



Automatic Star Delta Starter by Micro Controller With Built In Timer

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ABSTRACT

Star or Delta starters are the most common reduced voltage starters in the 50 Hz industrial motors. They are used in an attempt to reduce the starting current applied to the motor during start. The Star/Delta starter is generally manufactured using three contactors, a timer and a thermal overload for operating a 3-phase motor at 440 volt at AC mains supply of 50 Hz. However, in our project we have taken up the same to operate a 3-phase motor at 440 volt AC mains supply 50 Hz with a set of 12 volt DC relays an electronically adjustable timer provided through Micro controller and a set of miniature circuit breakers. The interlocking arrangement of the relay coils and the electronic Micro controller is all wired in low voltage DC of 12 Volt fed from an in-built DC power supply for safe handling of the starter during the study, still retaining its application for a 3-phase motor starting with a single phasing prevention. The timer comprises of Micro controller the output of which is fed to a relay for changing the mains supply from 3-phase star to delta. The project also has the provision of single phase protection, since the 3-phase motors may get burnt if any one phase goes missing during operation. The output to the lamps shall be completely cut off in the event of any phase failure. Furthermore, the project can be enhanced by using thyristors in a firing angle control principle for soft start of the induction motor that would overcome all the drawbacks of the star delta starter.

KEYWORDS: Star Delta Starter, DC power supply

1. INTRODUCTION

Induction motor is the most common types of electric motor in industry. This is motor very simple structure any other moving machine. But the motor is very power full and high efficiency. The most common feature of the motors are low cost, quick pick up and easy maintenance. If the induction motor start in DOL method, the motor is started with application of full voltage and the starting current will be 7-10 times of rated current. So large induction motors do not start DOL method. Another induction motor start only star

system, its gives low torque and if motor start only delta method, its gives high starting current. So we need a secure protection to avoid such conditions and protect the motor. For this reason we use automatic star delta starters with help of magnetic conductor, timer relay and overload protection. This is the best protection against high current.

2. OBJECTVIES OF THE PROPOSED WORK

```
#include <SoftwareSerial.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);
const int numReadings = 10;
int readings[numReadings]; // the readings from the
analog input int Array[numReadings];
int total = 0; // the running total
int average; // the average
int PBSTART = 5; int PBSTOP = 3; int MAINS = A1; int
STAR = A3; int DELTA = A5;
int TIMER = A10;
int strtonvalue=0; int strttoffvalue=0; int totalVoltage;
int x;
int Voltage;
int timeVoltage; void setup()
{
  Serial.begin(9600);
  Serial.println("Initializing setup ...");
  pinMode(PBSTART, INPUT); pinMode(PBSTOP,
  INPUT); pinMode(MAINS, OUTPUT); pinMode(STAR,
  OUTPUT);
  pinMode(DELTA, OUTPUT); pinMode(TIMER, INPUT);
  lcd.clear();
  // initialize the lcd
  cd.init();
  // Print a message to the LCD. lcd.backlight();

}
void loop()
{
  totalVoltage=0;
  for(int x = 0; x < 100; x++) {
    //rawVal=analogRead(A10); //Connect LM35 on Analog
    5 timeVoltage = analogRead(TIMER);
    //temp=(500 * rawVal) /1024; Voltage=(500 * timeVoltage)
    /1024;
    //temptotal = temptotal + temp;
    totalVoltage=(totalVoltage+timeVoltage);
  }
  //temp=temptotal/100; Voltage=totalVoltage/100;
  //.....
  //int timeVoltage = analogRead(TIMER);
  //float Voltage = timeVoltage / 5.118;
  lcd.setCursor(0,0);
```

```
lcd.print(" Time Set: "+String(round(Voltage ))+"Sec");
delay(100);
lcd.setCursor(0,1);
//lcd.print("M-OFF;S-OFF;D-OFF;");
strtonvalue=digitalRead(PBSTART);
strttoffvalue=digitalRead(PBSTOP);
if (strtonvalue == HIGH && digitalRead(DELTA) ==
LOW && strttoffvalue == LOW)
{
  digitalWrite(MAINS, HIGH); digitalWrite(DELTA,
  LOW);
  //displayOnLCD(" TIMER set "+
  String(round(Voltage))+" S", "M-ON;S-OFF;D-OFF;");
  lcd.setCursor(0,1);
  lcd.print("M-ON;S-OFF;D-OFF;");
  delay(1000);

  digitalWrite(STAR, HIGH); delay(100);
  // displayOnLCD(" TIMER set "+
  String(round(Voltage))+" S", "M-ON;S-ON;D-OFF;");
  lcd.setCursor(0,1);
  lcd.print("M-ON;S-ON;D-OFF;");
}
if (digitalRead(MAINS) == HIGH && digitalRead(STAR)
== HIGH && digitalRead(DELTA) == LOW) {
  delay(Voltage * 1000);
  { digitalWrite(MAINS, HIGH); digitalWrite(STAR,
  LOW);
  // displayOnLCD(" TIMER set "+
  String(round(Voltage))+" S", "M-ON;S-OFF;D-OFF;");
  lcd.setCursor(0,1);
  lcd.print("M-ON;S-OFF;D-OFF;");
  delay(2000);
  digitalWrite(DELTA, HIGH);
  // displayOnLCD(" TIMER set "+
  String(round(Voltage))+" S", "M-ON;S-OFF;D-ON;");
  lcd.setCursor(0,1);
  cd.print("M-ON;S-OFF;D-ON;");
}
  delay(200);
}
if (strtonvalue == LOW && strttoffvalue == HIGH) {
  digitalWrite(MAINS, LOW);
  digitalWrite(STAR, LOW); digitalWrite(DELTA, LOW);
  // displayOnLCD(" TIMER set "+
  String(round(Voltage))+" S", "M-OFF;S-OFF;D-OFF;");
  lcd.setCursor(0,1);
```



```

lcd.print("M-OFF;S-OFF;D-OFF;");
}

}

```

3. IMPLEMENTATION OF THE SOFTWARE

The automatic star delta starter system is designed and developed by contactor and timer relay. The induction motor have wide variety characteristics, industrially it plays the premier role. Some of those are self-starting mechanism, heavy construction, high efficiency, good power factor etc. Different types of induction motor are available. Squirrel cage induction motors are mostly used than the other types. Small and medium size induction motors are started directly on line, but when very large motors are started that way, because of large amount of current flow through the motor. To reduce the high starting current, large induction motors are started at reduced voltage and then have full supply voltage reconnected when they reached to near to the rated speed.

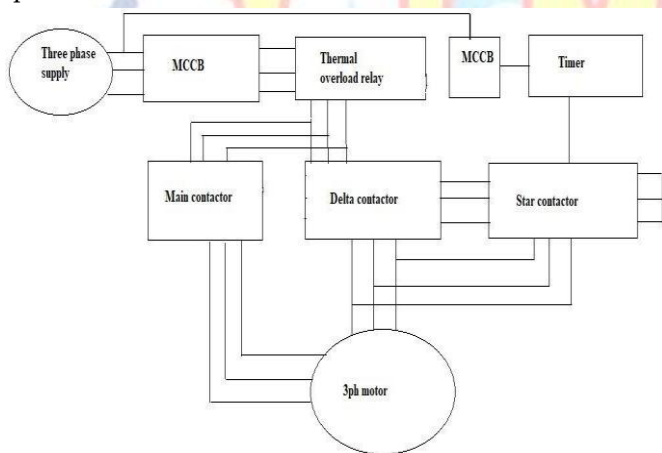


Fig 1 Block diagram of star-delta starter

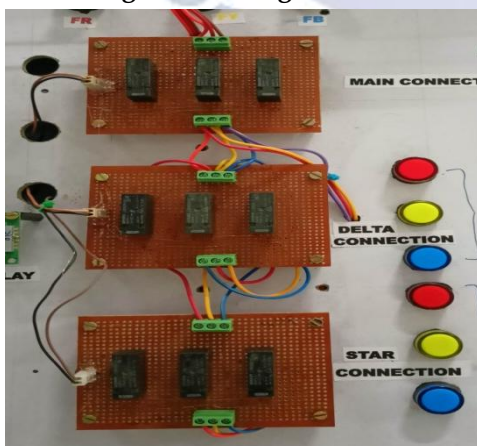


Fig 2 starter contact

These are the 3 connections which are present in the starter. Main connection delta connection and star connection at the start the connection must be in the star connection and while at the running condition the starter will convert in to main and star connection for some time while it convert into main the connection will be shifted to the delta connection. there are three relays are placed at each of the connection for the safety purpose the connections which are given are in series to each other .

When the connection is at star the star connected lights will glow and time to glow will be decide by the timer. The timer will be decided by the motor HP. that is present at the name plate details. There are three lights when the connections at the 3 phase then the three lights will be glow . if we connect the connections to the 1 phase the connected lights will be glow.

When the connection is at the delta connected lights will glow and time to glow will be decide by the timer. The timer will be decided by the motor HP. that is present at the name plate details. There are three lights when the connections at the 3 phase then the three lights will be glow . if we connect the connections to the 1 phase the connected lights will be glow.



Fig 3 LCD Display

At the starting condition all the connections are at off condition because we did not switch on the motor. When we start the motor it will change its condition and the time set represent the time required to change the connections that is based on the HP of the motor



Fig 4 LCD Display

At the end the both main and delta will be at ON condition star will be at off condition. at this the motor will get required amount torque and it will run at the constant speed.

TABLE 1 OPERATION OF STAR DELTA CONNECTIONS

MAIN CONNECTION	STAR CONNECTION	DELTA CONDITION
OFF Condition	OFF Condition	OFF Condition
ON Condition	ON Condition	OFF Condition
ON Condition	OFF Condition	OFF Condition
ON Condition	OFF Condition	ON Condition

4. CONCLUSION

This project uses a system to start a 3 phase motor at 440 volt AC mains supply 50 Hz with a set of 12 volt DC relays in star mode first and then to delta mode by an electronically adjustable timer. It still retains its application for a 3 phase motor starting with single phasing prevention also. The project also has the provision of single phasing protection since 3 phase motors get burnt if any one phase goes missing during running. The output to the lamps shall be completely cut-off in the event of any phase failure.

Further the project can be enhanced by using a thyristors in firing angle control principle for soft start of the induction motor that would overcome all the drawbacks of star delta starter.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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