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Abstract

The paper is describes to provide a soft and smooth start to a 3 phase induction motor. The three phase induction motor during the starting condition draws higher current than its rating and the motor instantly reaches the full speed. This results in a mechanical and high electrical stress on the windings of the motor. Sometimes the windings may get burnt. The induction motor should be start smoothly and gradually catch up the speed for a reliable operation. This paper is describes to give a soft start to the induction motor based on the SCR firing triggered by heavily delayed firing angle during starting and then gradually reducing the delay till it reaches null voltage triggering. This results in minimum voltage during start and then gradually to full voltage. Thus the motor starts slow and then slow picks up to full speed.

This paper consists of a six anti-parallel SCRs, two for each phase, the output of which is connected to a set of lamps representing the coils of a 3 phase induction motor. The charging and discharging of capacitors is interact to comparators resulting in delayed firing pulses during start and then gradually reducing the delay till the motor runs at full speed. Output from the comparators is fed through opto-isolators to trigger the SCRs.

Further the paper can be enhanced by using IGBTs in place of SCRs with PWM control to reduce harmonic distortions often encountered in SCR triggering mechanism.

Index Terms: Transformer, Voltage, Regulator, Rectifier, Filter, Transistor, Op-amp, Optoisolator, 3phase induction motor, SCR,, Capacitor.

1.INTRODUCTION

This is the starting method that reduces the starting current and starting torque. At starting the induction motor the supply is star connected and when it reaches at its approximate operational speed it switches to delta. The motor is delta connected during the normal speed in order to able to use this starting method. This starting method is only works when the operation is in light loaded during the starting. If the motor is too heavily loaded, there will be not enough torque to accelerate the motor up to speed before the switching it into delta position. The induction motor must be built to run normally with a mesh loop-connected stator winding. At the starting, the winding is connected temporally in star. The phase voltage is thus reduced to 0.58times of the normal.

Starter during the method is cheap and effective, so long as the starting torque is not required to exceed about 50 percentage of full load torque. The operation of the soft starter in done using six thyristor in firing angle control principle it can

therefore be used for machine tools, pumps, motor generator ,etc. The method is unsuitable for motors that voltages exceeding 3000V.. This is the starting method that reduces the starting current

andstarting torque. At starting the induction motor the supply is star connected and when it reaches at its approximate operational speed it switches to delta. The motor is delta connected during the normal speed in order to able to use this starting method. This starting method is only works when the operation is in light loaded during the starting. If the motor is too heavily loaded, there will be not enough torque to accelerate the motor up to speed before the switching it into delta position. The induction motor must be built to run normally with a mesh loop-connected stator winding. At the starting, the winding is connected temporally in star. The phase voltage is thus reduced to 0.58times of the normal.

Because of excessive no of starter turns need for delta running. Where induction motor are require to run for considerable

periods on small loads, a star delta switches permits the machine to be star connected during these periods, with reduction of magnetizing current and increase in efficiency.

The paper is supplied with six lamps instead of three phase motor i.e. two lamps showing each phase winding of the motor. During the star operation the lamps would glow deem indicating the supply voltage across the coil are $400/\sqrt{3}$. In delta connection after the time of operates the bulb will glow with full intensity indicating full supply voltage of 440 volts. The project use three step down transformer the primary of which are connected in star mode while their secondary develops filtered dc while after passing to respective bridge rectifier and filter capacitor such dc derived and used for operation of electronic component situated on PCB .

1.1 Principle of Operation

The electrical section of the three-phase induction motor as shown in Fig1.1 consists of the fixed stator or frame, a three-phase winding supplied from the *three-phase mains* and a turning rotor. In this starter no electrical connection between the stator and the rotor. The currents in the rotor are induced by the air gap from the stator side. Stator and rotor are made of highly magnetisable core sheet providing low eddy current and hysteresis losses.



Fig.1.1 Three Phase Induction Motor

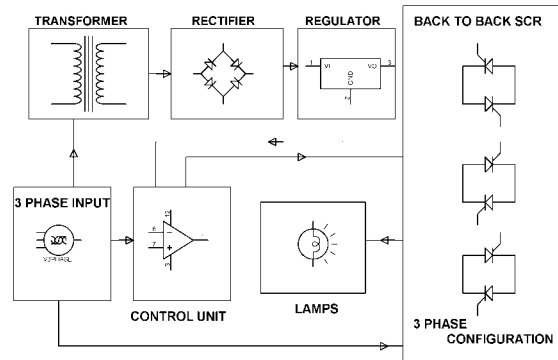


Fig.2.1 Block Diagram Of Soft Starter

2.1.HARDWARE REQUIREMENT

HARDWARE COMPONENTS:

- TRANSFORMER (230 – 12 V AC)
- FEATURES OF VOLTAGE REGULATOR (LM 7812)
- RECTIFIER
- FILTER
- OP-AMP (LM324, LM339)
- SCR
- RESISTOR
- CAPACITOR

2.1.1 TRANSFORMER

Transformers are use for transfer the power from one side to another side and convert AC electricity from one voltage to another with a very less loss of power. Step-up transformers increase voltage and step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the hazardous high voltage to a low volt.



Fig.2.1.1 Typical Transformer

The input coil is called as the primary winding and the output coil is called the secondary winding. There is no electrical connection between the two coils; instead they are linked by an alternating magnetic field i.e. magnetic flux created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol show the core winding. Transformers lost very less amount of power so the power out is (almost) equal to the power in. Note that as the voltage is stepped down then current will stepped up.

2.Block Diagram

The ratio of number of turns on each coil side, called the turn's ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary as compared to secondary which is connected to the high voltage and a small number of turns on its secondary to give a less output voltage.

$$\text{TURNS RATIO} = (V_P / V_s) = (N_P / N_s)$$

Where,

V_P = primary (input) voltage.

V_s = secondary (output) voltage

N_P = number of turns on primary coil

N_s = number of turns on secondary coil

I_P = primary (input) current

I_s = secondary (output) current.

Features of Voltage Regulator 7805

- Output Current up to 1A.
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24V.
- Thermal Overload Protection.
- Short Circuit Protection.
- Output Transistor Safe Operating Area Protection.

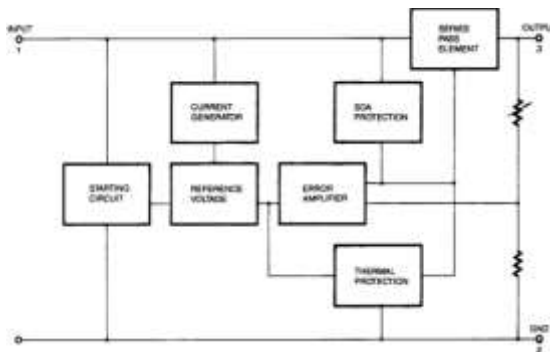


Fig.2.1.2 Block Diagram Of Voltage Regulator

2.2.RECTIFIER

A rectifier is an electrical and electronic device which converts alternating current (AC) to direct current (DC) current this process known as rectification. Rectifiers have many uses such as including as components of power supplies and as detection of radio signals. Rectifiers may made of solid state diodes, vacuum tube diodes, mercury arc valves, and other components. The output power from the transformer is fed to the rectifier. It converts A.C. into pulsating D.C. The rectifier may be a half wave as well as full wave rectifier. In this project, a bridge rectifier is used because of its merits like good stability and full wave rectification than other component. In positive half cycle only two diodes (1 set of parallel diodes) will conduct, in negative half cycle remaining two diodes will conduct and they will conduct only in forward bias only.

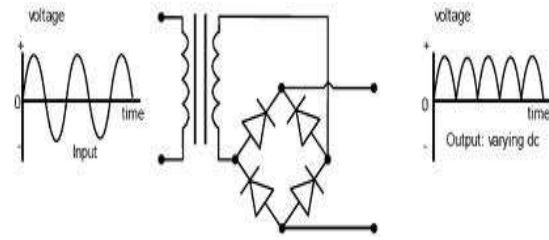


Fig.2.2.1 Circuit Of Rectifier

2.3. FILTER

. If either of the two is varied, D.C. voltage received at this point changes. Therefore regulator is applied at the output stage of filter.

The simple capacitor filter is the Capacitive filter is used in our project as it is a charge storing device. It removes the ripples from the output of rectifier and give smoothness to the D.C. Output received from this filter is constant until the mains voltage and load most basic type of power supply filter and it is very reliable. The use of this filter is very limited. It removes the unnecessary waveform i.e. pulsating component. It is sometimes used on extremely high-voltage and low-current power supplies for cathode-ray and similar electron tubes that require very little load current from the supply. This filter is play very important role as it remove pulsating dc, also used in circuits where the power-supply ripple frequency is not critical and can be relatively high. Below figure can show how the capacitor charges and discharges.

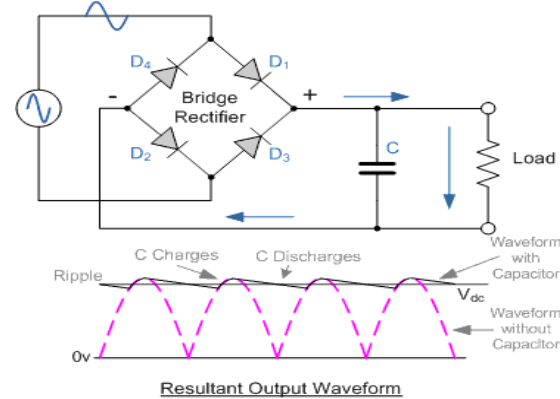


Fig.2.3.1 Circuit And Out Put waveform Of Filter.

2.4.OPAMP (LM324, LM339) LM324:

2.4.1General Description

Is 14 pin IC. The LM324 series consists of four independent operational amplifiers compensated in single pack , high gain, internally frequency compensated operational amplifiers which were designed specific to operate from a single power supply over a various range of voltages. Operation from split power supply is also possible and the low power supply current drain does not depend on the magnitude of the power supply voltage.

The conventional op-amp use in very widely in applications can be more easily implemented with LM324. Application areas included transducer amplifiers and also DC gain blocks

and all the conventional op-amp circuits can be easily implemented in single power supply systems.

Fig.2.5.(b) Symbol Of SCR

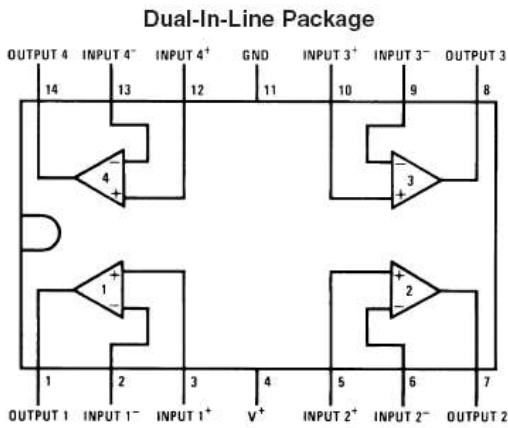


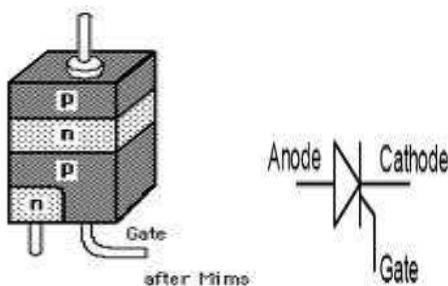
Fig.2.4.1 Circuit Of OP-AMP

2.5.Construction of SCR

An SCR consists of four layers alternating P and N type semiconductor materials sandwich one on another. Silicon is used as the intrinsic. The doping of PNPN will depend on application basis of SCR, since its characteristics are similar to the thyatron. The term thyristor applied for the larger family of multilayer devices that exhibit biteable state of change behaviour semiconductor to which the proper decants are added. The junctions are either diffused or alloyed. In this case junction J2 is obtained by the diffusion method and then the outer two layers are alloyed to it, since the PNPN pellet is required to handle large currents. One of these plates is hard soldered to a copper stud which is threaded for attachment of of sinker that is switching either ON or OFF



Fig.2.5.(A) SCR



Explanations on Soft Starters for Induction Moto

2.6.Resister

A resistor is two-terminal electronic device designed to oppose an electric current by producing a voltage drop between its terminals in proportion to current, that is, accordance with Ohm's law:

$$V = IR$$

Resistor are used as part of electrical networks and circuits. Practical resistors can be made of various compounds, as well as resistance wire. The primary characteristics of resistors are their resistivity and the power they can dissipate. Other characteristics also include temperature coefficient, noise, and inductance., and above which the limit is applied voltage. Critical resistance depends upon the matter constituting the resistor as well as its physical dimensions; it's determined by design.

Resistors can be integrated into hybrid and printed circuits, as well as integrated circuits. Size, and position of leads (or terminals) are relevant to equipment designers; resistors must be physically large enough not to overheat when dissipating their power.

2.7.Soft Starters:

A soft starter is other form of reduced voltage form of starter for A.C. induction motors. The soft starter is somewhat similar to a primary resistance or primary reactance starter in that it is connected in series with the supply to the motor. The current into the starter is equals the current out. The soft starter employs solid state devices to control the current flow and therefore the voltage applied to the motor. In theory knowledge soft starters can be connected in series with the line voltage applied to the motor or can be connected inside the delta loop of a delta connected motor, controlling the voltage applied to each winding.

2.8.Voltage Control:

Voltage control is achieved by means of solid state A.C. switches in series with one or more phases.

3.Advantages

- 1.Simple design and operation .
- 2.Comparatively cheaper than other voltage controlling method.
- 3.Torque and current performance of starter is well.
- 4.it reduces starting current to one-third as compare to dole starter.

4.Applications

- 1.The soft starter is probability used as reduced voltage starter
- 2.Common applications which require controlling the starting current or torque can be found in many industries including material handling

3.It is also used in HV AC, mining, etc.

4.The main applications are fan ,pumps, conveyer and compressors

5. CONCLUSION

1.This type of starting is used for low to medium voltage and light starting torque motors.

2.It is cheapest way to reduce the starting current and it is in order of 3-4 times that in case of direct online starting of induction motor.

3.It is insufficient torque available while connecting in star the motor can only accelerate the partial speed compare to the full speed.

4. The proposed method has been implemented to analyse and categorization of power quality data connected. Result are given to illustrate the effective nests and robustness of proposed method in power quality. More work is currently in progress to validate the proposed tools, which will be reported in future.

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