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DEMONSTRATION OF ROTATING MAGNETIC FIELD THROUGH LIGHTING EFFECT

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ABSTRACT :

"Demonstration of rotating magnetic field through lighting effect" is a device used to demonstrate the rotating magnetic field on induction motor. When the induction motor connected through different type of supply like as – DC, Single phase AC, Three Phase supply, which type of magnetic field is produced by stator we can see through the LEDs placed on stator slots.

Main parts of device

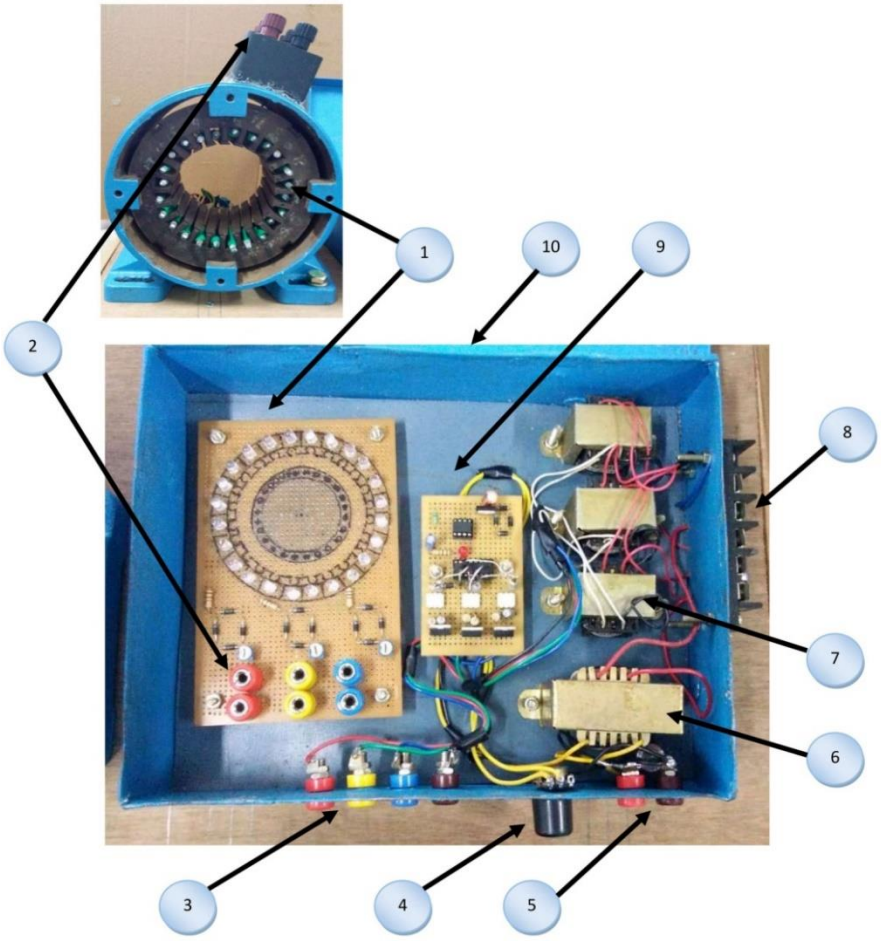


Fig (i) Main parts of device

Name and working of each parts

SL. No.	Name of Parts	Working
1	3 Phase Stator Winding through 3 colour LED (Red, Yellow, Blue)	It is show rotating lighting field. (Circuit diagram put on Page No 11)
2	Terminal of Stator LEDs. A1, B1, C1 A2, B2, C2	It is used for make different types of connection as single phase, two phase, star and delta etc.
3	Low voltage 3 Phase and Neutral output from converter circuit.	Connection for low voltage three phase and single phase supply.
4	Frequency controller –	It is parts of converter circuit to change the frequency output.
5	Low voltage DC output terminal–	Connection for low voltage DC supply.
6	Transformer (230/12-0-12, 500 milliampere)	These three transformers are used for converting 230v to 12v low voltage three phase ac supply. (Circuit diagram put on Page No 10)
7	Transformer (230/12-0-12, 1A)	This transformer is used for converting 230 v AC supply to 12 V DC with help of centre tapped full wave rectifier. This DC output supplied to the converter circuit.
8	3 Phase 415 V Supply Input. (R,Y,B,N,E)	Connection for three phase and neutral supply.
9	3 Phase Converter Circuit.	Converter circuit is a combination of many electronic components like as ICs, diode, capacitor, triac, resistance etc. It is used for generate low voltage dc supply to 3 phase low voltage output. (Working and circuit diagram put on Page No. 7 to 9.)
10	Cabinet	Iron sheet box.

Demonetration of rotating lighting field like as magnetic field on different types of supply

Connect the 3 Phase 415 V supply, neutral and earth wire on the supply input terminal (R, Y, B, N, E) of the device.

Fig (ii) Supply input terminal box

Demonstration in DC Supply

Theoretically

A Direct Current (DC) **electromagnetic field refers to a constant** or static DC electric or DC magnetic field emission which has a frequency of 0 Hz.

Demo

1. Make a single winding on stator because dc has two supply terminals.
2. Connect A1 to B1, B2 to C2 and connect the supply on A2 and C1.
3. Connect DC supply on the terminal A2 and C1 as per the circuit diagram.
4. Switch on the supply and observe the LED lights on the stator.
5. These are constant glowing, no any fluctuation in lighting field.

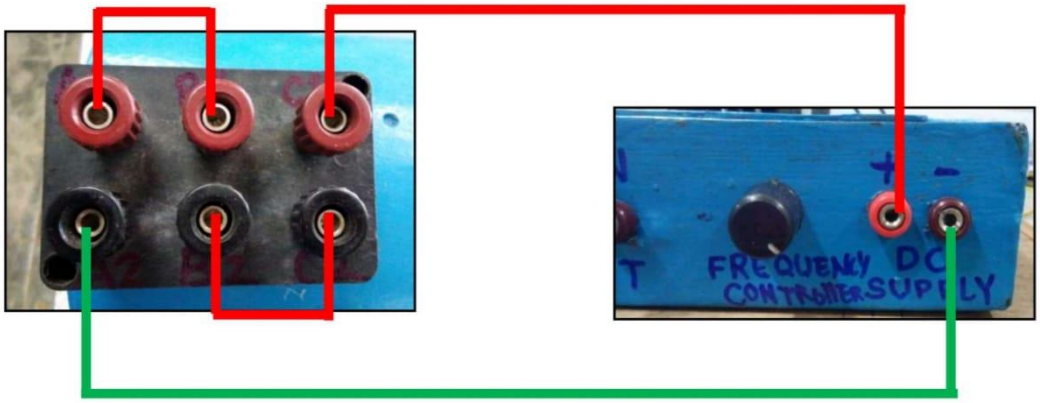


Fig (iii) Connection diagram for demo on dc supply

Demonstration in single phase supply

Theoretically

The single coil of a single phase induction motor does not produce a rotating magnetic field, but a pulsating field intensity reaching minimum to maximum and maximum to minimum at particular time period.

Demo

1. Make a single winding on stator because single phase has two supply terminals (Phase and neutral).
2. Connect A1 to B1, B2 to C2 and connect the supply on A2 and C1.
3. Connect single phase low voltage supply (R and N Low output) on the terminal A2 and C1 as per the circuit diagram.
4. Switch on the supply and observe the LED lights on the stator.
5. Lighting field intensity is a pulsating.
6. Change the frequency through frequency controller and observe the rate of change of fluctuation is varied.

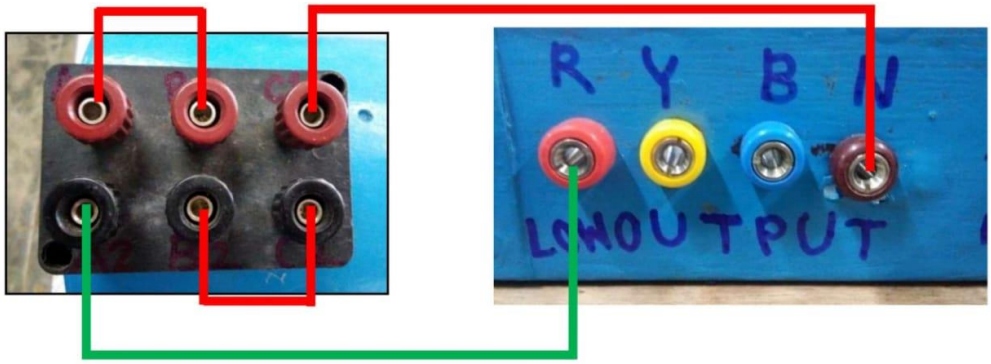
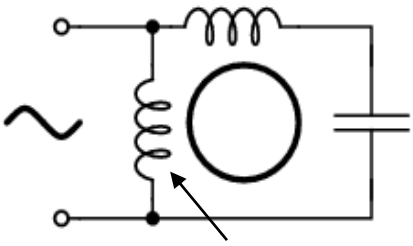


Fig (iv) Connection diagram for demo on single phase supply

Demonstration in two phase supply

Theoretically

One way to solve the single phase problem is to build a 2-phase motor, deriving 2-phase power from single phase. This requires a motor with two windings (Running and starting winding) spaced apart 90o electrical, fed with two phases of current displaced 90o in time. This is called a permanent-split capacitor motor in Figure below.



RUNNING WINDING

Demo

1. As per the circuit diagram, stator winding have two part one is starting winding and another is called running winding.
2. Now we get the 3 terminal (Common, Running and starting).
3. Connect A2 and C2 to the neutral of low voltage output.
4. Connect A1 to B2.
5. Connect B1 to Y phase and C1 to R phase of low voltage output.
6. Switch on the supply and observe the LED lights on the stator.
7. Lighting field is a rotating field.
8. Change the frequency through frequency controller and observe the speed of rotation is increased and decreased.
9.

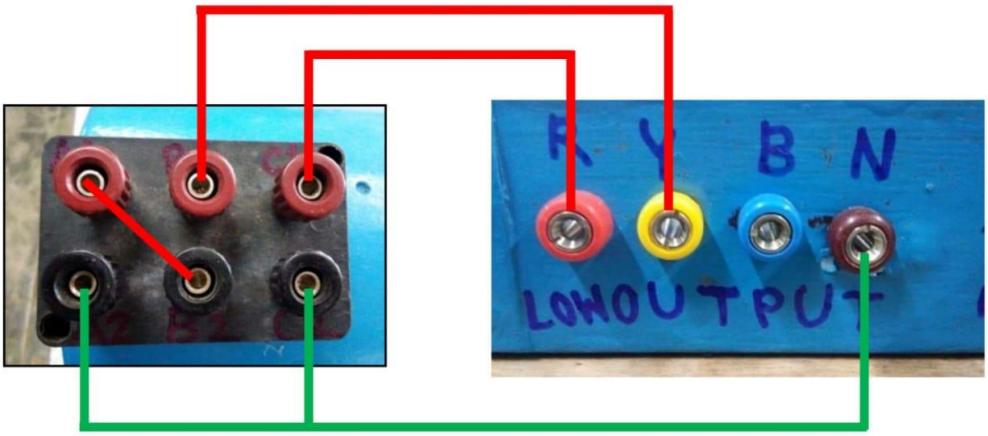


Fig (v) Connection diagram for demo on two phase supply

Demonstration in three phase supply

Theoretically

The stator of an induction motor consists of a number of overlapping windings offset by an electrical angle of 120°. When the primary winding or stator is connected to a three phase alternating current supply, it establishes a rotating magnetic field which rotates at a synchronous speed.

In 3 phase motor, stator has consisted of 3 phase winding. We get the 3 pair of terminals and motor can runs only two types of connections. (star and delta)

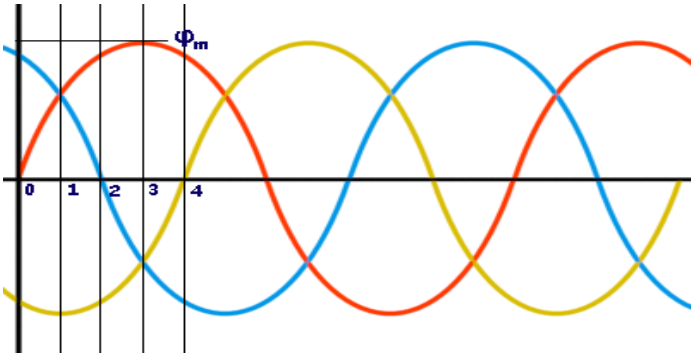


Fig (vi) Sine wave

For delta connection

1. For delta Connection make connection of A1B2, B1C2 and C1A2.
2. Now we get the 3 terminal for 3 phase supply.
3. Connect 3 phase supply as per the circuit diagram.
4. Switch on the supply and observe the LED lights on the stator.
5. Lighting field is a rotating field.
6. Change the frequency through frequency controller and observe the speed of rotation is increased and decreased.

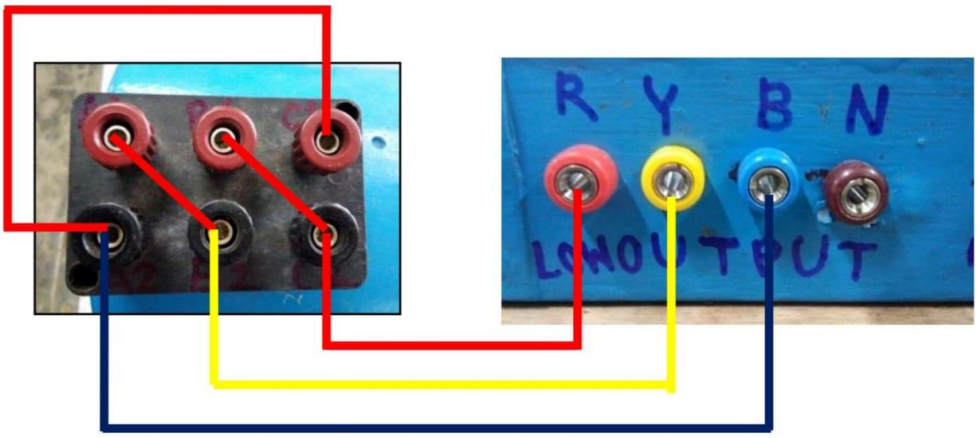


Fig (vii) Connection diagram for demo on three phase delta connection

For star connection

1. For star Connection make connection of A1B1C1 is shorted.
2. Now we get the 3 terminal for 3 phase supply.
3. Connect 3 phase supply as per the circuit diagram.
4. Switch on the supply and observe the LED lights on the stator.
5. Lighting field is a rotating field.
6. Change the frequency through frequency controller and observe the speed of rotation is increased and decreased.

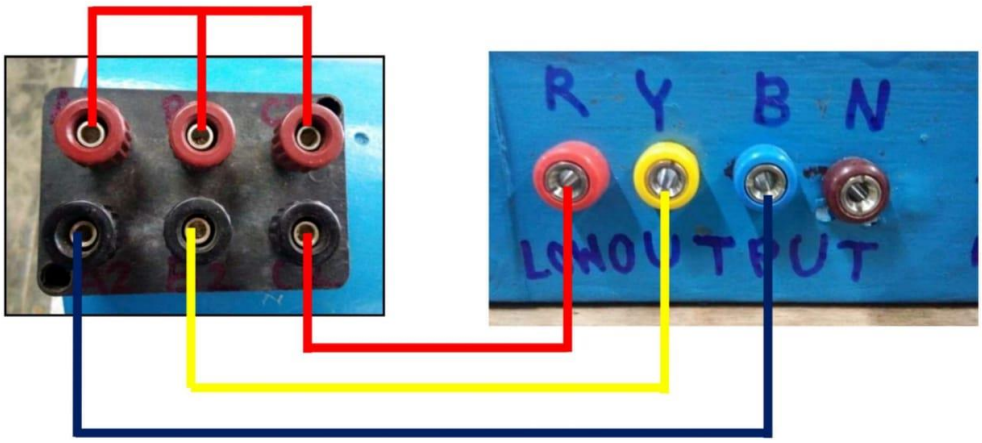


Fig (viii) Connection diagram for demo on three phase star connection

Working of DC to 3 Phase converter circuit

The circuit consists of a 555 timer with 4017 sequential led flasher. The output of the 555 a-stable multi vibrator is connected to the clock input of the decade counter. So that for each positive edge triggering of the clock input, the counter shifts the high state of the output in a sequence from output 0 to output 9. In a 4017 counter IC, only one output will be high at a time and the remaining outputs will be in the low state. And the shifting cycle repeats as like a ring counter. Thus the LEDs will visually see as like a light feeding in a rotary manner. That three pulse use for triggering the traic BT 136 through opt coupler (moc3021). One variable resistance 10k is used for changing the supply frequency output. We can calculate output frequency using this formula.

Output Frequency = 1.44/((R1 + 2RV1) * C1)

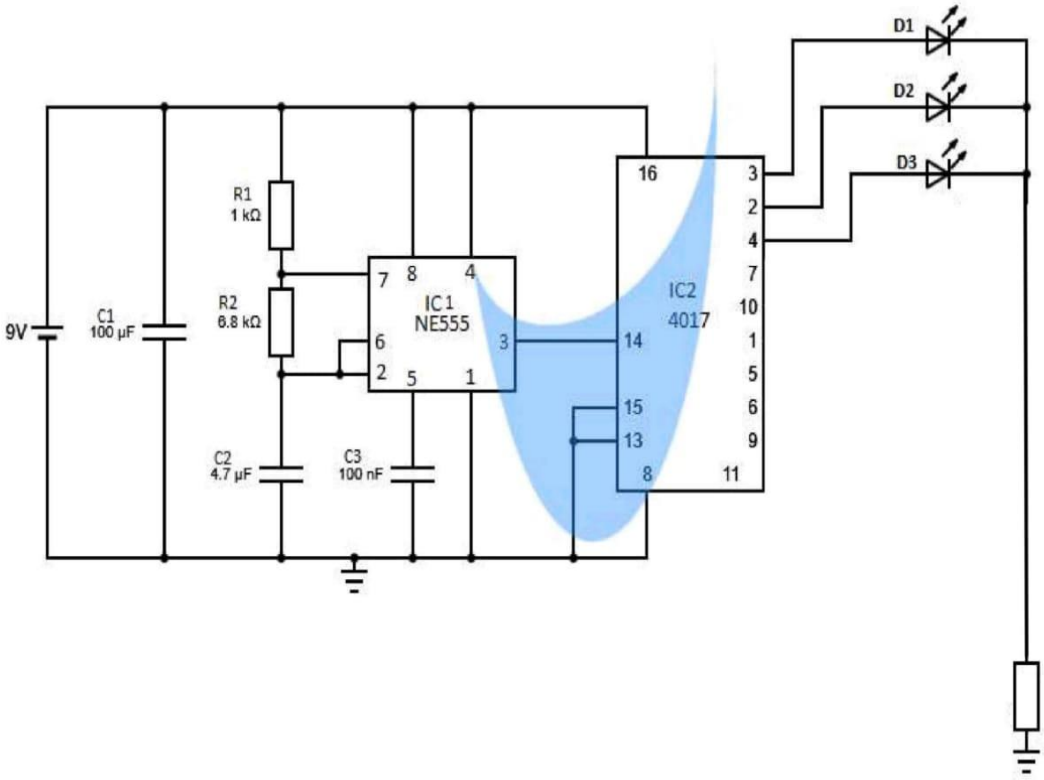
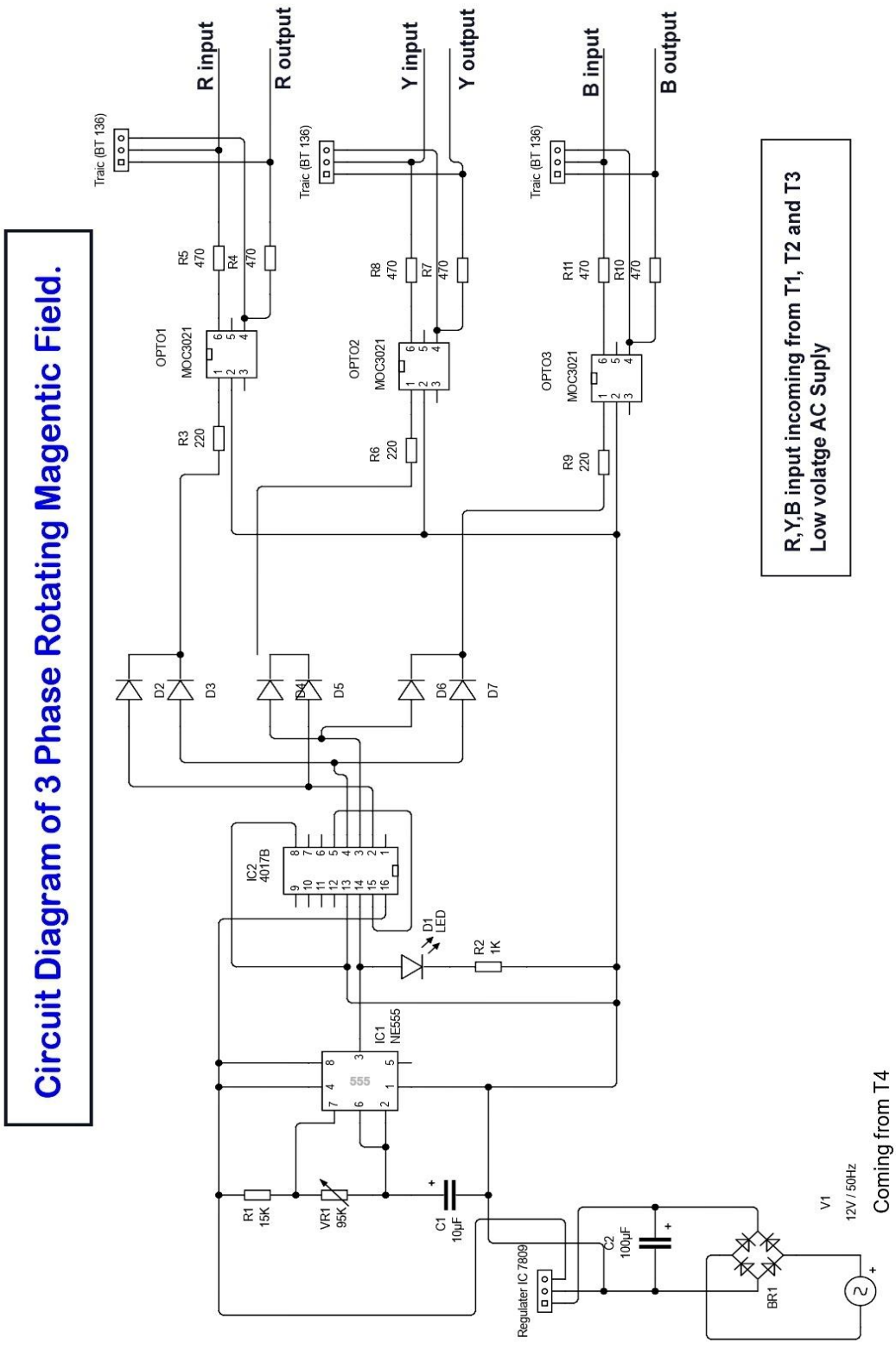
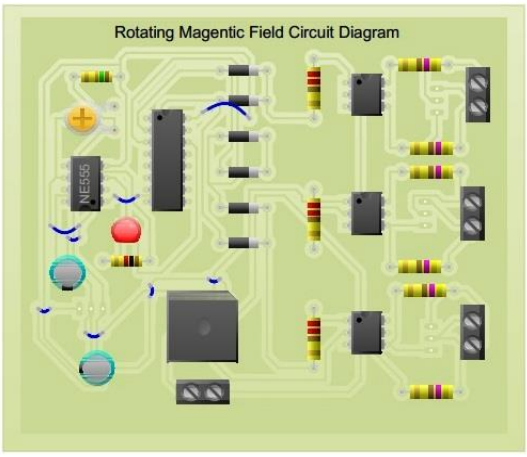


Fig (ix) Circuit consists of a 555 timer with 4017 sequential LED flasher

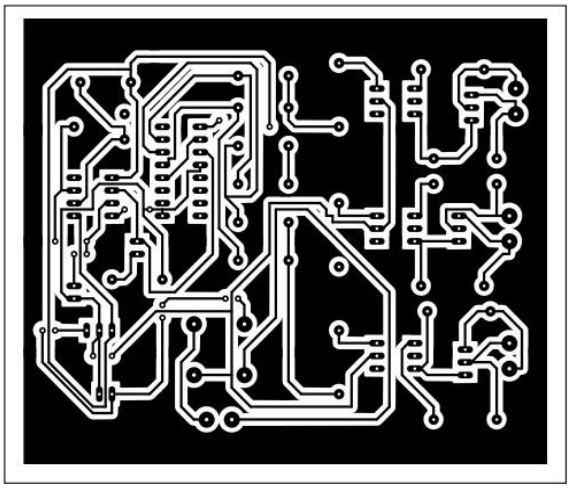


Layout Diagram for 3-Phase Converter Circuit

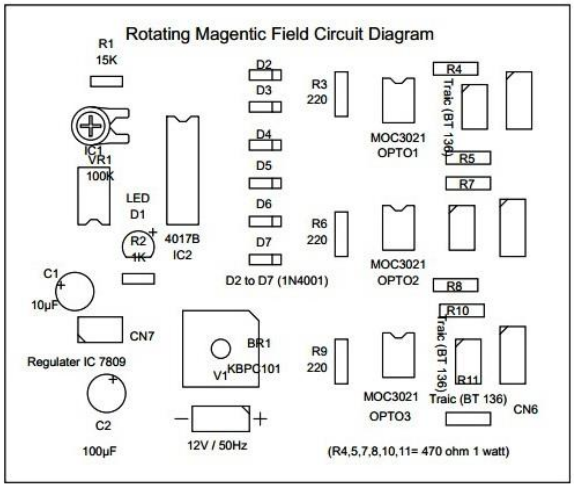
PCB Layout with component



PCB Layout for Copper Clad board Aching

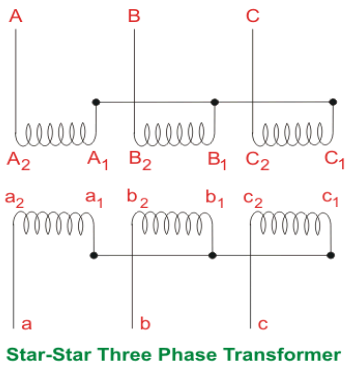


PCB Silk screen

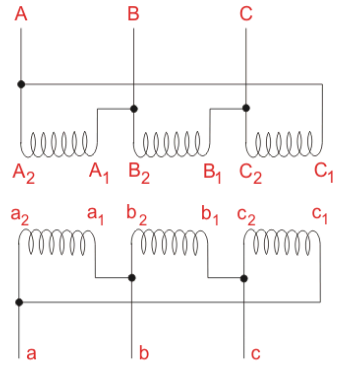


Working of 3 phase high voltage to low voltage converter circuit

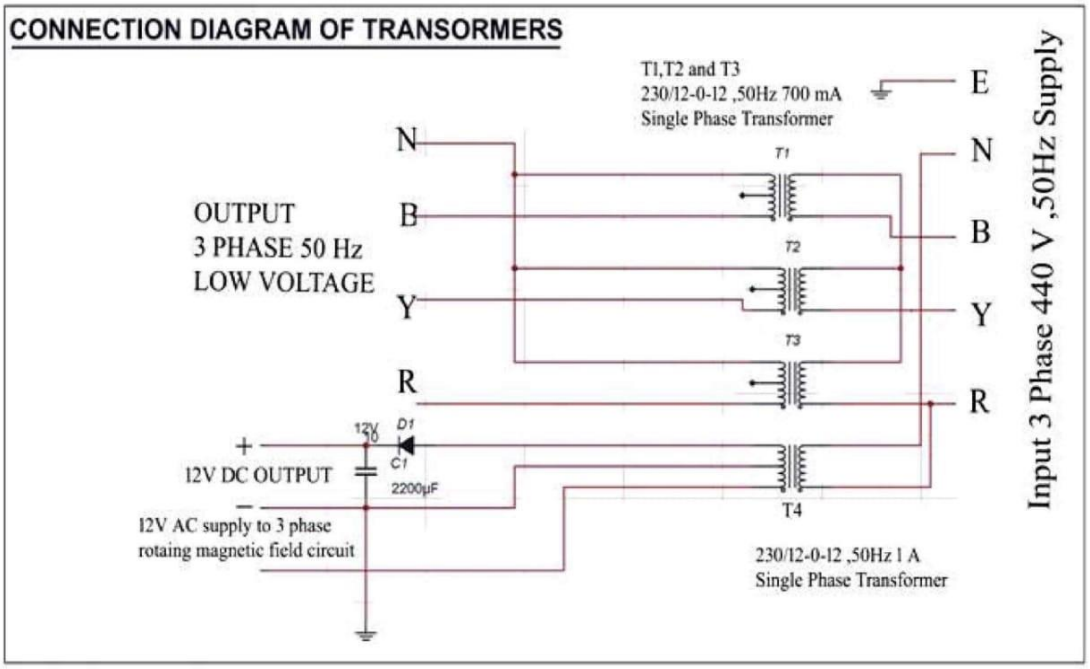
The primary and secondary windings of three single-phase transformers can be connected in different configurations to meet specific 3-phase system requirements. For single-phase transformers with equal transformation ratio of the phase windings, the ratio of the line voltages and their phase relations depends on the winding connection. Based on the phase relation between primary and secondary voltages, the vector group of the transformer is determined. Identification of the transformer vector group is very important for connecting three phase transformers in parallel.



Star-Star Three Phase Transformer

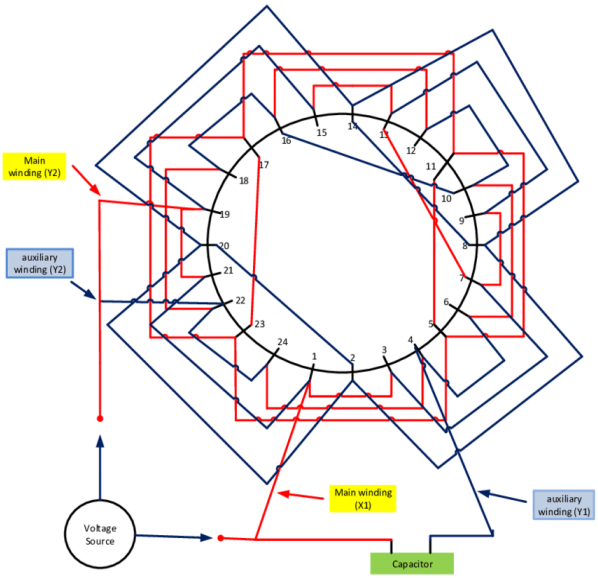


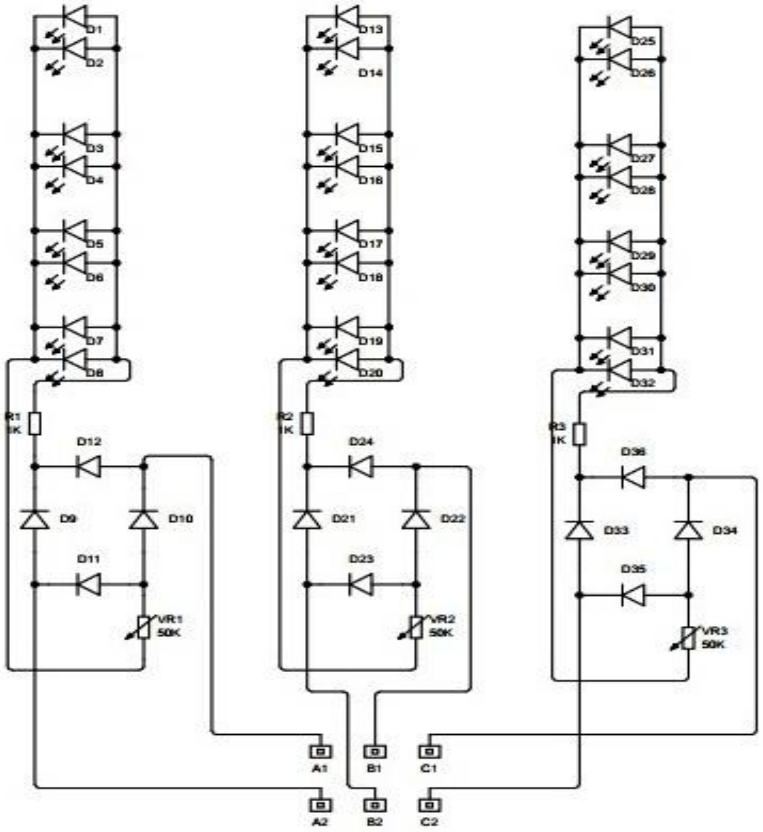
Delta-Delta Three Phase Transformer



Woriking of stator LED connection diagram

Three phase asynchronous motor is most common used motor in the world. Rotor is usually made as squirrel-cage, and it is inserted in stators hole. Stator is made out of iron core and winding. Stator is used to generate magnetic field. 3 phases generates rotation magnetic field so we don't need capacitor on three phase motor. Rotation magnetic field "cut" squirrel-cage, where it induces voltage. Because cage is short-circuited, voltage generates flow of electric current. Current in magnetic field generates force.





Summary :

This device is able to show the rotating magnetic field through lighting effect when an induction motor connected through different type of supply like as – DC, Single phase AC, Three Phase supply, which type of magnetic field is produced by stator we can see through the LEDs placed on stator slots. We can understand the different types of fault and conditions occurring on running time of the motor.

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