrical and Electronics Engineering, empowering them to pursue higher studies or succeed in their professional careers in the electrical Power Industry.

PEO 2: MREM B.Tech EEE graduates shall be able to design and implement complex electrical systems, meeting the electrical and electronics industry demands.

PEO 3: MREM B.Tech EEE graduates shall be able to handle societal and environmental problems with ethical values as demanded by society.

Program Specific Outcomes (PSOs):

PSO1: Provide efficient problem-solving techniques in the areas of Power Electronics, Power Systems, Control systems, and Electrical Machines using MATLAB/MULTISIM.

PSO2: Design and develop a wide range of Electrical and Electronics Systems, specifically emphasizing Electric Drives, Conventional Renewable Energy, and Automation to demonstrate overall knowledge and contribute to the betterment of society.

GENERAL LABORATORY INSTRUCTIONS

1. There must be atleast two(2)people in the laboratory while working on live circuits or chemical processing
2. Shoes and apron must be worn at all times.
3. Remove all loose conductive jewelry and trinkets, including rings, which may come in contact with exposed circuits. (Do not wear long loose ties, scarves, or other loose clothing around machines.)
4. Consider all circuits to be "hot" unless proven otherwise.
5. When making measurements, form the habit of using only one hand at a time. No part of a live circuit should be touched by the bare hand.
6. Keep the body, or any part of it, out of the circuit. Where interconnecting wires and cables are involved, they should be arranged so people will not trip over them.
7. Be as neat as possible.Keep the work area and workbench clear of items not used in the experiment.
8. Always check to see that the power switch is OFF before plugging into the outlet.Also,turn instrumentor equipment OFF before unplugging from the outlet.
9. When unplugging a power cord, pull on the plug, not on the cable.
10. When disassembling a circuit, first remove the source of power.
11. Noungroundedelectricalorelectronicapparatusistobeusedinthelaboratoryunlessitisdoubleinsulatedor battery operated.
12. Keep fluids, chemicals, and beat away from instruments and circuits.
13. Report any damages to equipment, hazards, and potential hazards to the laboratory instructor.
14. If in doubt about electrical safety, see the laboratory instructor. Regarding specific equipment, consult the instruction manual provided by the manufacturer of the equipment. Information regarding safe use and possible- hazards should be studied carefully.

Head of the Department **Principal**

LIST OF EXPERIMENTS

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

ELECTRICAL & ELECTRONICS DESIGN LAB

(R-18,EEE - B.Tech IV YEAR-I SEM)

LIST OF EXPERIMENTS:

Group A:

1. Design and fabrication of reactor/ electromagnet for different inductance values.
2. Design and fabrication of single-phase Induction/three phase motor stator.
3. Star delta starter wiring for automatic and manual operation.
4. Wiring of distribution box with MCB, ELCB, RCCB and MCCB.
5. Wiring of 40 W tube, T-5, LED, Metal Halide lamps and available latest luminaries.
6. Assembly of various types of contactors with wiring.
7. Assembly of DOL and 3-point starter with NVC connections and overload operation.

Group B:

This group consists of electronic circuits which must be assembled and tested on general purpose PCB or bread boards.

1. Design and development of 5 V regulated power supply.
2. Design and development of precision rectifier.
3. Design and development of first order/ second order low pass/high pass filters with an application.
4. Microcontroller Interface circuit for temperature/level/speed/current/voltage measurement.
5. Peak detector using op-amplifiers.
6. Zero crossing detector using op-amplifiers.
7. PCB design and layout.

LIST OF EXPERIMENTS

Head of the Department

SUBJECT: ELECTRICAL & ELECTRONICS DESIGN LAB (C405)

SNO	COURSE OUTCOMES	BT Level
C405.1	Get practical knowledge related to electrical	2
C405.2	Fabricate basic electrical circuit elements/networks	2
C405.3	Trouble shoot the electrical circuits	2
C405.4	Design filter circuit for application	2
C405.5	Get hardware skills such as soldering, winding etc.	2

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
C405.1	3	1	1	1	1	1							2	2
C405.2	2	2	2	3	1								2	2
C405.3	1	3	3	1	1								2	2
C405.4	2	3	1	2	1	1							2	2
C405.5	1	1	1	3	1								2	2
Average	2	2	2	2	1	1							2	2

Faculty Incharge

MALLAREDDY ENGINEERING COLLEGE AND MANAGEMENT SCIENCES
(Approved by AICTE New Delhi & Affiliated to JNTU Hyderabad)
Kistapur Village, Medchal, Medchal District-501401

Electrical & Electronics Design Lab

S. No	Name of the Experiment	CO Mapping	PO/PSO Mapping
1	Design and fabrication of reactor/electromagnet for different inductance values.	Creating	PO3, PO5
2	Design and fabrication of single phase Induction/ three phase motor stator.	Creating	PO3, PO5
3	Start delta starter wiring for automatic and manual operation.	Understanding	PO2, PO3
4	Wiring of distribution box with MCB,ELCB,RCCB and MCCB.	Understanding	PO2, PO3
5	Wiring of 40Wtube,T-5, LED,Metal Halide lamps and available latest luminaries.	Understanding	PO2, PO3
6	Assembly of various types of contactor switch wiring.	Understanding	PO2, PO3
7	Assembly of DOL and 3 point starter with NVC connections and overload operation.	Analyzing	PO2, PO5
8	Design and development of precision rectifier.	Creating	PO3, PO5
9	Design and development of first order/second order low pass/high pass filters with an application	Creating	PO3, PO5
10	Peak detector using op-amplifiers.	Remembering	PO1,PO2
11	Zero crossing detector using op-amplifiers	Remembering	PO1,PO2
12	Microcontroller Interface circuit for temperature/level/speed/current/voltage measurement.	Understanding	PO2, PO3
13	Design and development of 5V regulated power supply.	Creating	PO3, PO5
14	PCB design and layout.	Remembering	PO1,PO2
BEYOND SYLLABUS EXPERIMENTS			
15	Connection Of Star to Delta Configuration	Remembering	PO1,PO2
16	Connection of Delta to Star configuration	Remembering	PO1,PO2

GROUP-A

EXPERIMENT-1

DESIGN AND FABRICATION OF REACTOR/ELECTROMAGNET FOR DIFFERENT INDUCTANCE VALUES.

AIM: Design and fabrication of Electromagnet for different inductance values

APPARATUS REQUIRED:

1. Assembled Control panel of electromagnetic coil.
2. Different Electromagnetic coils
3. Winding machine.
4. Connecting wires.

Theory : An **electromagnetic coil** is an electrical conductor such as a wire in the shape of a coil, spiral or helix. Electromagnetic coils are used in electrical engineering, in applications where electric currents interact with magnetic fields, in devices such as electricmotors,generators,inductors,electromagnets,transformers, and sensor coils. Either an electric current is passed through the wire of the coil to generate a magnetic field, or conversely an external *time-varying* magnetic field through the interior of the coil generates an EMF (voltage) in the conductor.

A current through any conductor creates a circular magnetic field around the conductor due to Ampere's law. The advantage of using the coil shape is that it increases the strength of magnetic field produced by a given current. The magnetic fields generated by the separate turns of wire all pass through the center of the coil and add (superpose) to produce a strong field there. The more turns of wire, the stronger the field produced.Conversely, a *changing* external magnetic flux induces a voltage in a conductor such as a wire, due to induction. The induced voltage can be increased by winding the wire into a coil, because the field lines intersect the circuit multiple times.

The direction of the magnetic field produced by a coil can be determined by the right hand grip rule. If the fingers of the right hand are wrapped around the magnetic core of a coil in the direction of conventional current through the wire, the thumb will point in the direction the magnetic field lines pass through the coil. The end of a magnetic core from which the field lines emerge is defined to be the North pole.


PROCEDURE:

1. Construct a magnetic coil using winding machine insert the coil into given iron core in the control panel.
2. Switch ON the main MCB and connect the supply terminals to the magnetic coil.
3. Observe the magnetic field of a constructed coil.
4. Switch off the main MCB.

RESULT:

Thus then construction and working of a magnetic coil is done.

EXPERIMENT-2

DESIGN AND FABRICATION OF SINGLE PHASE INDUCTION/THREE PHASE MOTOR STATOR.

AIM: Design and fabrication of single phase Induction motor stator

APPARATUSREQUIRED:

1.Control Panel for Induction Motor

2.1-PhaseInductionMotor.

3.Motor Winding Machine

4.. Connecting wires.

Theory:

Single phase induction motor

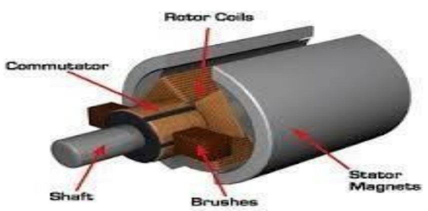
Generally, the conversion of electrical power into mechanical power takes place in the rotating part of an electric motor [2]. In a.c motors the rotor of the machine receives electric power by induction in a similar manner as the energy is transferred from the primary part to the secondary part of the transformer [1, 2].

Construction of an Induction motor

An induction motor consists essentially of two main parts:

I) Stator

II) Rotor



I) The Stator

The stator of an induction consists of a number of stampings, which are strategically placed to house the windings. The windings are wound for a definite number of poles which is determined by the required speed of the motor [1, 2, and 3]. The greater the number of poles, the lower the speed of the motor [2].When supplied with the current, the stator windings produce a rotating flux which is of constant magnitude but which rotates at synchronous speed.

II).Rotor

A single phase induction motor has a squirrel- cage rotor. The squirrel-cage rotor consists of a cylindrical laminated core with parallel slots for carrying the rotor conductors (heavy bars of copper or aluminum). The rotor bars are electrically welded to two short-circuiting end-rings thereby forming a squirrel case construction. The rotor bars are not aligned straight to the rotor bar but are skewed to reduce the locking tendency of the rotor and to reduce the magnetic hum hence allowing the motor to run quietly [2].

Single phase induction motor operation

When the motor is fed from a single-phase supply, the stator winding produces a flux which only alternates along one space axis only, i.e. the flux produced does not rotate [1, 2 and 3]. A single – phase induction motor is therefore not self-starting. However, if the rotor is given a push in either direction, it accelerates to its final speed and continues to rotate in the given direction even after the force has been removed.

PROCEDURE:

1. Check whether main MCB in off position.
2. Connect input3-ØsupplytotheinputofaDOL starter.
3. Connect the output of a DOL starter to the Induction motor (OR) connect the output of a Variac to Induction motor
4. Switch on the main MCB and push on green Starter button,
5. When motor starts rotating observe the speed Rotation
6. Observe the readings, and switch off the Red button and switch off main MCB.

CONTROL PANEL IMAGE

RESULT: Thus we verified and constructed a Induction motor with different stator winding and observed its working condition.

EXPERIMENT-3
STAR DELTA STARTER WIRING FOR AUTOMATIC AND MANUAL OPERATION.

AIM: To construct and observe the parts and working of a star delta starter.

APPARATUSREQUIRED:

1. Assembled Control panel of a star delta starter.
2. 3-phaseinduction motor.
3. Connecting wires.

THEORY:

The Star Delta Starter is a very common type of starter and is used extensively as compared to the other type of starting methods of the induction motor. A star delta is usedforacagemotordesignedtorunnormallyonthedeltaconnectedstatorwinding. The connection of a three-phase induction motor with a star delta starter is shown in the figure below.

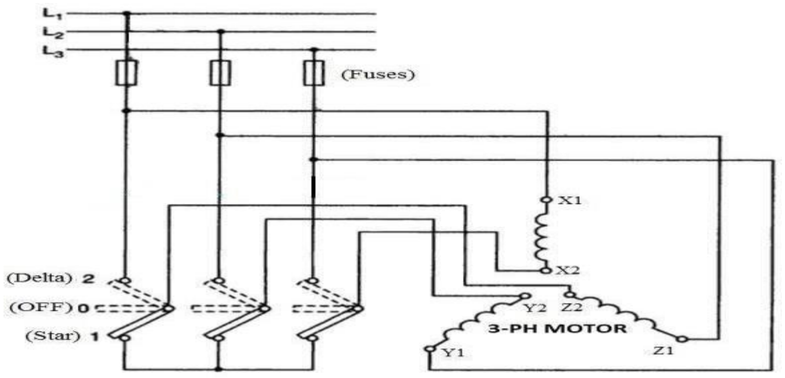
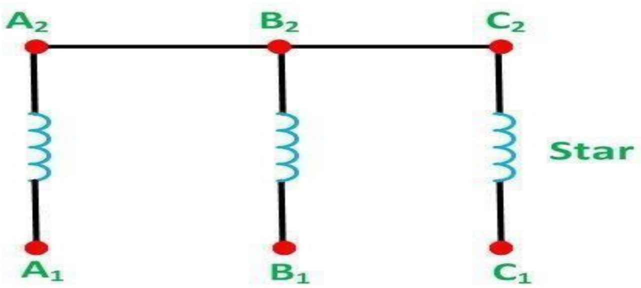
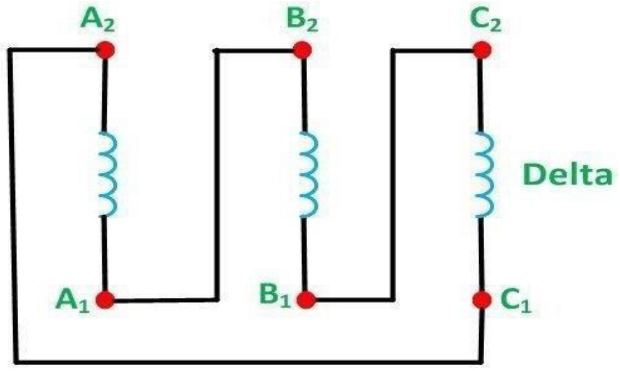


Fig: STAR-DELTA Starter

When the switch S is in the START position, the stator windings are connected in the star as shown below.



When the motor picks up the speed, about 80 percent of its rated speed, the switch S is immediately put into the RUN position. As a result, a stator winding which was in star connection is changed Into DELTA connection now. The delta connection of the stator winding in shown in the figure below.

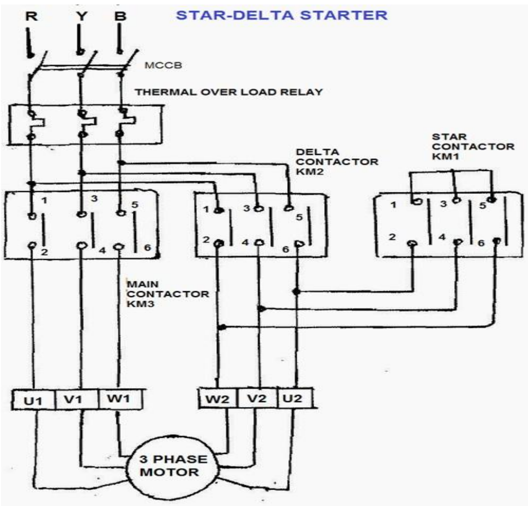


Firstly, the stator winding is connected in star and then in Delta so that the startinglinecurrentofthemotorisreducedtoone-thirdascomparedtothestarting current with the windings connected in delta.

At the starting of an induction motor when the windings of the stator are star connected,eachstatorphasegetsavoltageVL/√3.HereVListhelinevoltage.Since the developed torque is proportional to the square of the voltage applied to an induction motor. Star delta starter reduces the starting torque to one-third that is obtained by direct delta starting.

PROCEDURE:

1. Check the main input MCB in OFF position or not.
2. Connect the circuit as shown in the diagram.
3. Connect main supply to the starter input i.e. L1L2L3.
4. Connect the starter output terminals R, Y,B to motor U1V1W1terminals and U V W, to motor U2 V2 W2 terminals correspondingly.
5. Switch ON the input supply and press the green push button then observe the motor start running.
6. Then, Press the red push button to stop the motor.
7. Switch OFF the main supply.



CONTROLEPANEL IMAGE

RESULT: Thus we done the wiring of a star delta starter and observed he working condition.

EXPERIMENT-4
WIRING OF DISTRIBUTION BOX WITH MCB,ELCB,RCCB AN MCCB.

AIM: To do the wiring of a Distribution Box with MCB,RCCB and MCCB and observe the working of each item.

APPARATUSREQU IRED:

1. Assembled Control panel of a MCB,RCCB and MCCB.
2. Connecting wires.

Theory: MCB(Miniature Circuit Breaker)

As we all know that, all fuses need to be replaced with the MCB for safety and control purposes. MCBs are electromechanical devices which are used to protect an electrical circuit from an over current. It can be reclosed without any hand-operated restoration. MCB is used as an option to the fuse switch in most of the circuits. Unlike a fuse, MCB does not have to be replaced every time after a failure as it can be reused.

Another huge advantage of MCBs is that the detection of a problem is easy. Whenever there is a fault in the circuit, the switch comes down automatically and we are hereby informed that there was a fault. We can then manually go and put the MCB back up and the electricity will start flowing again

Miniature Circuit Breaker

RCCB (Residual Current Circuit Breaker)

RCCB(Residual current circuit breaker) or RCD (Residual-current device) are aimed to protect people from the risk of electrocution and fire that are generally caused due to the faulty wiring. An RCCB is also very useful when a sudden earth fault occurs in the circuit.

RCCB is basically an electric wiring that trips or disconnects when imbalance or mismatch in electric current is detected. The best part about RCCB is that it does not take much time to take the control over the imbalanced electric current; RCCB takes only about 20 milliseconds to trip. RCCB is essentially a current sensing equipment that is used to control the low voltage circuit from the fault. It comprises a switch device which is used to turn off the

circuit when there is a fault.

Residual Current Circuit Breaker

MCCB-Molded Case Circuit Breaker

The MCCB is used to control energy in distribution n/k and is having short circuit and overload protection. This circuit Breaker is an electro-mechanical device which guards a circuit from short circuit and over current. They offer short circuit and over current protection for circuits ranges from 63 Amps-3000 Amps. The primary functions of MCCB is to give a means to manually open a circuit, automatically open a circuit under short circuit or overload conditions. In an electrical circuit, the over current may result faulty design

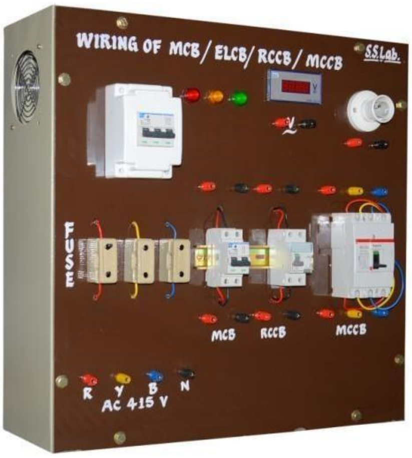
MCCB

The MCCB is an option to a fuse since it doesn't need an alternate once an overload is noticed. Unlike a fuse, this circuit breaker can be simply reset after a mistake and offers enhanced operator safety and ease without acquiring operating cost. Generally, these circuits have thermal current for over current and the magnetic element for short circuit release to work faster

PROCEDURE:

1. Check the main input MCB is in OFF position.
2. Connect the input supply to the input of a corresponding MCB,RCCBorMCCB.
3. Connect the output of components to the load or a bulb.
4. Now, switch on the input supply, switch on the MCB ,or RCCB or MCCB and observe the corresponding outputs.

RESULT: Thus we done the wiring of a MCB,RCCB and MCCB and observed the working condition.



<u>CONTROL E-PANEL IMAGE</u>

EXPERIMENT-5
WIRING OF 40WTUBE,T-5, LED,METAL HALIDE LAMPS AND AVAILABLE LATEST LUMINARIES

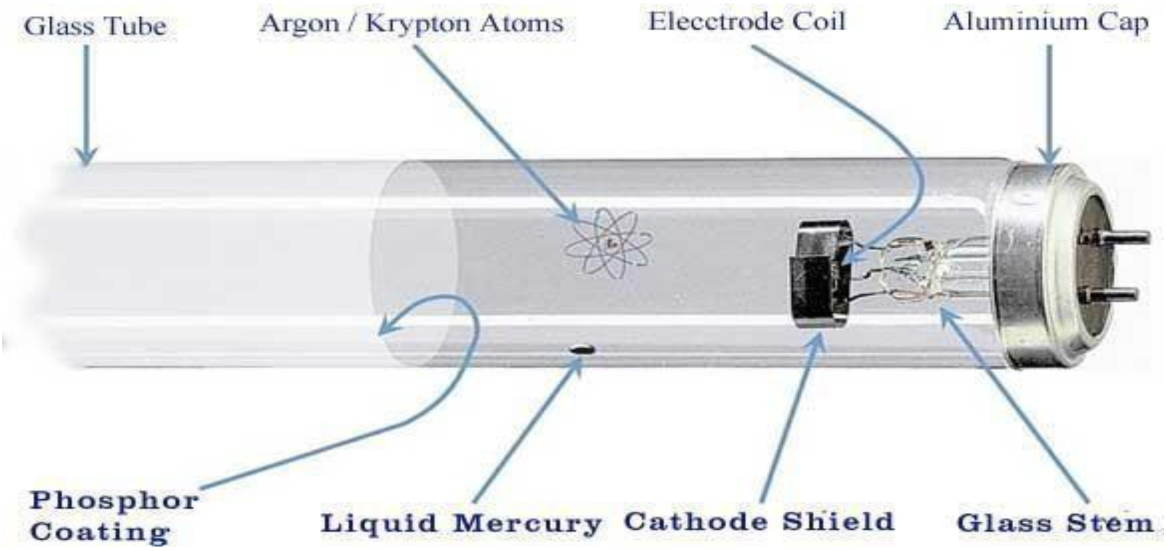
AIM: To do the wiring of a tubelight, incandescent bulb, metal halide lamp and led lamp.

APPARATUS REQUIRED:

1. Assembly Control panel of a tube light trainer.
2. Tubelight,metal halide lamp, led lamp
3. Connecting wires.

THEORY: Tube shaped fluorescent lamp is termed as tube light.The materials used to build a tube light are given below.

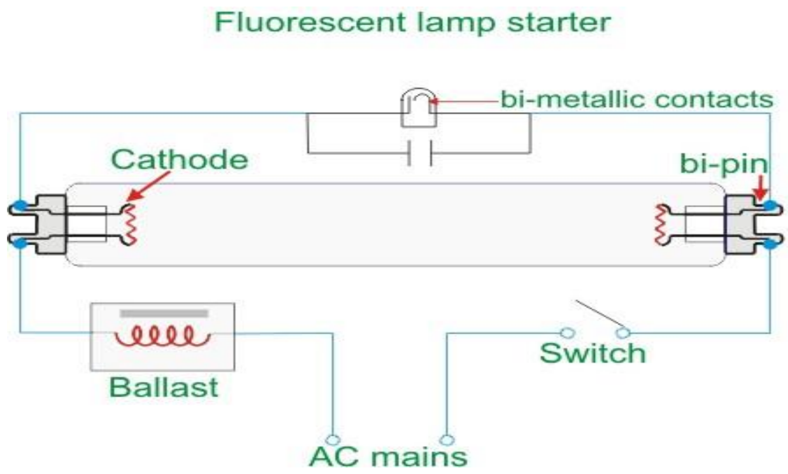
1. Filament coils as electrodes
2. Phosphor coated glass bulb
3. Mercury drop
4. Inert gases(argon)
5. Electrode shield
6. End cap
7. Glass stem



The tube light does not work directly on power supply .It needs some auxiliary components to work. They are-

Ballast: It may be electromagnetic ballast or electronic ballast.

Starter: The starter is a small neon glow up lamp that contains a fixed contact, a bimetallic strip and a small capacitor.

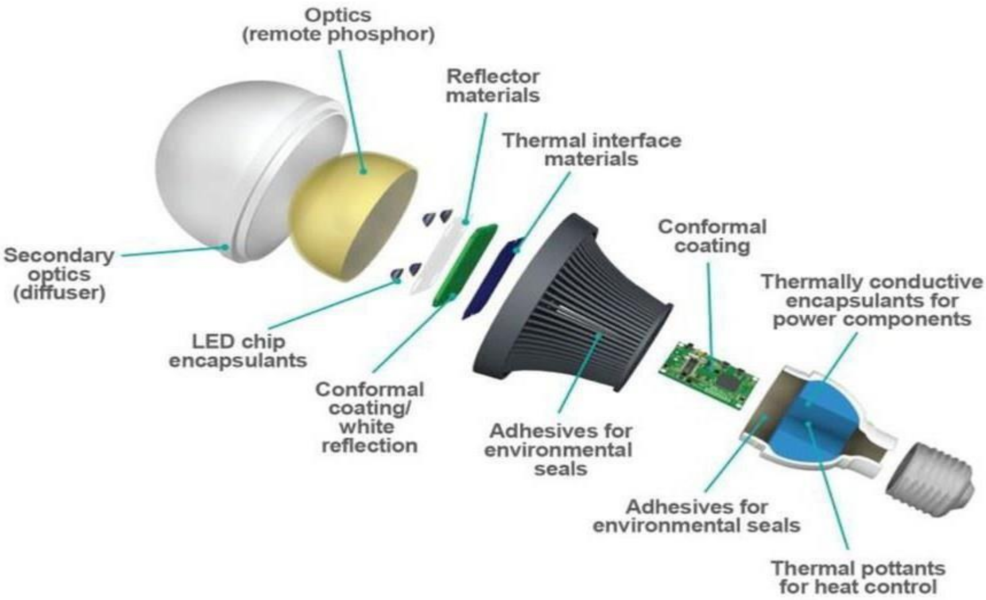


Working Principle of Tube Light:

- When the switch is ON, full voltage will come across the tube light through ballast and fluorescent lamp starter. No discharge happens initially i.e.no lumen output from the lamp.
- At that full voltage first the glow discharge is established in the starter.
- Thisisbecausetheelectrodesgapintheneonbulbofstarterismuchlesserthanthatof inside the fluorescent lamp.
- Then gas inside the starter gets ionized due to this full voltage and heats the bimetallic strip that is caused to be bent to connect to the fixed contact. Current starts flowing through the starter. Although the ionization potential of the neon is little bit more than thatoftheargonstillduetosmallelectrodegaphighvoltagegradientappearsintheneon bulb and hence glow discharge is started first in starter.
- Asvoltagegetsreducedduetothecurrentcausingavoltagedropacrosstheinductor, the strip cools and breaks away from the fixed contact. At that moment a large Ldi/dt voltage surge comes across the inductor at the time of breaking.
- This high valued surge comes across the tube light electrodes and strike penning mixture (mixture argon gas and mercury vapor).
- Gasdischargeprocesscontinuesandcurrentgetspathtoflowthroughthetubelightgas only due to low resistance as compared to resistance of starter.
- The dischargeofmercuryatomsproducesultravioletradiationwhichinturnexcitesthe phosphor powder coating to radiate visible light.

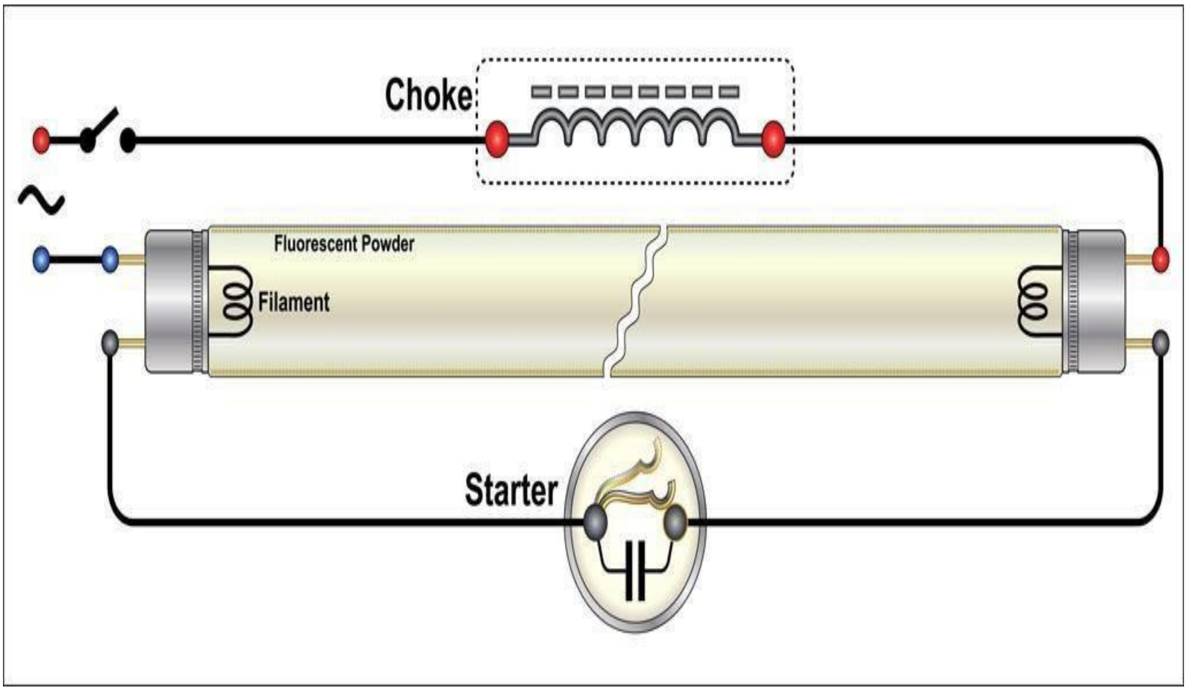
• Starter gets inactive during operation of tube light.

• LED Lamp:



LED Lamp

TUBE LIGHT 40W:



CFL Lamp:

Working Principle of CFL Lamp:

• CFLs produce light differently than incandescent bulbs. In an incandescent, electric current runs through a wire filament and heats the filament until it starts to glow. In a CFL, an electric current is driven through a tube containing argon and a small amount of mercury vapor .This generates invisible ultraviolet light that excites a fluorescent coating (called phosphor)on the in side of the tube, which then emits visible light.

• CFLs need a little more energy when they are first turned on, but once the electricity starts moving, CFLs use about 70% less energy than incandescent bulbs. A CFL’s ballast helps" kick start "the CFL and then regulates the current once the electricity starts flowing.

• Thisentireprocesstypicallytakes30secondsto3minutestocomplete,whichis why CFLs take longer than other lights to become fully lit. CFLs with decorative covers like globe or reflector shapes have a unique design challenge that results in the trade off of as lower warm up time, which is why these CFLs take longer than bare spirals to reach full brightness

PROCEDURE:

1. Check the main MCB in off position.

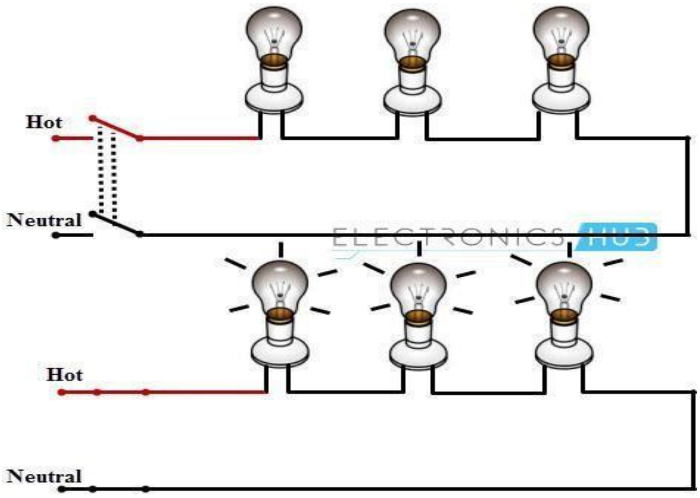
2. Now, connect input phase to the one end of a choke coil and the other end is connected to the holder first terminal.

3. Connect holder second terminal to the first end of a starter, and starter second end to holder third terminal.

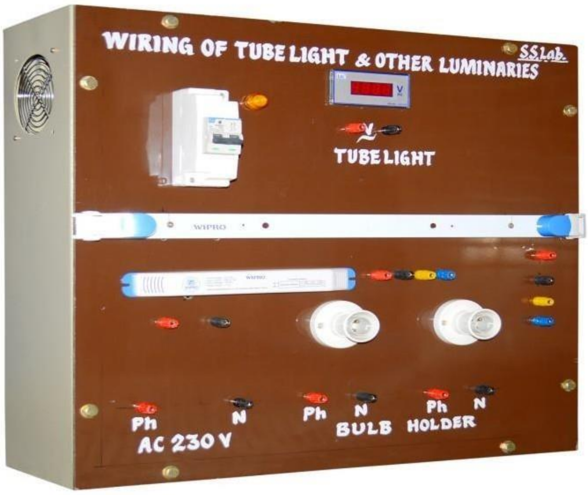
4. Connect holder for the terminal to the neutral of a supply input.

5. Now, switch on MCB and observe that tube light is glows.

6. For other luminaries connect phase and neutral to the holder terminal and switch on supply and observe.



RESULT: Thus we done the wiring and observed the different types of luminaries.



CONTROL E-PANEL IMAGE

EXPERIMENT-6
ASSEMBLY OF VARIOUS TYPES OF CONTACTOR SWITCH WIRING.

AIM: Assembly of various types of contact or switch wiring.

APPARATUSREQUIRED:

1. Assembled panel of a contactor and timer.

2. Connecting wires.

Theory:

A **contactor** is an electrically-controlled switch used for switching an electrical power circuit.[1]a contactor is typically controlled by a circuit which has a much lower power level than the switched circuit, such as a 24-volt coil electromagnet controlling a 230-volt motor switch.

Unlike general-purpose relays, contactors are designed to be directly connected to high-current load devices. Relays tend to be of lower capacity and are usually designed for both *normally closed* and *normally open* applications. Devices switching more than 15 amperes or in circuits rated more than a few kilowatts are usually called contactors. Apart from optional auxiliary low-current contacts, contactors are almost exclusively fitted with normally open ("form a") contacts. Unlike relays, contactors are designed with features to control and suppress the arc produced when interrupting heavy motor currents.

Contactors come in many forms with varying capacities and features. Unlike a circuit breaker, a contactor is not intended to interrupt a short circuit current. Contactors range from those having a breaking current of several amperes to thousands of amperes and 24 v dc to many kilo volts. The physical size of contactors ranges from a device small enough to pick up with one hand, to large devices approximately a meter (yard) on a side.

Contactors are used to control electric motors,lighting,heating,capacitor banks, thermal evaporators, and other electrical loads. AC contactor is widely used in power transmission system. Applicable to long-distance frequent switching on and switching end DC main circuit and large capacity control circuit in, it main control object is all motor, and can also be used for electric welder control, capacitor banks, and the electric heating device, lighting equipment and other loads. For example, power industry,industrial and mining enterprises,iron and steel plants,and some large power will use it. Can also cooperate with the fuse, the dynamic air circuit breaker, thermal relay and other electrical use, in order to better protect the line current.

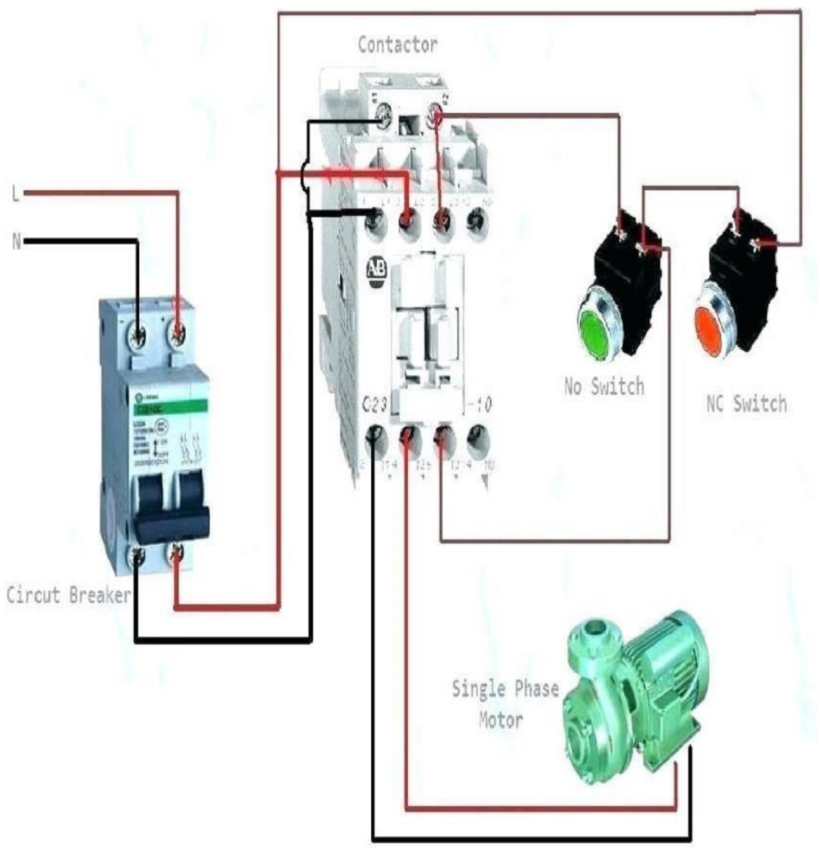
An air conditioning unit is a complex system of electronic components that must work together so that to AC contactor is widely used in power transmission system.

Applicable to long-distance frequent switching on and switch in DC main circuit and large capacity control circuit in, it main control object is all motor, and can also be used for electric welder control, capacitor banks, and the electric heating device, lighting equipment and other loads. For example, power industry, industrial and mining enterprises, iron and steel plants, and some large power will use it. Can also cooperate with the fuse, the dynamic air circuit breaker, thermal relay and other electrical use, in order to better protect the line current.

An air conditioning unit is a complex system of electronic components that must work together so that your AC system can run at the right times at AC system can run at the right times.

PROCEDURE:

1. Check the input MCB in OFF position.
2. Connect the circuit as shown in the diagram.
3. Switch on the main MCB, set the timer for different time delays by using small rotating part given on the timer.
4. Observe the working of a contactor and timer.



RESULT: Thus we done the wiring of a contactor and timer, observed the working condition.

<u>CONTROL E-PANEL IMAGE</u>

EXPERIMENT-7
ASSEMBLY OF DOL AND 3 POINT STARTER WITH NVC CONNECTIONS AND OVERLOAD OPERATION.

AIM: To do the assembly and wiring of a DOL and3 point starter with NVC Connections and Over load Protection.

APPARATUSREQUIRED:

1. Assembly Control panel of DOL and 3-point starter.

2.3-Ø induction motor.

3. DC shunt motor

4. Connecting Wires

Principle of Direct On Line Starter (DOL)

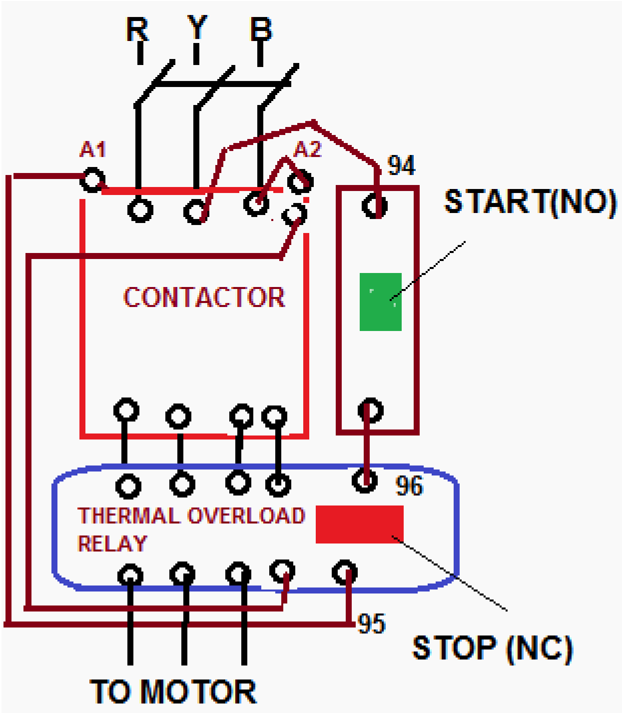
To start, the contactor is closed, applying full line voltage to the motor windings. The motor will draw a very high inrush current for a very short time, the magnetic field in the iron, and then the current will be limited to the Locked Rotor Current of the motor. The motor will develop Locked Rotor Torque and begin to accelerate towards full speed.

As the motor accelerates, the current will begin to drop, but will not drop significantly until the motor is at a high speed, typically about 85% of synchronous speed. The actual starting current curve is a function of the motor design, and the terminal voltage, and is totally independent of the motor load.

The motor load will affect the time taken for the motor to accelerate to full speed and therefore the duration of the high starting current, but not the magnitude of the starting current.

Provided the torque developed by the motor exceeds the load torque at all speeds during the start cycle, the motor will reach full speed. If the torque delivered by the motor is less than the torque of the load at any speed during the start cycle, the motor will stops accelerating. If the starting torque with a DOL starter is insufficient for the load, the motor must be replaced with a motor which can develop a higher starting torque.

The acceleration torque is the torque developed by the motor minus the load torque, and will change as the motor accelerates due to the motor speed torque curve and the load speed torque curve. The start time is dependent on the acceleration torque and the load inertia.



Working of Three Point Starter

Having studied its construction, let us now go into the **working of the 3 point starter**. To start with the handle is in the OFF position when the supply to the DC motor is switched on. Then handle is slowly moved against the spring force to make contact with stud No.1. At this point, field winding of the shunt or the compound motor gets supply through the parallel path provided to starting the resistance, through No Voltage Coil. While entire starting resistance comes in series with the armature. The high starting armature current thus gets limited as the current equation at this stage becomes:

$$I_a = \frac{E}{(R_a + R_{st})}$$

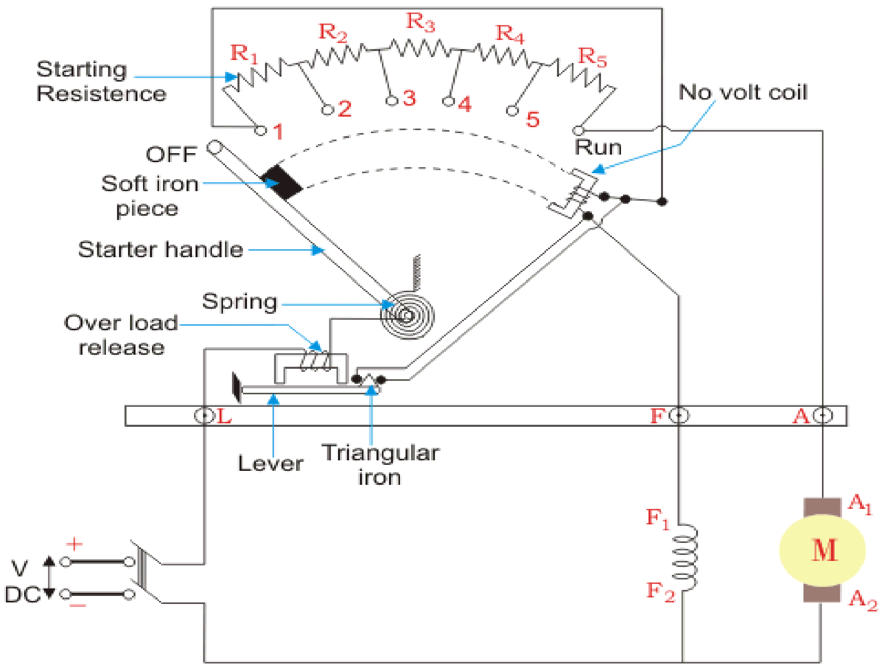
As the handle is moved further, it goes on making contact with studs 2, 3, 4, etc., thus gradually cutting off the series resistance from the armature circuit as the motor gathers speed. Finally, when the starter handle is in 'RUN' position, the entire starting resistance is eliminated, and the motor runs with normal speed.

This is because back emf is developed consequently with speed to counter the supply voltage and reduce the armature current.

So the external electrical resistance is not required anymore and is removed for optimum operation. The handle is moved manually from OFF to the RUN position with the development of speed. Now the obvious question is once the handle is taken to the RUN position how it is supposed to stay there, as long as the motor is running.
To find the answer to this question let us look into the working of No Voltage Coil.

Working of No Voltage Coil of 3-Point Starter

The supply to the field winding is derived through no voltage coil. So when field current flows, the NVC is magnetized. Now when the handle is in the 'RUN' position, a soft iron piece is connected to the handle and gets attracted by the magnetic force produced by NVC, because of flow of current through it. The NVC is designed in such a way that it holds the handle in 'RUN' position against the force of the spring as long as supply is given to the motor. Thus NVC holds the handle in the 'RUN' position and hence also called **hold on coil**.



Three Point Starter

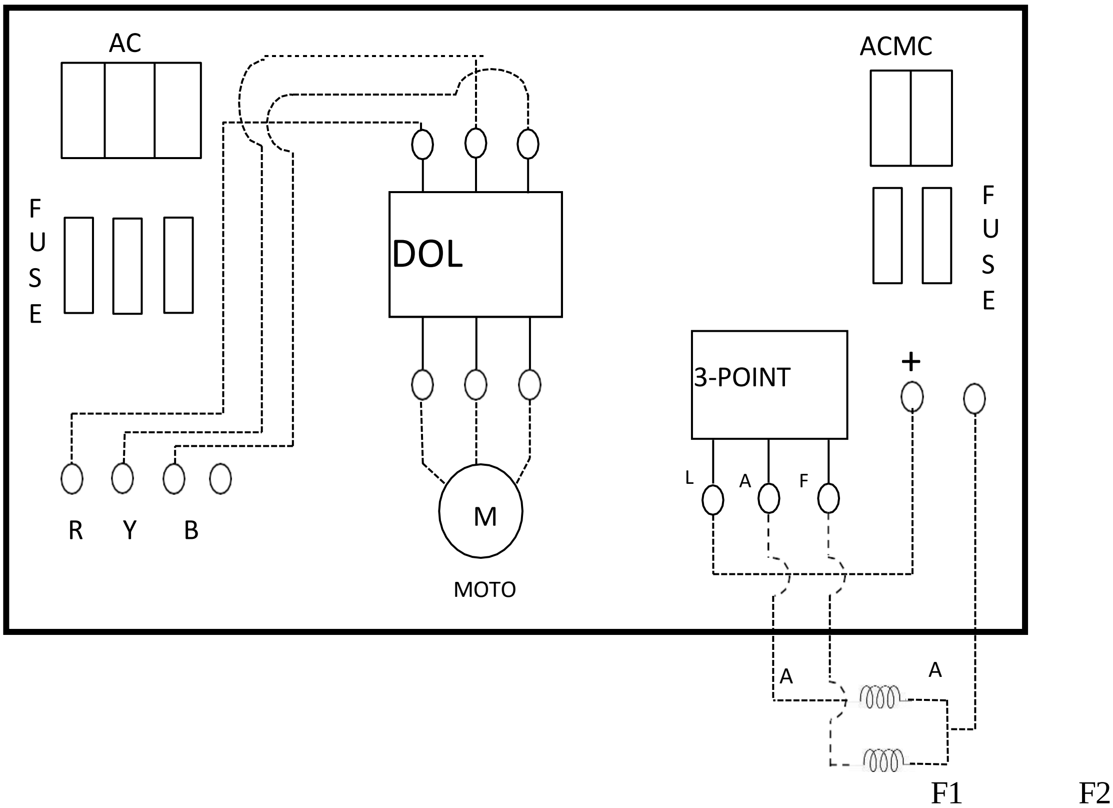
PROCEDURE:

1. Check the main AC MCB in off position.
2. Connectthemain3-ØsupplytotheinputofDOLstarter.
3. Connect the output of a DOL starter off the input off a motor.
4. Switch on the main MCB, push on green button and observe the working of DOL starter.
5. Check the main DC MCB in off position.
6. Connect the+vetotheinputofa3pointstarterLandAtothemotorArmature A1 terminal.
7. Starter F to the motor field F1 terminal.
8. ConnectA2toF2and-Veoftheinputsupply.
9. Switch on main MCB and start the 3-points starts with hand liver and observe working Starters

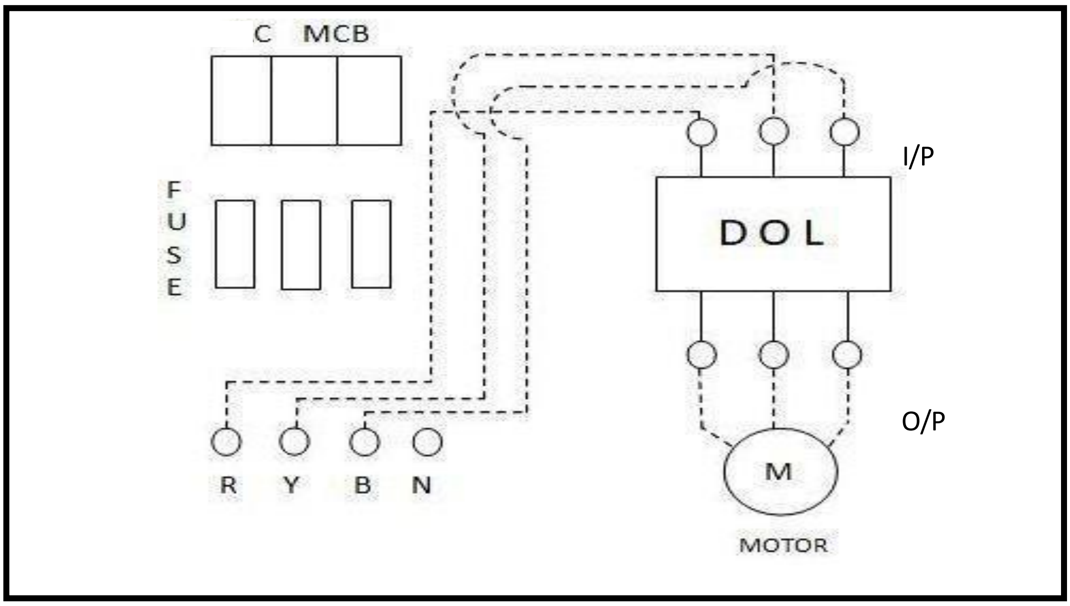
RESULT: Thus we are assembled and observed the working of a DOL and 3-point starter.

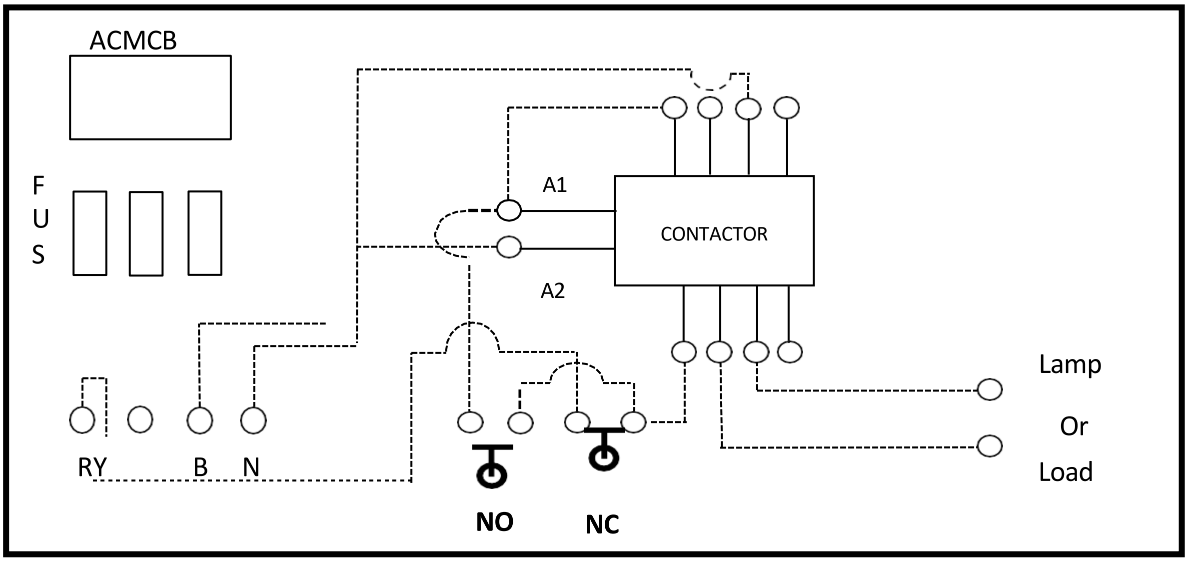
CONTROL E-PANEL IMAGE

ASSEMBLY AND WIRING OF DOL & 3-POINTSTARTER

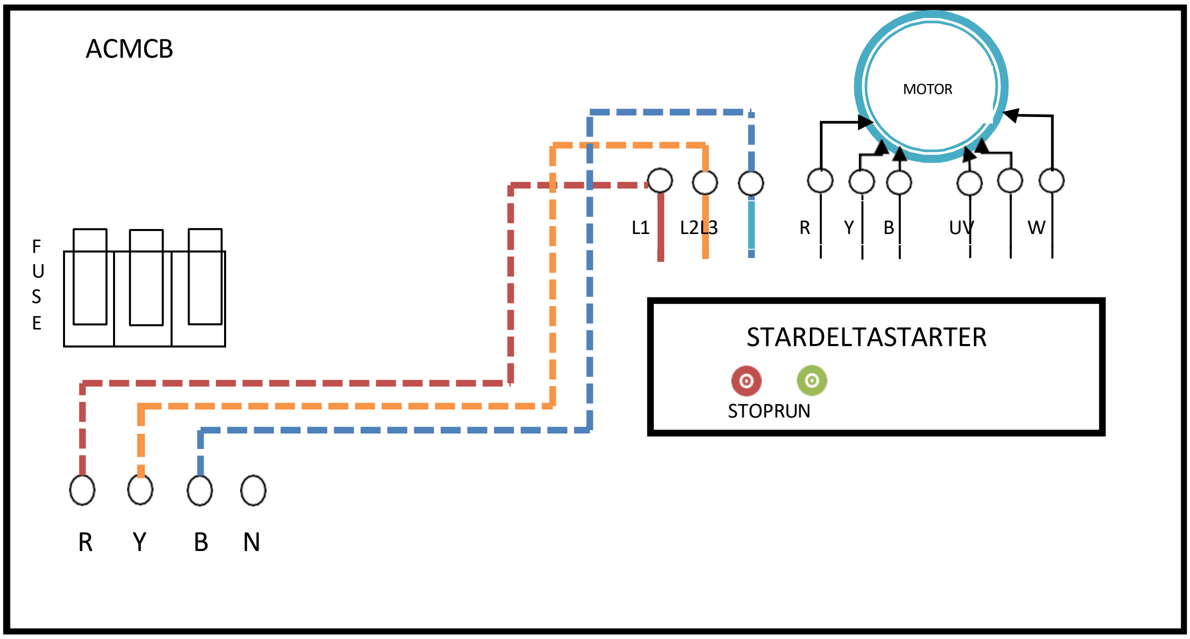


WORKING OF DOL STARTER

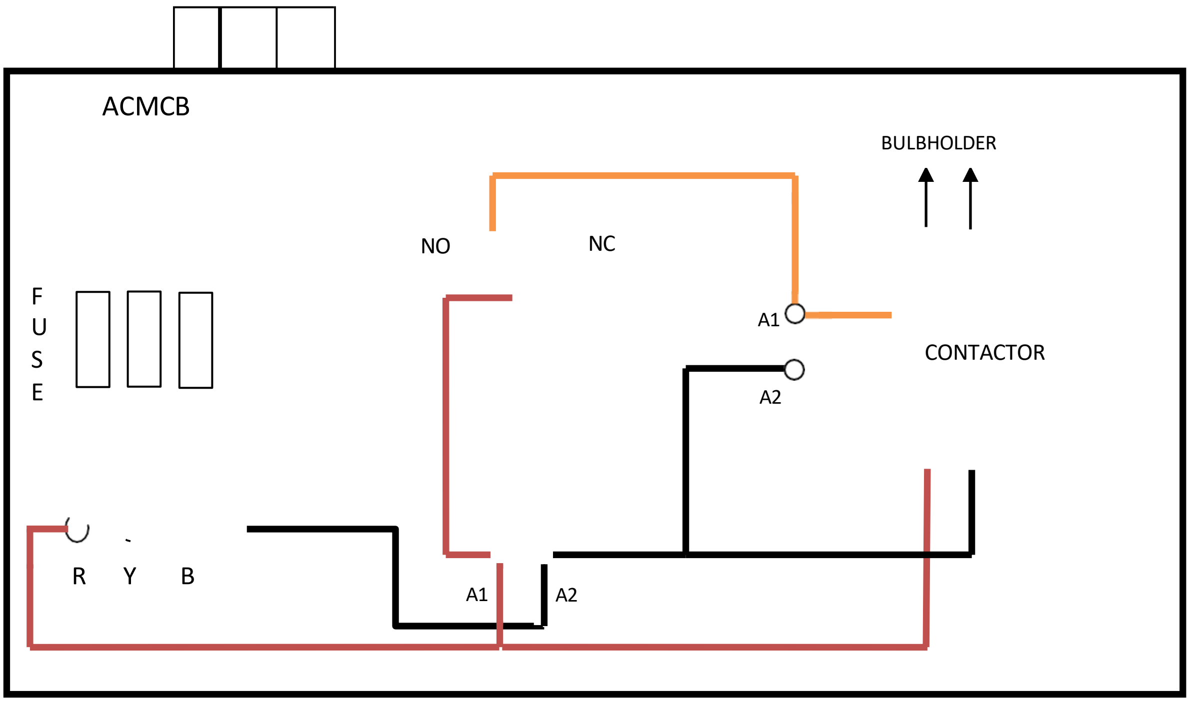




ACMCB
F
U
S
A1
CONTACTOR
A2
Lamp
Or
Load
RY
B
N
NO
NC



ACMCB
MOTOR
F
U
S
E
L1
L2L3
R
Y
B
UV
W
STARDELTASTARTER
STOPRUN
R
Y
B
N


ACMCB
BULBHOLDER
NO
NC
F
U
S
E
A1
CONTACTOR
A2
R
Y
B
A1
A2

GROUP-B

Experiment-8

DESIGN AND DEVELOPMENT OF PRECISION RECTIFIER.

Precision Rectifier Circuits Rectifier circuits are used in the design of power supply circuits. In such applications, the voltage being rectified is usually much greater than the diode voltage drop, rendering the exact value of the diode drop unimportant to the proper operation of the rectifier. Other applications exist, however, where this is not the case. For example, in instrumentation applications, the signal to be rectified can be of very small amplitude, say 0.1 V, making it impossible to employ the conventional rectifier circuits. Also the need arises for very precise transfer characteristics.

Precision Half-Wave Rectifier- The Super diode There are many applications for precision rectifiers, and most are suitable for use in audio circuits. A half wave precision rectifier is implemented using an op amp, and includes the diode in the feedback loop. This effectively cancels the forward voltage drop of the diode, so very low level signals (well below the diode's forward voltage) can still be rectified with minimal error.

Limitations• The circuit has some serious limitations. The main one is speed. It will not work well with high frequency signals. • For a low frequency positive input signal, 100% negative feedback is applied when the diode conducts. The forward voltage is effectively removed by the feedback, and the inverting input follows the positive half of the input signal almost perfectly.

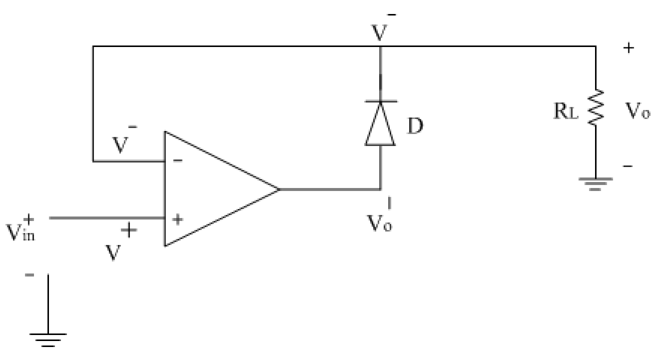
When the input signal becomes negative, the op amp has no feedback at all, so the output pin of the op amp swings negative as far as it can. • When the input signal becomes positive again, the op amp's output voltage will take a finite time to swing back to zero, then to forward bias the diode and produce an output. This time is determined by the op amp's slew rate, and even a very fast op amp will be limited to low frequencies.

Exercise 13.24:Consider the operational amplifier in Figure 13.33(a), with R= 1 kΩ. For v = 10 mV, 1 V, and -1 V, what are the voltages that result at the rectifier output and at the output of the op am? Assume that the op amp is ideal and its output saturates at ±12 V. The diode has a 0.7-V drop at 1-mA current, and the voltage drop changes by 0.1 V per decade of current change

Precision HWR

Saturating type Precision HWR

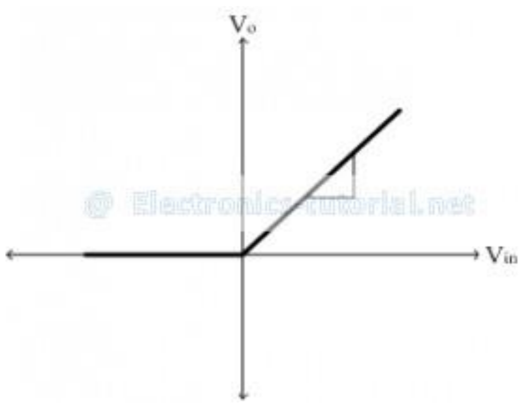
In positive halfc-ycle, output of op-amp is positive so diode D is forward biased.



From the above circuit diagram
V^+=Vin
V^-=Vo
The output of op-amp is given by
Vo^'=A [V^+ – V^-]
Vo^'=A[Vin–Vo] Now
from KVL
Vo^'=VD+Vo
Comparing the above two equations of Vo^'
A[Vin-Vo]=VD+Vo
AVin-AVo=VD+Vo
AVin=VD+Vo+AVo
AVin=VD+Vo(A+1)
AVin=VD+VoA(since..(A+1)≈A)
A[Vin-Vo]=VD
Vin-Vo=VD/A≈0(Since..A is very large)
∴Vin=Vo
In negative half cycle, output of op-amp is negative so diode 'D' is reverse biased.Thus op-amp is in open loop configuration & goes into saturation.In negative half cycle, input voltage magnitude is negative.
∴Vo^'=-Vsat
And output voltage across load is zero
∴Vo=0V
Thus in negative half cycle op-amp goes into negative saturation. This type of rectifier is called Saturating type of precision half wave rectifier.

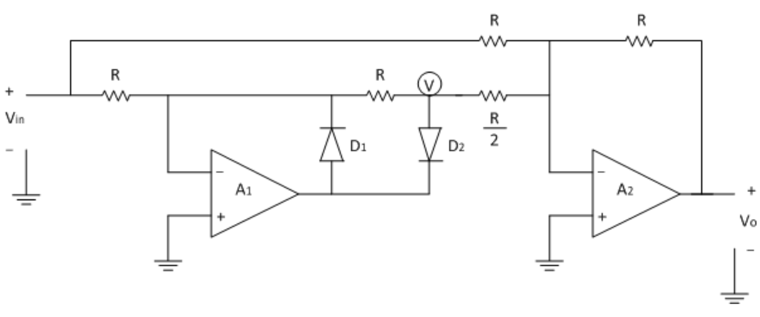
Limitation:

The op-amp takes long time to come out of saturation and to go back in linear range. Time of one cycle depends on the frequency of input signal. If input frequency is very high, the time duration of the negative half cycle is very small.So it is not possible or op-amp to come out of negative saturation. Thus this type of circuit is suitable for low frequency input signals. To overcome this problem, non-saturating type of precision half wave rectifiers are suitable for low as well as high frequency signals. The transfer characteristic of the above rectifier is shown below.



Precision Full Wave Rectifier

In PFWR, for both the half cycles output is produced & in one direction only. The diagram below shows an inverting type of Precision FWR with positive output.Itisalsocalledasabsolutevaluecircuitbecauseoutputsignalswingis only in positive direction. So we get absolute value of input signal.



In positive half cycle of applied ac input signal, output of first op-amp (A1) is Negative. Therefore diode D2 is forward biased & diode D1 is reverse biased.Hereop-ampA1worksasaninvertingamplifierwithgain=(-R/R)=-1

Therefore output of op-amp A1is,V=(-1)Vin=-Vin
Op-ampA2worksasaninvertingadder.Thetwoinputstotheop-ampA2are voltage V(outputofA1)andinputvoltageVin.Thusoutputofop-ampA2i.e. Output voltage is given as ∴Vo=-[R/R Vin+R/(R⁄2) V] ∴Vo=-[Vin+2V] Substituting V=-Vin ∴Vo=Vin

In negative half cycle of applied ac input signal, output of first op-amp (A1)ispositive.ThereforediodeD2isreversedbiased&diodeD1isforward biased. Duetovirtualgroundconceptoutputofop-ampA1iszero.(∴V=0) Thus output of op-amp A2, i.e. Output voltage is given as

∴Vo=-[R/R Vin+R/(R⁄2)V]

∴Vo=-[R/R Vin+R/(R⁄2)(0)]

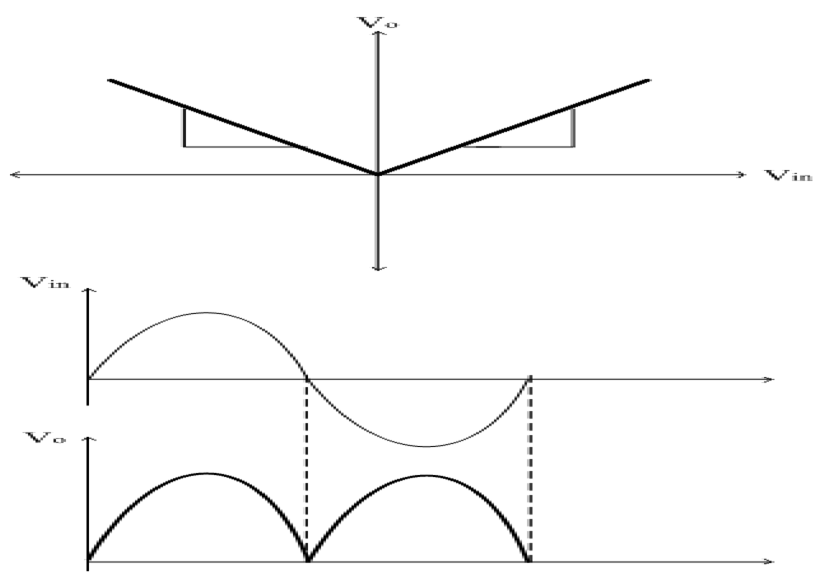
But in negative half cycle input magnitude is negative therefore we get,

∴Vo=-[R/R(-Vin)]

∴Vo=Vin

Thus in both the half cycles output is positive &in one direction &also have same magnitude. Thus it is also called as non-saturating type of PFWR because op-amp A1 is not going in saturation.

The transfer characteristics and input-output waveforms of PFWR are shown below,



b

Experiment-9
DESIGN AND DEVELOPMENT OF SECOND ORDER LOW PASS/HIGH PASS FILTERS WITH AN APPLICATION

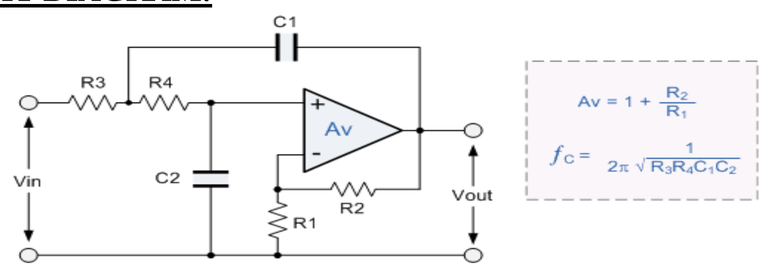
SECOND ORDER ACTIVE LOW PASS FILTER

AIM: To design and development of the Second Order Low Pass Filter.

APPARATUS:

1. Second Order Low Pass Filter Trainer kit.
2.1MHzFunctionGenerator.
3.20MHz C.R.O
4. Digital Millimeter.
5. Connecting Patch chords.

CIRCUIT DIAGRAM:



FILTER DESIGN OF SECOND ORDER LPF:

Gain of the filter= $\frac{VO}{Vin}$

A=1+ $\frac{RF}{R1}$(Pass band gain)

Higher cut–off frequency(fh)= $\frac{1}{2\pi RC}$

Choose a value of high cut – off frequency fH.
Select the C(which is provided on the trainer).
Calculate the R value

R= $\frac{1}{2\pi f_H C}$ Adjust the pot resistance equal to the R-value

PROCEDURE:

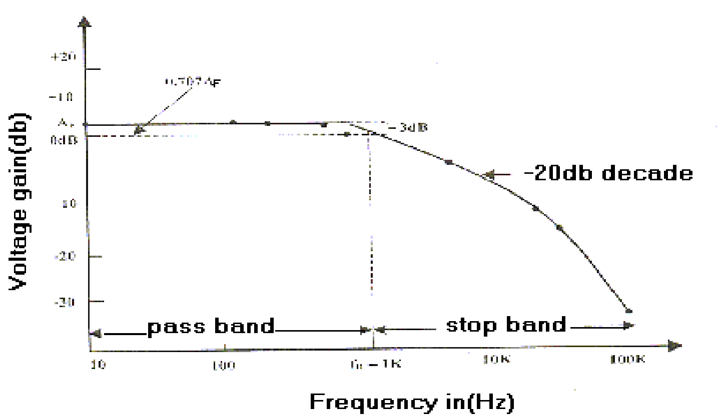
1. Wire the circuit as shown in fig (1) and connect the function generator at the input terminals and C.R.O at the output terminals.
2. Switch ON the trainer and see that the supply LED glows.
3. Now apply the frequencies step by step below the cut –off frequency. And after cut off frequency, record and observe the gain of the filter.
4. Plot the frequency response and compare with Fig(1.a), the frequency response graph of first order Low pass filter.

OBSERVATIONTABLE:

Vin=______

I/P Frequency in Hz	O/P voltage (VO) in volts	Gain= $\frac{VO}{VIN}$	Gain in dB= 20log($\frac{VO}{VIN}$)

Frequency Response:



RESULT: The Second first order LPF is designed for chosen f_H and the frequency response curve is plotted between voltage gain (dB) and frequency (Hz).

9.2. SECOND ORDER ACTIVE HIGH PASS FILTER

AIM: To design and development of second order high pass filter.

APPARATUS:

1. Second order high pass filter trainer kit.
2. 1MHz Signal Generator.
3. 20MHz C.R.O
4. Multimeter.
5. Connecting Patch chords.

CIRCUITDIAGRAM:

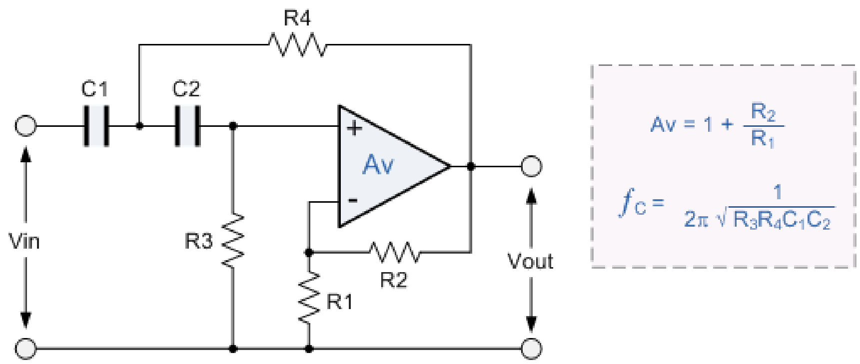


Fig (1)

FILTER DESIGN:

Gain of the filter= $\frac{VO}{Vin}$

AF=1+ $\frac{RF}{R1}$(Pass band gain)

Lower cut–off frequency(f_L)=1/2π

Choose a value of low cut–off frequency f_L.

Select the C (which is provided on the trainer),note the value of capacitor.

Calculate the R-value

R= $\frac{1}{2\square fLC}$

Finally, select R_1 and R_f depending on the desired pass band gain (A_f).

PROCEDURE:

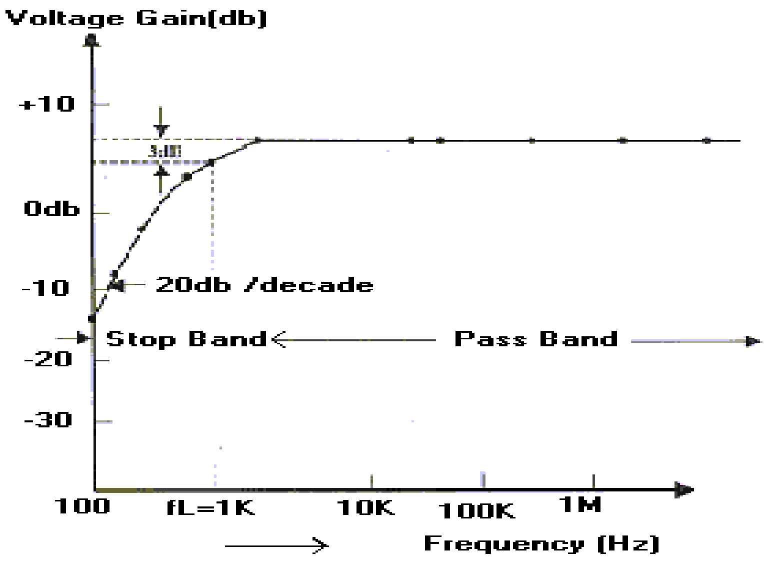
1. Wire the circuit as shown in fig(1)and connect the function generator at the input terminals and C.R.O at the output terminals.
2. Switch ON the trainer and see that the supply LED glows.
3. Now apply the frequencies step by step upto the lower cut–off frequency. Observe and record the output and input voltages and calculate the gain.
4. Plot the frequency response of the filter and compare with Fig(2),the frequency response graph of second t order High pass filter.

OBSERVATIONTABLE:

Vin=

I/P Frequency in Hz	O/P voltage(V_O) in volts	Gain=$\frac{VO}{VIN}$	Gain in dB= 20log($\frac{VO}{VIN}$)

Frequency Response:



RESULT: The second order HPF is designed for chosen f_L and the frequency response curve is plotted between voltage gain (dB) and frequency (Hz).

Experiment-10
PEAK DETECTOR USING OP-AMPLIFIERS.

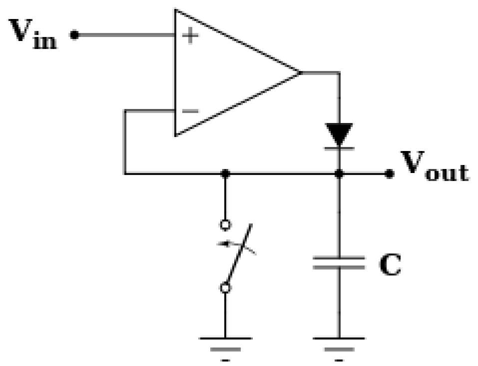
Op-amp peak detector

Definition

Peak detector detects and holds the most positive value of attained by the input signal prior to the time when the switch is closed.

Working of Op-amp peak detector

The op-amp peak detector is as shown below



Op-amp Peak Detector

The operation can be explained as follows assume the switch is open and if

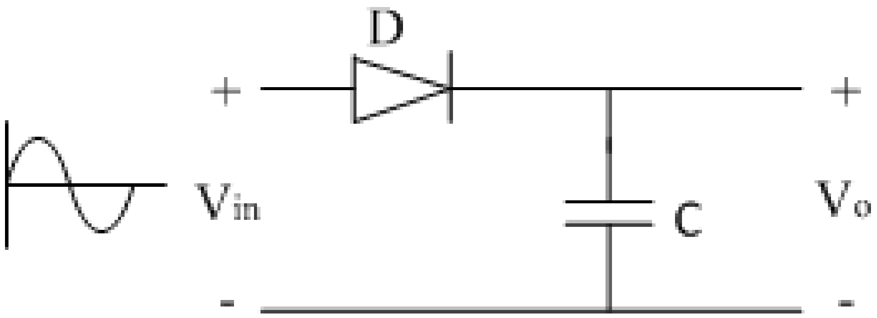
a) Vout < Vinthe op amp output V' is positive so that the diode conducts and the capacitor charges to the input value at that instant as it forms a voltage follower circuit.

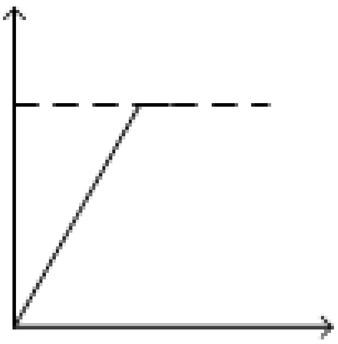
b) When out>Vin,op-amp output V'is negative and the diode becomes reverse biased.

Thus the capacitor charges to the most positive value of input.

Peak Detector:

Rectifier circuit gives average value of input signal; but in practice we need peak value of input signal.This is achieved by peak detector circuit.The following figure shows a simple peak detector circuit using diode and capacitor.

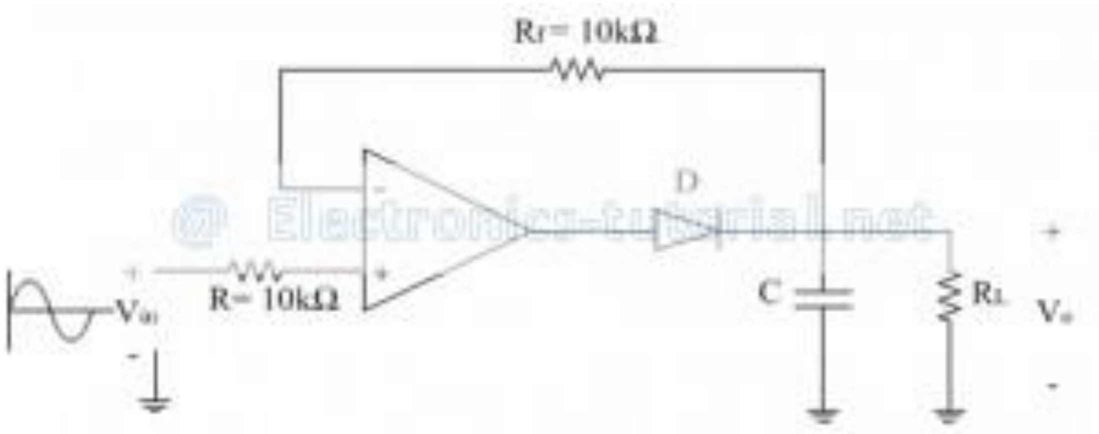




In the positive half cycle, diode D is forward biased and capacitor C starts charging. When input reaches its peak value capacitor gets charged to positive peak value. In negative half cycle, as input decreases, diode D is reversed biased and capacitor is isolated and holds the peak value of previous cycle.Hence called as peak detector.But in practice, output is taken across some load RL, so when input voltage decreases capacitor discharges through load RL. To avoid this select RL of very large value so that capacitor discharges very slowly hence almost holds the charge. Whatever charge it lost through RL is gets back in next half cycle.

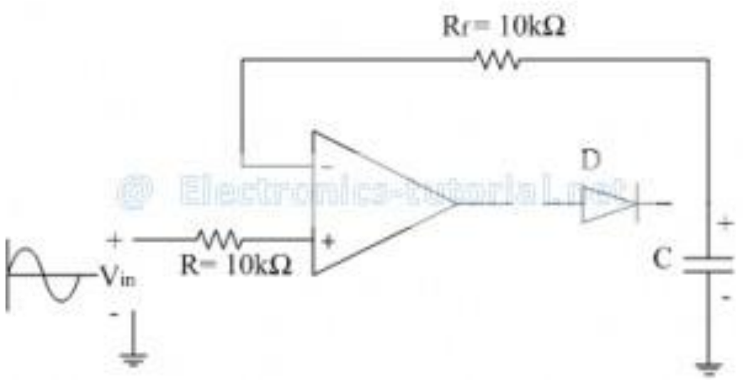
Limitation:

The diode D is acting as an instant switch, so supply gets loaded.
To avoid the loading while charging capacitor, we use op-amp as follows. Op-amp is placed between input and diode D so loading is avoided as shown in circuit diagram below,

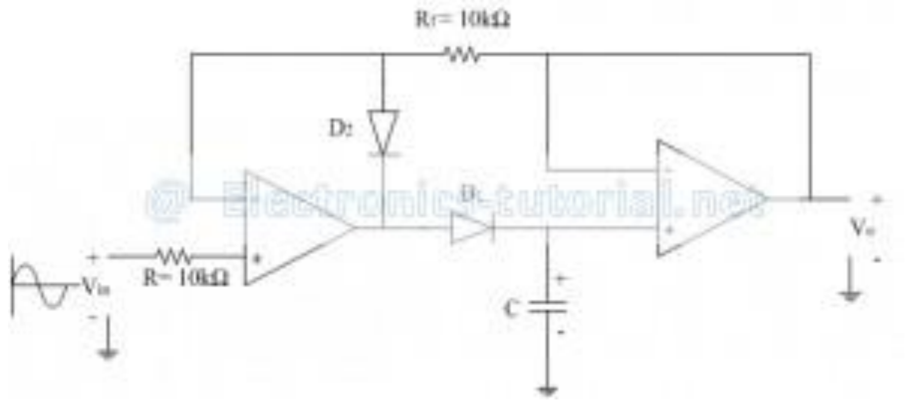


Inpositivehalfcycle,outputofop-ampispositivesodiodeDisforwardbiased, capacitor charges to peak value of input signal.
In negative half cycle, when input decreases diode D is reversed biased and capacitor is isolatedandholdsthechargeofprevioushalfcycle.Sincediodeisreversedbiased,op-amp is in open loop condition and goes into saturation. Capacitor starts discharging through RL. Let peak value of input is Vin peak = 10 V.

In the positive half cycle the capacitor holds the positive peak value i.e. +10V. In the negative half cycle negative peak input is Vinpeak = -10V. Due to negative output diodeDisreversebiasedandactsasopencircuitisolatingop-ampoutputandcapacitorC. Capacitor C has a charge of +10V from previous positive half cycle. This voltage is appeared to be as input to inverting terminal of op-amp.



Therefore differential input (Vid)t o op-amp is, Vid=-10-10=-20V=2×V(in peak)
For every op-amp there is a limit for maximum differential input voltage Vid.So care must be taken while selecting op-amp.
The load resistance RL is not possible to have a very large value always, so we use another op-amp as follows,



Here second op-amp acts as a voltage follower. Its input impedance is very high so capacitor discharges very slowly i.e. capacitor almost holding the charge. Therefore output voltageisnothingbutvoltageacrosscapacitor(Peakvalueofinputsignal). Vout =Voltage across capacitor,Vc As output impedance of voltage follower is very small we can connect any value of RL.

Experiment-10.1

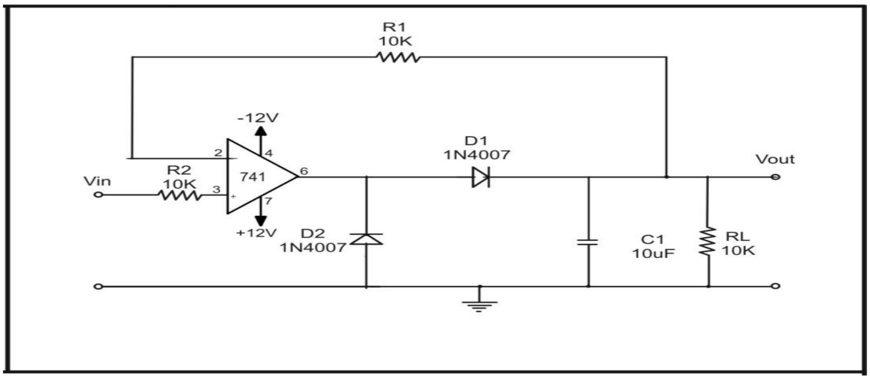
Objective: The study of the Positive Peak detector

Equipments Needed:

1. Analog board,
2. DC Power Supply±12V-12vInternalConnected
3. Function Generator
4. Oscilloscope
5. 2mm Patch Cords.

Circuit diagram:

Circuit used to study the positive peak detector is given below:



Figure

Procedure:

1. Connect patch chords between socket ‘a’&‘b’ and between socket‘d’&‘f’.
2. Switch on the Power Supply.
3. Apply 1KHz square wave signal at the input (between points $V_{IN}$and ground) of peak detector of board and observe same on the oscilloscope CH 1.
4. Observe the output between socket V_{OUT}andgroundonoscilloscopeCH2.
5. Vary the amplitude of square wave input signalfrom1V to8V positive peak and note the readings of input and output amplitude on oscilloscope.

Observation table:

S.No.	Input positive peak voltage V_{IN} (Vp)	Output voltage V_{OUT}

Conclusion:

We can see that using positive peak detector we detect the positive peak of non- sinusoidal waveform.

Experiment:10.2

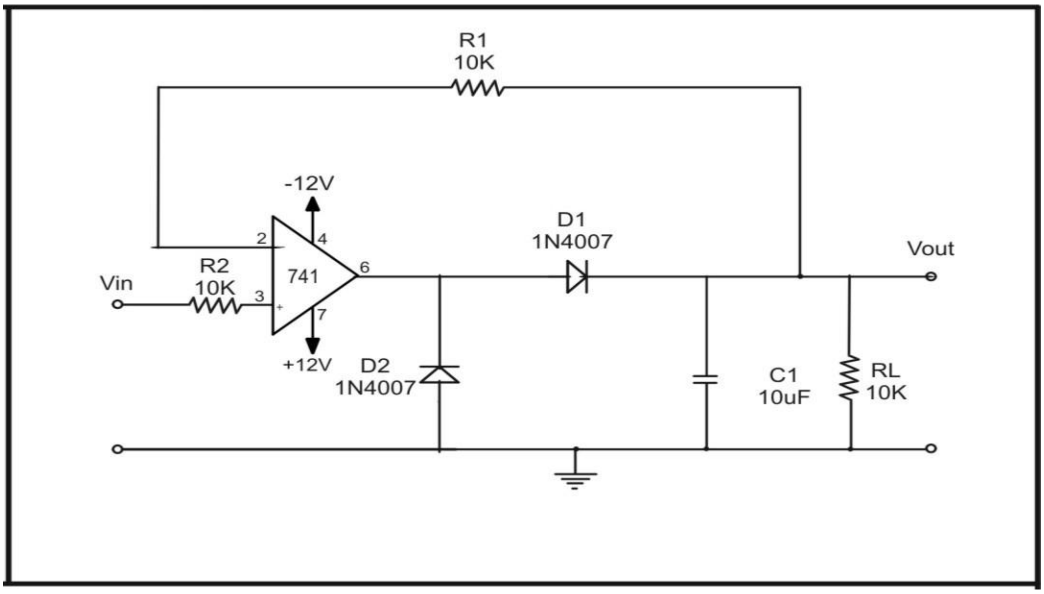
Objective: Study of negative peak detector

Apparatus required :

1. Analog board,
2. DC Power Supply +12V/-12V Internal Connected
3. Function Generator.
4. Oscilloscope.
5. 2mmPatchCords.

Circuit diagram:

Circuit used to study the negative peak detector is given below:



Procedure:

1. Switch 'On' the Power Supply.
2. Connect patch chords between socket'a'&'c'and between socket'e'&'f'.
3. Switch on the Power Supply.
4. Apply 1KHz square wave signal at the input(between points VIN and ground)of peak detector of board and observe same on the oscilloscope CH I.
5. Observe the output between socket VOUT and ground on oscilloscope CHII.
6. Varytheamplitudeofsquarewaveinputsignalfrom1Vto8Vnegativepeak and note the readings of input and output amplitude on oscilloscope.

Observation table:-

S.No.	Input negative peak voltage $V_{IN}(V_p)$	Output Voltage V_{OUT}

Conclusion:

We can see that using negative peak detector we detect the negative peak of non- sinusoidal waveform.

EXPERIMENT-11

ZERO CROSSING DETECTOR USING OP-AMPLIFIERS

Introduction

Zero crossing detectors as a group are not a well-understood application, although they are essential elements in a wide range of products. It has probably escaped the notice of readers who have looked at the lighting controller and the Link witz Cosine Burst Generator, but both of the surely on a zero crossing detector for their operation.

A zero crossing detector literally detects the transition of a signal waveform from positive and negative, ideally providing a narrow pulse that coincides exactly with the zero voltage condition. At first glance, this would appear to be an easy enough task, but in fact it is quite complex, especially where high frequencies are involved. In this instance, even 1kHz starts to present a real challenge if extreme accuracy is needed.

The not so humble comparator plays a vital role - without it, most precision zero crossing detectors would not work, and we'd be without digital audio, PWM and a multitude of other applications taken for granted.

Comparators

The comparator used for a high speed zero crossing detector, a PWM converter or conventional ADC is critical. Low propagation delay and extremely fast operation are not only desirable, they are essential.

Comparators may be the most underrated and underutilized monolithic linear component. This is unfortunate because comparators are one of the most flexible and universally applicable components available. In large measure the lack of recognition is due to the IC op-amp, whose versatility allows it to dominate the analog design world. Comparators are frequently perceived as devices that crudely express analog signals in digital form - a 1-bit A/D converter. Strictly speaking, this viewpoint is correct. It is also wastefully constrictive in its outlook. Comparators don't "just compare" in the same way that op-amps don't "just amplify". [2]

The above quote was so perfect that I just had to include it. Comparators are indeed underrated as a building block, and they have two chief requirements ... low input offset and speed. For the application at hand (a zero crossing detector), both of these factors will determine the final accuracy of the circuit. The XOR has been demonstrated to give a precise and repeatable pulse, bits accuracy depends upon the exact time it 'sees' the transition of the AC waveform across zero. This task belongs to the comparator.

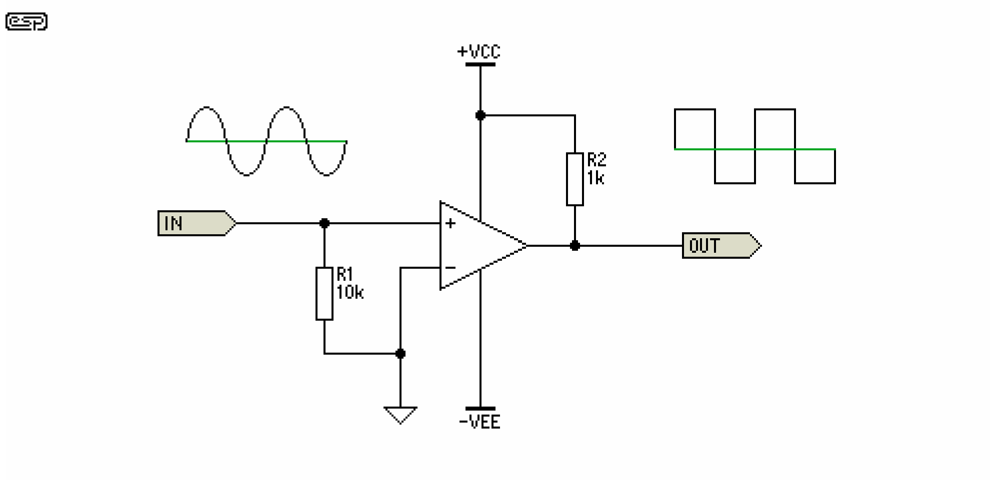


Figure3-Comparator Zero Crossing Detector

In Figure 3 we see a typical comparator used for this application. The output is a square wave, which is then sent to a circuit such as that in Figure 2. This will create a single pulse for each square wave transition, and this equates to the zero crossings of the input signal. It is assumed for this application that the input waveform is referenced to zero volts, so swings equally above and below zero.

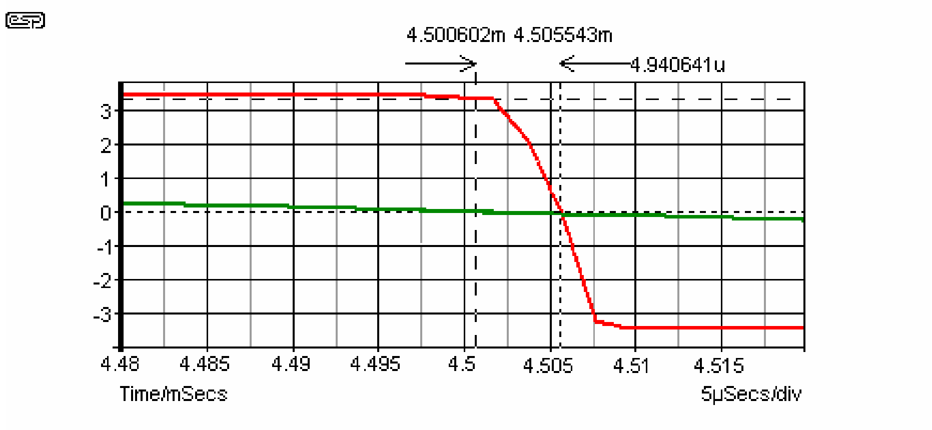


Figure4-ComparatorTiming Error

Figure 4 shows how the comparator can mess with our signal, causing the transition to be displaced in time, thereby causing an error. The significance of the error depends entirely on our expectations - there is no point trying to get an error of less than 10ns for a dimmer, for example.

TheLM339 comparator that was used for the simulation is a very basic type indeed, and with a quoted response time of 300ns it is much too slow to be usable in this application. This is made a great deal worse by the propagation delay, which (as simulated) is 1.5us. In general, the lower the power dissipation of a comparator, the slower it will be, although modern IC techniques have overcome this to some extent.

You can see that the zero crossing of the sine wave (shown in green) occurs well before the output (red) transition - the cursor positions are set for the exact zero crossing of each signal.

the output changes - in this case, about 5us for the total 7V peak to peak swing. That gives us a slew rate of 1.4V/us which is useless for anything above 100Hz or so.

One of the critical factors with the comparator is its supply voltage. Ideally, this should be as low as possible, typically with no more than ±5V. The higher the supply voltage, the further the output voltage has to swing to get from maximum negative to maximum positive and vice versa. While a slew rate of 100V/us may seem high, that is much too slow for an accurate ADC, pulse width modulator or zero crossing detector.

At 100V/us and a total supply voltage of 10V (±5V), it will take 0.1us (100ns) for the output to swing from one extreme to the other. To get that into the realm of what we need, the slew rate would need to be 1kV/us, giving a 10ns transition time. Working from Figure 3, you can see that even then there is an additional timing error of 5ns - not large, and in reality probably as good as we can expect.

The problem is that the output doesn't even *start* to change until the input voltage passes through the reference point (usually ground). If there is any delay caused by slew rate limiting, by the time the output voltage passes through zero volts, it is already many nanoseconds late. Extremely high slew rates are possible, and Reference 2 has details of a comparator that is faster than a TTL inverter! Very careful board layout and attention to bypassing is essential at such speeds, or the performance will be worse than woeful.

Basic Low Frequency Circuit

Figure1showsthezerocrossingdetectorasusedforthedimmerrampgeneratorinProject 62. This circuit has been around (almost) forever, and it does work reasonably well. Although it has almost zero phase inaccuracy, that is largely because the pulse is so broad that any inaccuracy is completely swamped. The comparator function is handled by transistorQ1 -very basic, but adequate for the job.

The circuit is also sensitive to level, and for acceptable performance the AC waveform needs to be of reasonably high amplitude. 12-15V AC is typical. If the voltage is too low, the pulse width will increase. The arrangement shown actually gives better performance than the version shown in Project 62 and elsewhere on the Net. In case you were wondering, R1 is there to ensure that the voltage falls to zero - stray capacitance is sufficient to stop the circuit from working without it.

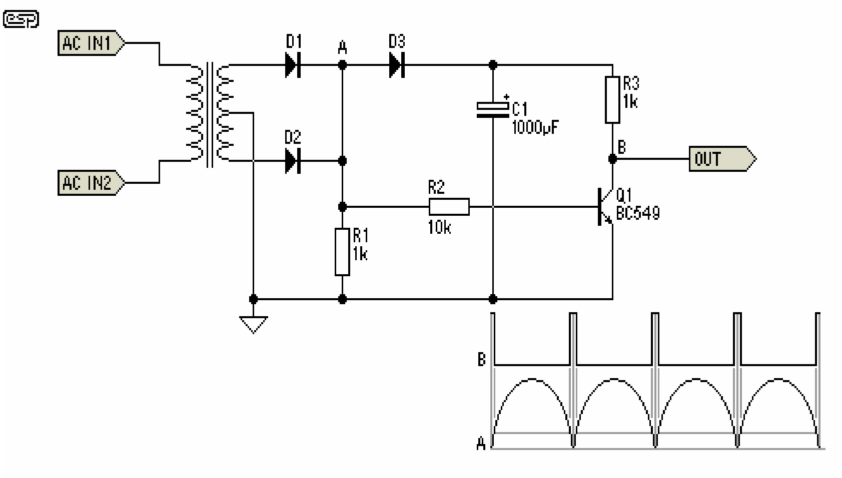


Figure1-Basic 50/60Hz Zero Crossing Detector

The pulse width of this circuit (at 50Hz) is typically around 600us (0.6ms) which sounds fast enough. The problem is that at 50Hz each half cycle takes only 10ms (8.33ms at 60Hz), so the pulse width is over5%of the total period. This is why most dimmers can only claim arangeof10%-90%- the zero crossing pulse lasts too long to allow more range.

While this is not a problem with the average dimmer, it is not acceptable for precision applications. For a tone burst generator (either the cosine burst or a 'conventional' tone burst generator), any inaccuracy will cause the switched waveform to contain glitches. The seriousness of this depends on the application.

Precision zero crossing detectors come in a fairly wide range of topologies, some interesting, others not. One of the most common is shown in Project 58, and is commonly used for this application. The exclusive OR (or XOR) gate makes an excellent edge detector, as shown in Figure2.

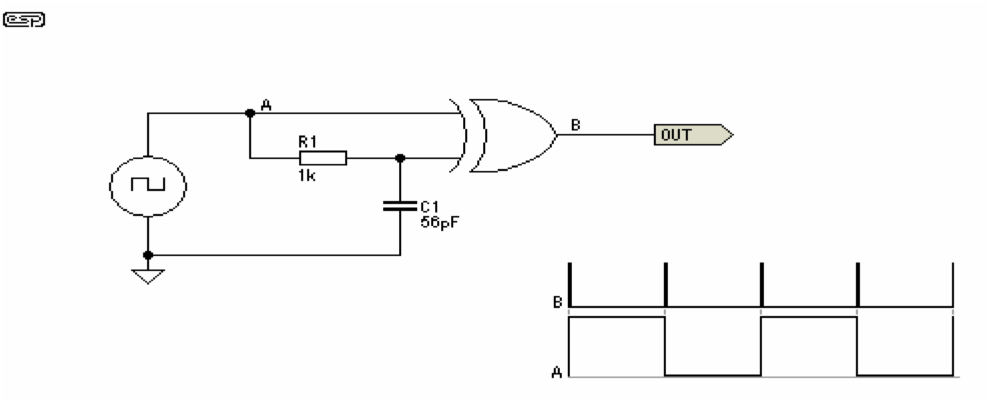


Figure2-ExclusiveORGateEdgeDetector

There is no doubt that the circuit shown above is more than capable of excellent results up to quite respectable frequencies. The upper frequency is limited only by the speed of the device used, and with a 74HC86 it has a propagation delay of only 11ns [1], so operation at 100kHz or above is achievable.

The XOR gate is a special case in logic. It will output a 1 only when the inputs are different (i.e. one input must be at logic high (1) and the other at logic low (0v). The resistor and cap form a delay so that when an edge is presented (either rising or falling), the delayed input holds its previous value for a short time. In the example shown, the pulse width is 50ns. The signal is delayed by the propagation time of the device itself (around 11ns), so a small phase error has been introduced. The rise and fall time of the square wave signal applied was 50ns, and this adds some more phase shift.

There is a pattern emerging in this article - the biggest limitation is speed, even for relatively slow signals. While digital logic can operate at very high speeds, we have well reached the point where the signals can no longer be referred to as '1' and '0' - digital signals are back into the analogue domain, specifically RF technology.

application), extreme speed is needed for accurate digitisation of an analogue signal. It may not appear so at first glance, but a zero crossing detector is a special purpose analogue to digital converter (ADC).

Using A Differential Line Receiver

This version is contributed by John Rowland [3]and is a very clever use of an existing IC for a completely new purpose. The DS3486 is a quad RS-422/ RS-423 differential line receiver. Although it only operates from a single 5V supply, the IC can accept an input signal of up to ±25V without damage. It is also fairly fast, with a typical quoted propagation time of 19ns and internal hysteresis of 140mV.

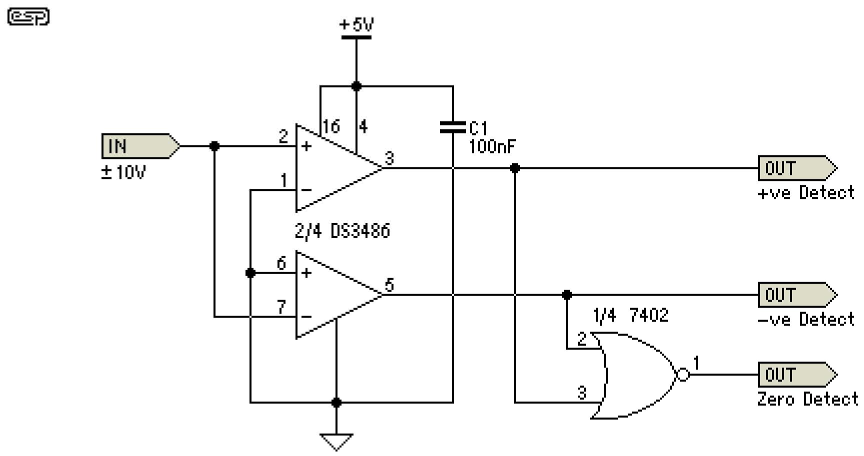
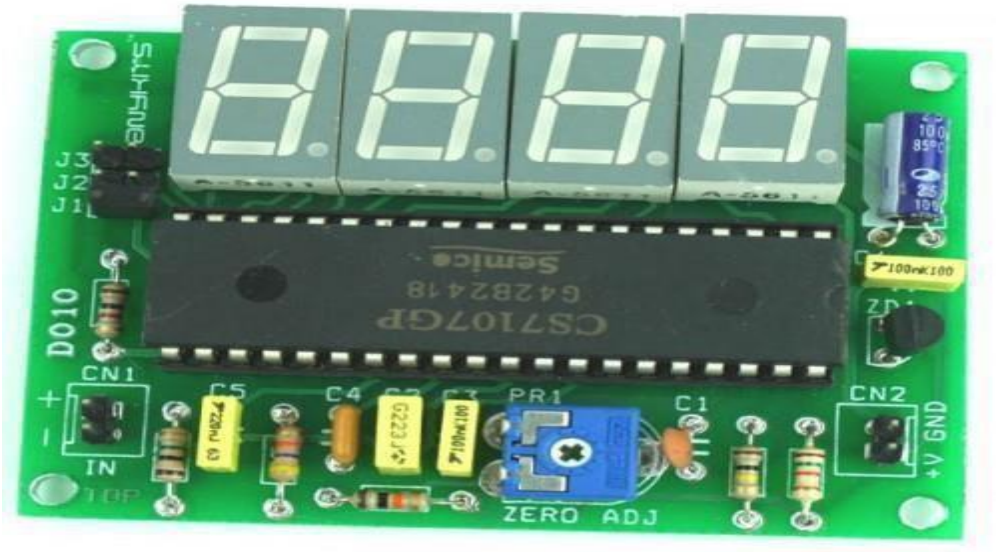
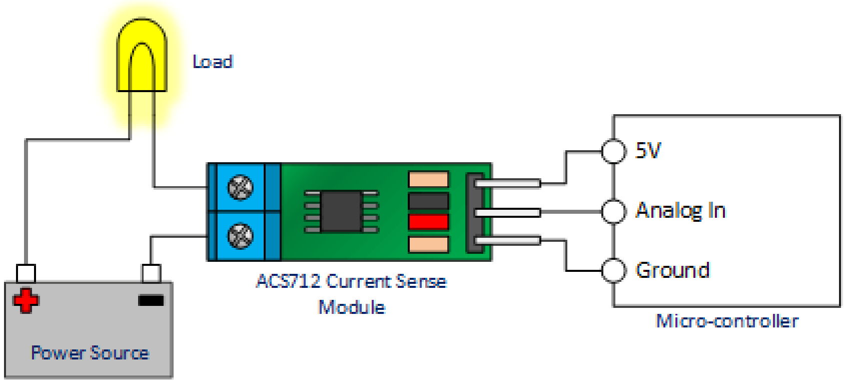


Figure5-Basic Zero Crossing Detector UsingDS3486

The general scheme is shown in Figure 5. Two of the comparators in the IC are used - one detects when the input voltage is positive and the other detects negative (with respect to earth/ ground). The NOR gate can only produce an output during the brief period when both comparator outputs are low (i.e. close to earth potential). However, tests show that the two differential receiver channels do not switch at exactly 0.00V.

With a typical DS3486 device, the positive detector switches at about 0.015V and the negative detector switches at approximately -0.010V. This results in an asymmetrical dead band of 25mV around 0V. Adding resistors as shown in Figure 6 allows the dead band to be made smaller, and (perhaps more importantly for some applications), it can be made to be symmetrical.





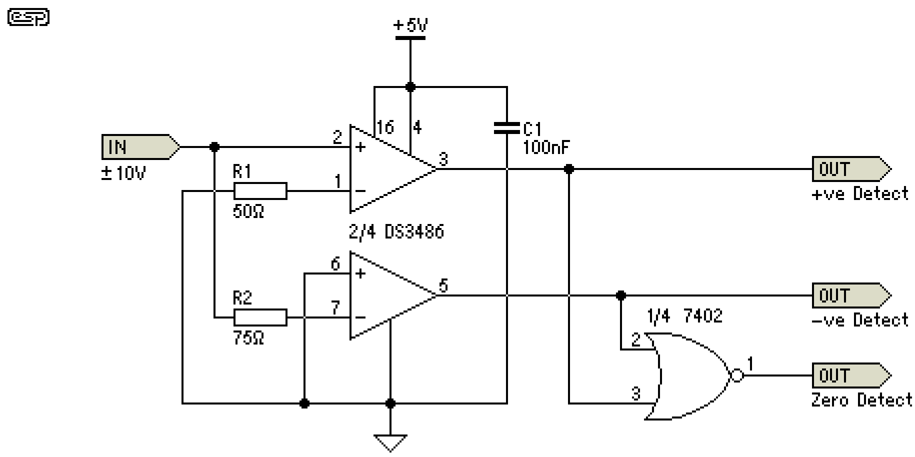


Figure6-Modified Zero Crossing Detector To Obtain True 0V Detection

Although fixed resistors are shown, it will generally be necessary to use pots. This allows for the variations between individual comparators - even within the same package. This is necessary because the DS3486 is only specified to switch with voltages no greater than ±200mV. The typical voltage is specified to be 70mV (exactly half the hysteresis voltage), but this is *not* a guaranteed parameter.

Indeed, John Rowland (the original designer of the circuit) told me that only the National Semiconductor devices actually worked in the circuit - supposedly identical ICs from other manufacturers refused to function. I quote ...

We did some testing with "equivalent" parts made by other manufacturers, and found very different behavior in the near-zero region. Some parts have lots of hysteresis, some have none, detection thresholds vary from device to device, and in fact even in a quad part like the DS3486 they are different from channel to channel within the same package. Eventually we settled on the National DS3486 with some added resistors on its input pins as shown in Figure 6. Themost recent version of the circuit uses trim pots, 100 ohm on the positive detector and 200 ohm on the negative detector. These values allow us to trim almost everyDS3486tobalance the noise threshold in the+/-5mVto
+/-15mV range. Occasionally we do get a DS3486 which will not detect in this range. Sometimes,we find that both the positive and negative detectors are tripping on the same side (polarity) of zero, if so we pull that chip and replace it.

The additional resistors allow the detection thresholds to be adjusted to balance the detection region around 0V. The resistor from pin 1 to earth makes the positive detector threshold more positive. The resistor from the input to pin 7 forces the negative detector threshold to become more negative. Typical values are shown for ±25mV detection using National's DS3486 parts. In reality, trim pots are essential to provide in-circuit adjustment.

EXPERIMENT-12
MICROCONTROLLER INTERFACE CIRCUIT FOR TEMPERATURE/CURRENT/VOLTAGE MEASUREMENT

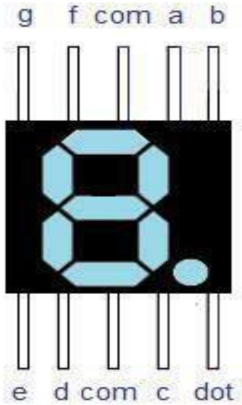
AIM: To design the Micro-controller interface circuit for voltage, Current &temp .measurement.

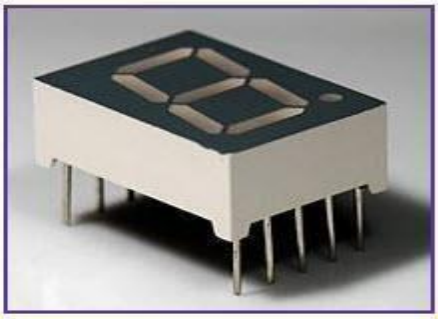
APPARATUS:

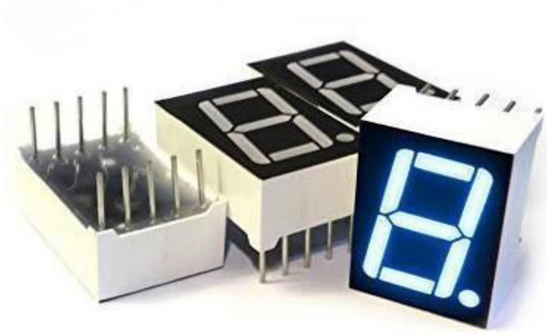
Sl.No	APPARATUS	TYPE	QUANTITY
01	Voltmeter (200mV DC)	Digital	01
02	Experimental board	Trainer kit	01
03	RPS(0-30V,2A)	Dual channel	01
04	Temp.Sensor(Temp.)	thermocouple	01
05	Connecting wires	Banana plug type	As required

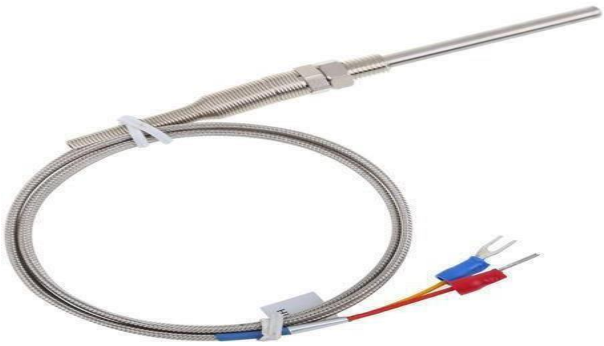
THEORY:


IC 7107


g f com a b
e d com c dot

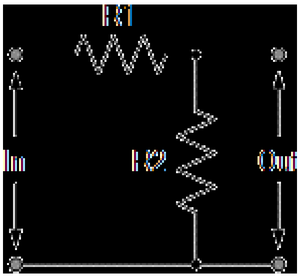






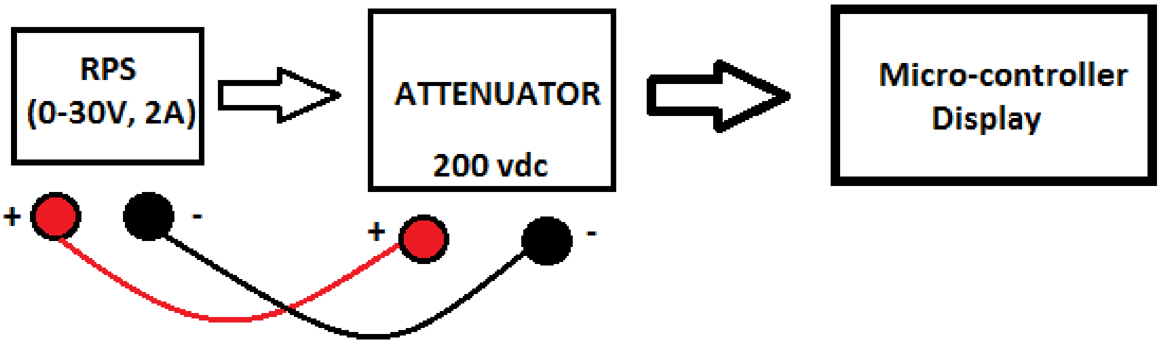
CIRCUITDIAGRAM:

a) Micro-controller interface circuit for Voltage measurement:



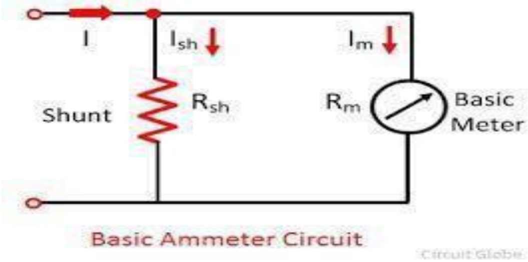
ATTENUATOR CIRCUIT

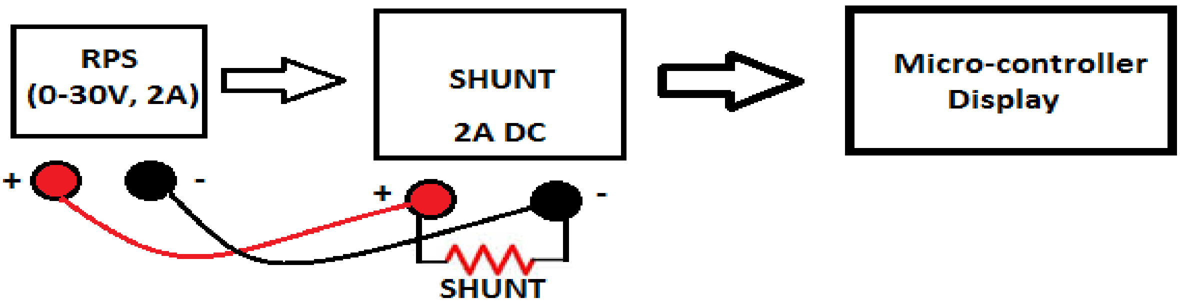
PROCEDURE:



1. Connect the Circuit as per the circuit diagram as shown above.
2. Apply the DC Voltage from RPS output terminals (0-30V).
3. Note down the Digital Meter reading in steps wise (5, 10,15Vupto30Volts).
4. Observe the Micro-controller operation.
5. We have interfaced Micro-controller circuit for voltage measurement.

b) Micro-controller interface circuit for Current measurement:

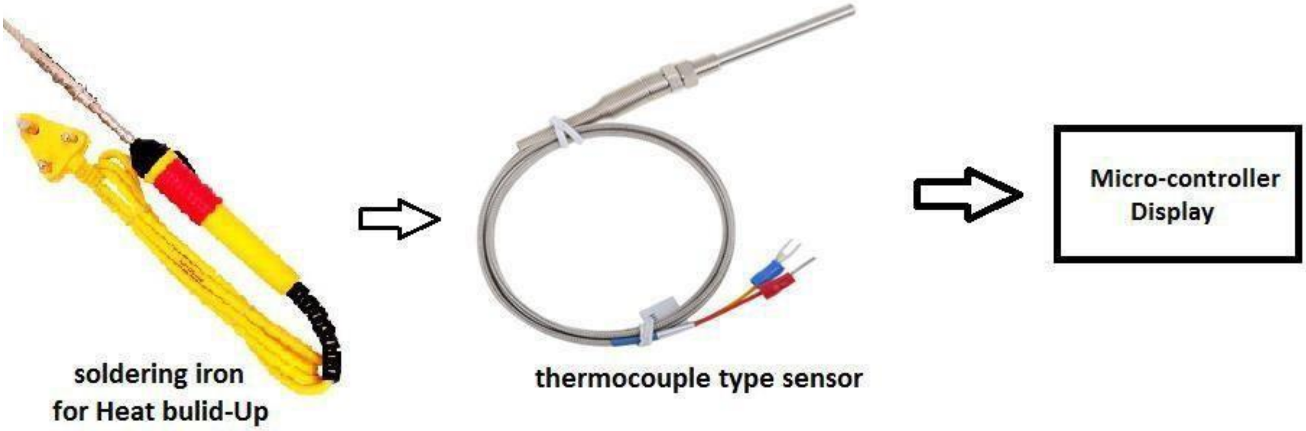




PROCEDURE:

1. Connect the Circuit as per the circuit diagram as shown above.
2. Apply the DC Current from RPS output terminals (0-2A).
3. Note down the Digital Meter reading in steps wise (200milliAmps).
4. Observe the Micro-controller operation.
5. We have interfaced Micro-controller circuit for Current measurement

c) Micro-controller interface circuit for Temperature measurement:



PROCEDURE:

1. Connect the Circuit as per the circuit diagram as shown above.
2. For Temperature Build-Up in the circuit connect Soldering rod iron.
3. Apply this developed heat to the thermocouple(0-200°C).
4. Observe the Micro-controller operation.
5. Note down the milli–volts(mV) developed in the digital meter.
6. Compare these milli-volts(mV) with the thermocouple sensor (Temp.Degrees/mVchart).
7. We have interfaced Micro-controller circuit for Temp.Measurement.

°C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10
					Thermoelectric Voltage in mV						
0	0.000	0.050	0.101	0.151	0.202	0.253	0.303	0.354	0.405	0.456	0.507
10	0.507	0.558	0.609	0.660	0.711	0.762	0.814	0.865	0.916	0.968	1.019
20	1.019	1.071	1.122	1.174	1.226	1.277	1.329	1.381	1.433	1.485	1.537
30	1.537	1.589	1.641	1.693	1.745	1.797	1.849	1.902	1.954	2.006	2.059
40	2.059	2.111	2.164	2.216	2.269	2.322	2.374	2.427	2.480	2.532	2.585
50	2.585	2.638	2.691	2.744	2.797	2.850	2.903	2.956	3.009	3.062	3.116
60	3.116	3.169	3.222	3.275	3.329	3.382	3.436	3.489	3.543	3.596	3.650
70	3.650	3.703	3.757	3.810	3.864	3.918	3.971	4.025	4.079	4.133	4.187
80	4.187	4.240	4.294	4.348	4.402	4.456	4.510	4.564	4.618	4.672	4.726
90	4.726	4.781	4.835	4.889	4.943	4.997	5.052	5.106	5.160	5.215	5.269
100	5.269	5.323	5.378	5.432	5.487	5.541	5.595	5.650	5.705	5.759	5.814
110	5.814	5.868	5.923	5.977	6.032	6.087	6.141	6.196	6.251	6.306	6.360
120	6.360	6.415	6.470	6.525	6.579	6.634	6.689	6.744	6.799	6.854	6.909
130	6.909	6.964	7.019	7.074	7.129	7.184	7.239	7.294	7.349	7.404	7.459
140	7.459	7.514	7.569	7.624	7.679	7.734	7.789	7.844	7.900	7.955	8.010
150	8.010	8.065	8.120	8.175	8.231	8.286	8.341	8.396	8.452	8.507	8.562
160	8.562	8.618	8.673	8.728	8.783	8.839	8.894	8.949	9.005	9.060	9.115
170	9.115	9.171	9.226	9.282	9.337	9.392	9.448	9.503	9.559	9.614	9.669
180	9.669	9.725	9.780	9.836	9.891	9.947	10.002	10.057	10.113	10.168	10.224
190	10.224	10.279	10.335	10.390	10.446	10.501	10.557	10.612	10.668	10.723	10.779
200	10.779	10.834	10.890	10.945	11.001	11.056	11.112	11.167	11.223	11.278	11.334
210	11.334	11.389	11.445	11.501	11.556	11.612	11.667	11.723	11.778	11.834	11.889
220	11.889	11.945	12.000	12.056	12.111	12.167	12.222	12.278	12.334	12.389	12.445
230	12.445	12.500	12.556	12.611	12.667	12.722	12.778	12.833	12.889	12.944	13.000
240	13.000	13.056	13.111	13.167	13.222	13.278	13.333	13.389	13.444	13.500	13.555
250	13.555	13.611	13.666	13.722	13.777	13.833	13.888	13.944	13.999	14.055	14.110
260	14.110	14.166	14.221	14.277	14.332	14.388	14.443	14.499	14.554	14.609	14.665
270	14.665	14.720	14.776	14.831	14.887	14.942	14.998	15.053	15.109	15.164	15.219
280	15.219	15.275	15.330	15.386	15.441	15.496	15.552	15.607	15.663	15.718	15.773
290	15.773	15.829	15.884	15.940	15.995	16.050	16.106	16.161	16.216	16.272	16.327
300	16.327	16.383	16.438	16.493	16.549	16.604	16.659	16.715	16.770	16.825	16.881
310	16.881	16.936	16.991	17.046	17.102	17.157	17.212	17.268	17.323	17.378	17.434
320	17.434	17.489	17.544	17.599	17.655	17.710	17.765	17.820	17.876	17.931	17.986
330	17.986	18.041	18.097	18.152	18.207	18.262	18.318	18.373	18.428	18.483	18.538
340	18.538	18.594	18.649	18.704	18.759	18.814	18.870	18.925	18.980	19.035	19.090
°C	0	1	2	3	4	5	6	7	8	9	10

RESULT: Design the Micro-controller interface circuit for voltage, Current &temp .measurement is calculated.

EXPERIMENT-13
DESIGN AND DEVOLOPMENT OF +5V SUPPLY

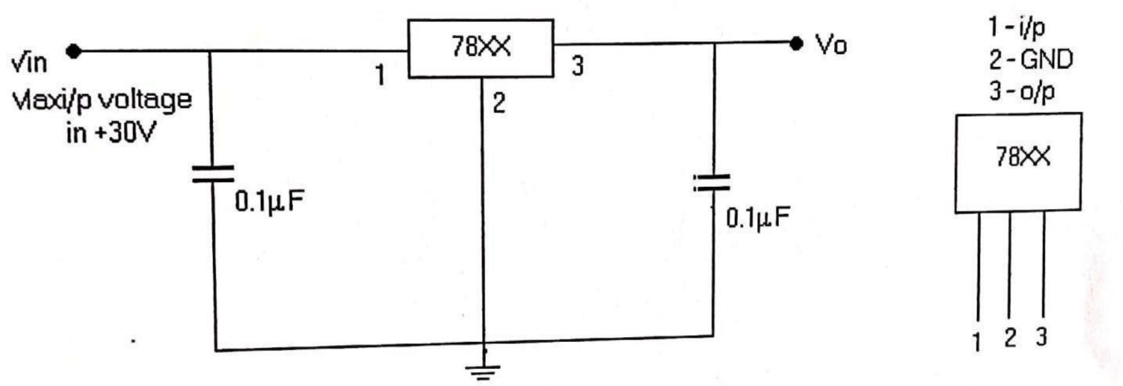
AIM:-

1) To construct and study the 3-terminal fixed voltage regulator using IC7805
2) To find line regulation and load regulation of the IC regulator.

APPARATUS: MultiMate

CIRCUITDIAGRAM:

I. 7805 fixed '+ ve' voltage regulator:



PROCEDURE:

1. Make connections of fig(1.a)on breadboard.
2. Connect input to Power supply and output to digital multimeter.
3. Apply input voltage of 7Vto input and note down output voltage.
4. Vary input voltage from 7V to20V and record the output voltages.
5. Connect fig(1.b) and repeat steps(2)to(4).6.Calculatelineregulationof IC' s used.

Observation Table

Vin	Vout

Vin	Vout

Vin	Vout

EXPERIMENT NO: 14
PCB DESIGN AND LAYOUT.

AIM: Development of PCB in hardware lab.

APPARATUS:

1) PCB art work

ACCESORIES:

1) Tray
2) Brush
3) PCB Laminate

THEORY:

The development of the PCB involves following steps.

1) PCB printing using screen printing
2) Etching of the PCB
3) Drilling of PCB.
4) Coating of etched PCB to protect it from oxidation.

PCB printing using screen printing:

Screen printing techniques actually the process that patterns the metal conductor to form the circuit. This PCB fabrication process involves a multistep integration of imaging materials, imaging equipment, and processing conditions with the metallization process to reduce the master pattern on a substrate.Screenprintingisconsideredasthemostversatileofallprinting processes as it can be done on wide variety of substrates of any shape, thickness and size.

The screen printing process is simple, and a wide variety of inks and dyes are available for use in screen printing than for use in any other printing process.

Drilling of PCB:

After etching of the PCB the next step is to drill the PCB for the interconnection of the various components on the PCB. The drill hole is having a diameter of generally one mm but the resistancesometimesrequire1.5mmdiameter.The drilling of the PCB is very important in terms of the working of the PCB hence the drilling is done by drilling machine of large precision and accuracy.

Coating of etched PCB to protect it from oxidation:

Since the upper layer of the PCB is a copper clad material which gets oxidised when comes in contactwiththeenvironmentthataffectstheperformanceofthePCB.Hence the copper layer is coated with the laminates that are basically an insulator, to protect the Etched PCB to get oxidized.

PROCEDURE:

1. Take50ml water in a beak errand add 3 gm of sensitizer powder to it.
2. Add 50ml water to sensitizer solution to make100 ml solution.
3. CuttheLightSensitivefilmasperthesizeofPCBlayout.ArrangethefilmandonPCB screen Printing Unit.
4. Coat the Light Sensitive film on the screen with the Squeeze and dry the screen in the curing machine for 5 minutes. Remove the plastic paper from film and dry it again for 5 minutes.
5. Take the print of PCB layout on the plotting paper and place it on UVexposure such that solder side is in contact with glass.
6. Place screen then Rubber sheet and then weight.
7. Developthescreenbysprayingwaterfrom1feetanddrythescreenfor15minutesinthe open air.
8. Mount the Screen with the help of clamp on PCB Screen.
9. Place PCB Laminate to print and pourt he ink inside the screen.
10. Pour7ltrwaterinthe tankandadd2kg Ferric Chloride and stirit.
11. Mount the PCB on the clamp of Dipping Arrangement and dip the PCB

CONCLUSION: Thus we have developed the PCB in the hardware Lab.

QUIZ QUESTIONS & ANSWERS

What's role Tin a play in Integrated PCB design?

Ans. The new fully integrated layout module of TINA has all the features you need for advanced PCB design, including multilayer PCB's with split power plane layers, powerful auto placement & auto routing, rip-up and reroute, manual and "follow-me" trace placement, DRC, forward and back annotation, pin and gate swapping, keep-in and keep-out areas, copper pour, thermal relief, fan out, 3D view of your PCB design from any angle, Gerber file output and much more.

What is PCB printing using screen printing?

Ans.Screenprintingtechniquesactuallytheprocessthatpatternsthemetalconductortoformthe circuit.

Q.3What do you mean by PCB fabrication process?

Ans. This PCB fabrication process involves a multistep integration of imaging materials,imaging equipment, and processing conditions with the metallization process to reduce the master pattern on a

Experiment No.15

CONNECTION OF STAR TO DELTA CONFIGURATION

To calculate the equivalent resistance between star connection and delta connection for the resistors networks**.**

APPARATUS REQUIRED:

- DC power supply.
- Electrical and electronic system trainer.
- Connecting wire.
- Multimeter.

Theory

Circuit configurations are often encountered in which the resistors do not appear to be in series or parallel .Under these conditions, it may be necessary to convert the circuit from one form to another. Two circuit configurations that often account for these difficulties are the Wye(Y) interconnection because the interconnection can be shaped to look like the letter Y.

The (Y) configuration also is referred to as tee (T) structure without disturbing the electrical equivalence of the two structures and delta (Δ) in which the interconnection looks like the Greek letter (Δ). It also is referred to as pi (Π) interconnection without disturbing the electrical equivalence of the two configuration depictedinFigures1and2

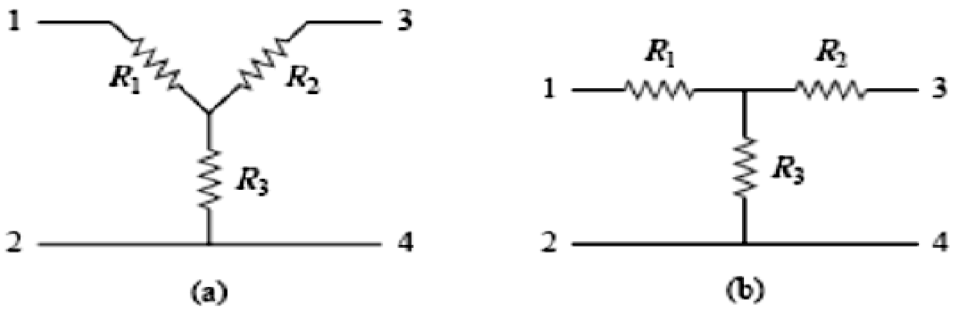


Figure 1 Two forms of the same network: (a) Y, (b) T.

Procedure:

1. Using the DC circuit trainer, connect the circuit shown in Fig.3.

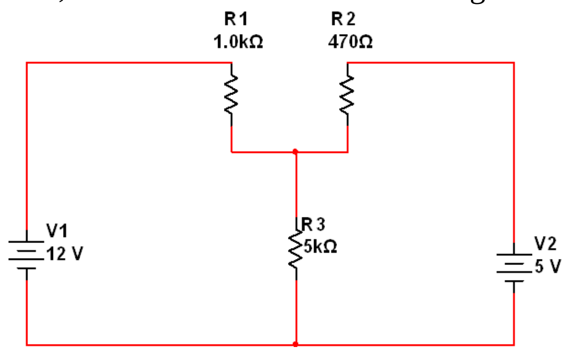


Fig.3: star(Y) circuit.

2. Use the multimeter to measure the currents in each branch.
3. Convert the Y circuit in Fig.3 to delta connection theoretically.
4. Using the DC circuit trainer, connect the circuit shown in Fig. 4.

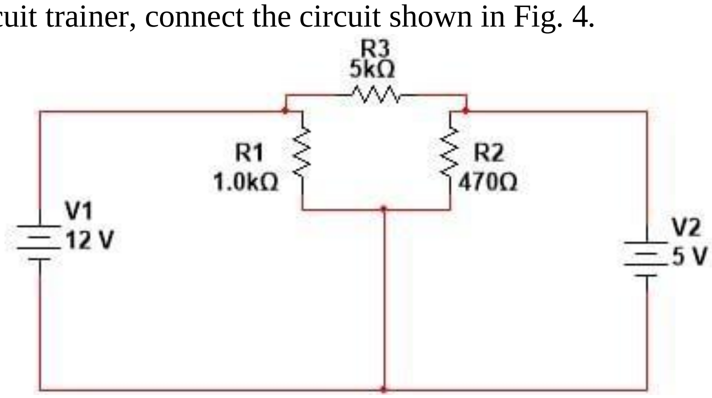


Fig.4: Delta circuit.

5. Repeat.step2 and convert it to the equivalent Y circuit.

VIVA QUESTIONS

1.Why do we convert Wye to Delta or Delta to Wye?
2.What is the difference between delta and star connection?
3.Did the power delivers from (DC power supply) is changed after using the conversion from A to Y. Prove that? Find R_T for the circuit below in Fig. 5.
4. Find I_T for the circuit below in Fig.6.

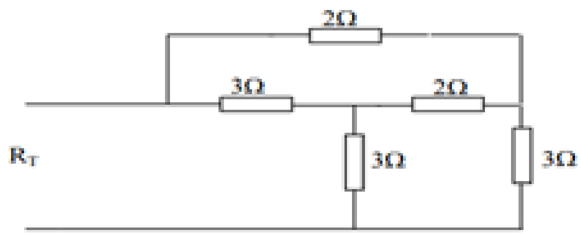
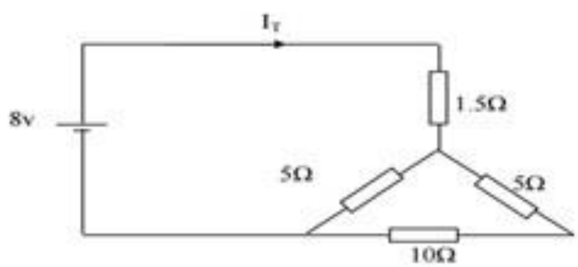


Fig.5



Experiment No.16
CONNECTION OF DELTA TO STAR CONFIGURATION

AIM:

To calculate the equivalent resistance between star connection and delta connection for the resistors networks**.**

APPARATUS REQUIRED:

- DC power supply.
- Electrical and electronic system trainer.
- Connecting wire.
- Multimeter.

Theory:

Circuit configurations are often encountered in which the resistors do not appear to be in series or parallel .Under these conditions, it may be necessary to convert the circuit from one form to another. Two circuit configurations that often account for these difficulties are the Wye(Y) interconnection because the interconnection can be shaped to look like the letter Y.

The (Y) configuration also is referred to as tee (T) structure without disturbing the electrical equivalence of the two structures and delta (Δ) in which the interconnection looks like the Greek letter (Δ). It also is referred to as pi (Π) interconnection without disturbing the electrical equivalence of the two configuration depictedinFigures1and2

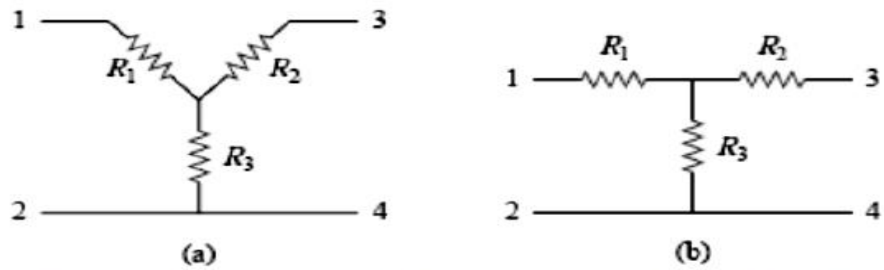


Figure 1 Two forms of the same network: (a) Y, (b) T.

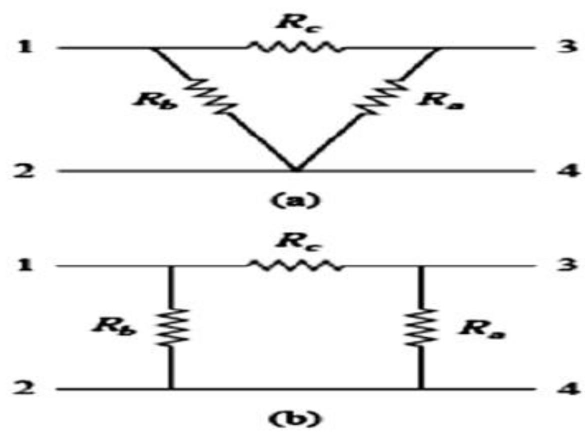


Figure: Two forms of the same network: (a) Δ, (b) π.

Delta to Star Conversion

Suppose it is more convenient to work with a **wye** network in a place where the circuit contains a delta configuration. We superimpose a **wye** network on the existing **delta** network and find the equivalent resistances in the **wye** network. For terminals 1 and 2 in **Figs. 1** and **2**

$$R_1 = \frac{R_b R_c}{R_a + R_b + R_c}$$

$$R_2 = \frac{R_c R_a}{R_a + R_b + R_c}$$

$$R_3 = \frac{R_a R_b}{R_a + R_b + R_c}$$

Star to Delta Conversion

Reversing the Δ-to-Y transformation also is possible. That is, we can start with the Y structure and replace it with an equivalent Δ structure. The expressions for the three Δ- connected resistors as functions of the three Y-connected resistors are

$$Ra = \frac{R1R2 + R2R3 + R3R1}{R1}$$

$$Rb = \frac{R1R2 + R2R3 + R3R1}{R2}$$

$$Rc = \frac{R1R2 + R2R3 + R3R1}{R3}$$

Procedure:

6. Using the DC circuit trainer, connect the circuit shown in Fig.3.

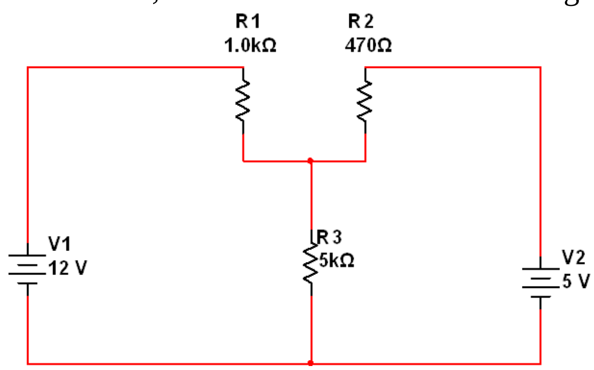


Fig.3: star(Y) circuit.

7. Use the multimeter to measure the currents in each branch.
8. Convert the Y circuit in Fig.3 to delta connection theoretically.
9. Using the DC circuit trainer, connect the circuit shown in Fig. 4.

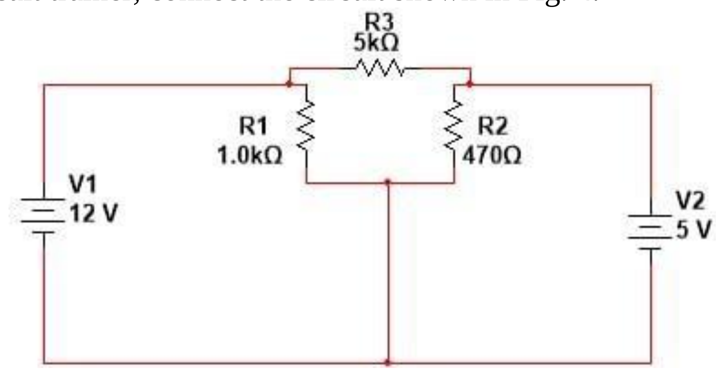


Fig.4: Delta circuit.

10. Repeat.step2 and convert it to the equivalent Y circuit.

VIVA QUESTIONS

1. Why do we convert Wye to Delta or Delta to Wye?
2. What is the difference between delta and star connection?
3. Did the power delivers from (DC power supply) is changed after using the conversion from A to Y. Prove that?
4. Find R_T for the circuit below in Fig. 5.
5. Find I_T for the circuit below in Fig.6.

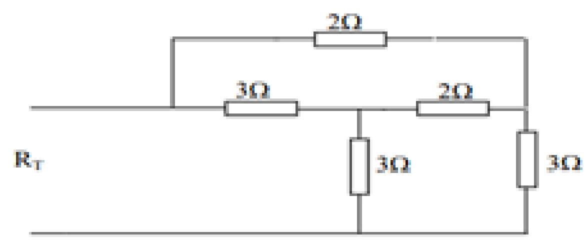


Fig.5