

# Automatic Star Delta Starter With An Electronic Adjustable Timer And Relay

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**Abstract-** The aim of the project is to design a model for low voltage starting to Induction Motors. With the growing use of Automatic starters in industries, star / delta starter is mostly preferable in industries for Induction Motors. The star delta starter is used to reduce the starting current applied to the motor. As high current is dangerous to the motor windings, it will help to protect the motor winding with various other advantages of the starter. When the motor start, at that time the motor runs in star connection drawing less current from the supply and then after few seconds it will switch to delta with the help of an electronic adjustable timer. The star delta starter consists of three contactors- a star contactor, a delta contactor and a timer. The circuit is protected with thermal overload relay which helps to protect the motor when operating in 3 phase, 440 volts ac mains, 50 Hz supply. The interlocking arrangement of all the contactors in with 440 volts ac mains, 3 phase 50 Hz supply. The motor is operated in star arrangement first and then switch to delta with a electronic adjustable timer. At load we use a induction motor. First when we run the motor in star, the motor will run at a slow speed which indicates that the supply voltage across the coil is about  $\frac{440}{\sqrt{3}}$  times. This is in case of star connection winding. After few moments the timer switch from star to delta and now the motor will run in delta connection. In this case, the motor will run at full intensity with catching it full speed. In case of any failure in the circuit the relay will react and it will protect the circuit and the motor from being damage. The output is being completely cut off in case of any failure in the circuit.

**Keywords-** Star Delta starter, Contactors, Relay ,Timers, Three- phase induction motor, Auto CAD

## I. INTRODUCTION

A three phase induction motor has two main parts, stator and rotor. Stator is stationary part and rotating part is called the rotor. These motors are popular due to their low cost, rugged construction, less maintenance, efficient and reliable. The DOL starters, Auto transformer starters and Star

delta starters are used for the starting and running of the induction motors. When connected to the supply, induction motor can draw large amount of current which can result in damage of the windings and the motor. To protect the motor a protective system is employed to reduce the current flow from the supply mains to the motor. Induction motor is a type of motor where the power to the rotor is supplied from stator through electromagnetic induction, rather than commutate or slip rings as in other types of motor. The speed of this variety of motor is determined by frequency of the supply current. These types are mostly used in industries for constant speed applications purpose. For variable speed versions VFDs (Variable Frequency Drives) are used.

## II. LITERATURE REVIEW

While operating the Star-Delta Starters to control the speed and switching of the induction motor. The motor is first star connected which draws less current and helps to protect the motor from over current if it is in delta. Then after few moments it will switch to delta and then the motor run in its full capacity. When the motor switch from star to delta the period, at that moment the motor is neither in star nor in delta, at that condition the motor is said to be in open transition switching. During star connected state, voltage applied is reduced to  $\frac{1}{\sqrt{3}}$  times of the line voltage. At first the motor is not in full speed but when it switch to delta with the help of timer it slowly gain it full potential and run in full speed. The making of the Star Delta Starter require :-

Threecontractors :- one main contractor, one star contractor, one delta contractor , one Over voltage relay, one timer for times setting, 2 pole MCB Fuse, Start Push Button, Stop Push Button.

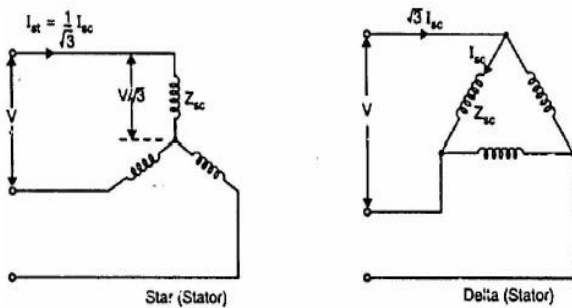


Figure 1: Star & Delta Diagram

The six leads of the stator windings are connected to the changeover switch. At the instant of starting, the changeover switch is thrown to “Start” position which connects the stator windings in star. Therefore, each stator phase gets  $V/\sqrt{3}$  volts where V is the line voltage. This reduces the starting current. When motor picks up speed, the changeover switch is thrown to “Run” position which connects the stator windings in delta. The disadvantages of this methods are:

1. With star- connection during starting, stator phase voltage is  $1/\sqrt{3}$  times the line voltage. Consequently, starting torque is 1/3 times the value it would have with delta connection. This is rather a large reduction in starting torque.
2. The reduction in voltage is fixed.

This method of starting is used for medium- size machines ( upto about 25 H.P.)

### III. METHODOLOGY

While operation of the motor, when it start the motor run in star connection. The circuit has three contractors, but during operation two contractors are close. One contractor is main, other is delta and star contractors. The current in star in one- third of the current in delta. At first the star will operate and after few moments it will switch to delta with the help of a Timer. The star and delta are electrically interlocked. When we press the ON button the voltage supply to the motor will reduce because there is a star contractor which is operating first. After that the timer is used to switch from star to delta connection. The time is preset depending on the requirements. The state in which the circuit is neither in star nor in delta is called as open transition switching. There is open state between the star and delta state.

Relation between Starting and Full load torques.

In direct starting,  
Starting current/phase,  $I_{sc} = V/Z_{sc}$   
( V= line voltage)

Starting line current =  $\sqrt{3} I_{sc}$   
In star starting,

Starting current/Phase,  $I_{st} = \frac{V/\sqrt{3}}{z} = \frac{1}{\sqrt{3}} I_{sc}$

Now,  $T_{st}/T_f = (I_{st}/I_f)^2 \times S_f = (I_{sc}/\sqrt{3} \times I_f)^2 \times S_f$

Or  $T_{st}/T_f = 1/3(I_{sc}/I_f)^2 \times S_f$   
where  $I_{sc}$  = Starting phase current (delta)  
 $I_f$  = F.L. phase current (delta)

Note that in star-delta starting, the starting line current is reduced to one-third as compared to starting with the winding delta connected. Further, starting torque is reduced to one-third of that obtainable by direct delta starting. This method is cheap but limited to applications where high starting torque is not necessary e.g., machine tools, pumpsetc.

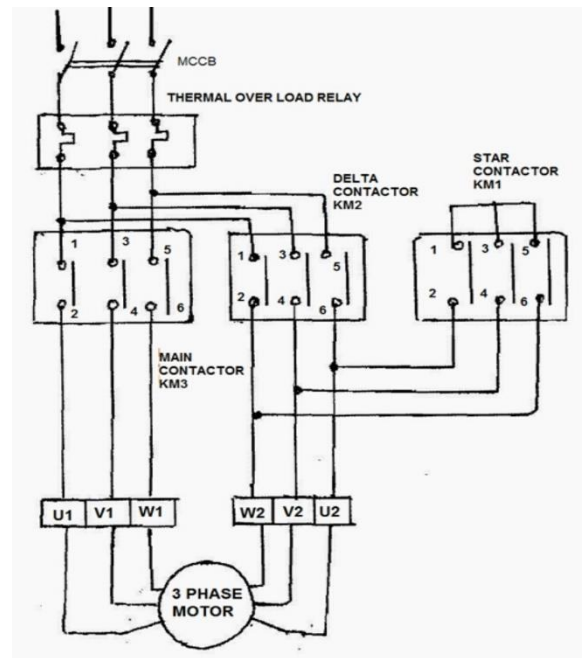


Figure 2: Star Delta Starter Circuit Diagram

In operation, the main contractor, KM3 and the star contractor KM1 are closed initially, and then delta contractor KM2 is closed. The control of the contactors is with the use of timer K1T built into starter. The Star and delta are electrically interlocked and preferably mechanically interlocked as well. The star contractor serves to initially short the secondary terminal of the motor U2, V2, W2 for the start sequence during the initial run of the motor from standstill. This provides one third of DOL current to the motor, thus reducing the high inrush current inherent with large capacity motors at startup.

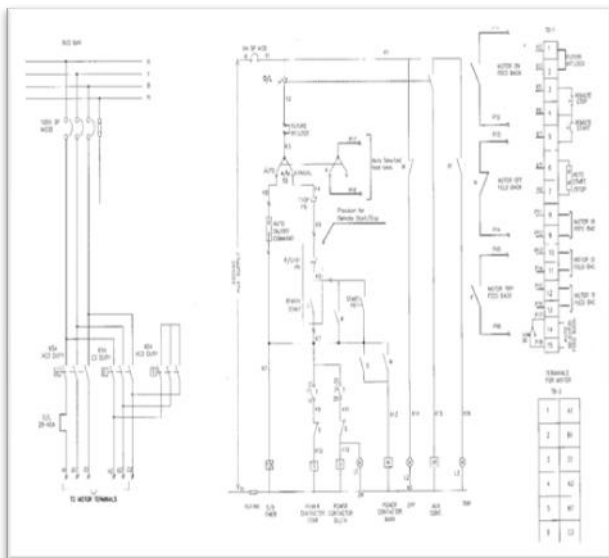


Figure 3: Star Delta Starter Electrical Auto CAD Diagram

The Project is designed to provide low voltage start to induction motors with 3 phase 440 volts AC Mains supply 50 Hz. The relay needs a DC supply of 12 volts in star mode and then to delta mode by an electronically adjustable timer.

#### IV. CONCLUSION

The electrical industries in growing day by day towards more efficient way to save energy for future use. The need is to implement the equipment's which serves as a energy saving in industries and also protect the instrument. Star Delta starter is used to protect the Induction motor from high inrush currents. Therefore, the use of star delta is most in industries compare to other methods.

#### V. FUTURE SCOPE

1. For large rating of induction motors, variable frequency drives are used instead of star delta starter. The star delta starter is used for a limited ratings of Induction motors.
2. An automatic voltage fluctuation protector system has been implemented for protection of induction motor.
3. The cost of the material used in this project is relatively low as compared to its function.
4. Star Delta starter are very compact in size and are easily portable to any places.

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