



# International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

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## Soft Switch Starter for Low Power Three Phase Induction Motor

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**ABSTRACT:** Induction motors are the most frequently used machines in various electrical drives. The project is designed to provide low voltage start to induction motors. This is achieved by using star to delta conversion. Star/Delta starters are probably the most common reduced voltage starters in the 50Hz industrial motor world. Star delta is used in an attempt to reduce the starting current applied to the motor. Thereafter, full load current is applied to the motor. The Star/Delta starter is generally manufactured from three contactors, electromechanical timer and a thermal overload for operating a 3 phase motor at 440 volt at ac mains supply 50 Hz. A thyristorised star/delta switch is proposed as a soft starter and energy saver for delta connected induction motor drives. A Gate-Turn-Off (GTO) switch and its gate drive circuit have been developed as a replacement for the relay contact switch.

**KEYWORDS:** Soft switch, GTO, Star Delta Starter, Microcontroller, Energy saver

### I. INTRODUCTION

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 Power GTOs in star mode first and then to delta mode by an electronically adjustable timer. A set of Power GTOs are used to shift the motor connections from star to delta with a time delay. The project is supplied with 3 phase 3HP motor i.e., two lamps representing each phase winding of the motor. The interlocking arrangement of the Power GTO and the electronic timer are all wired in low voltage DC of 12 volt fed from an inbuilt DC power supply for safe handling of the starter during the study. It still retains its application for a 3 phase motor starting with single phasing prevention. During star operation the lamps would glow dim indicating the supply voltage across the coils are 440/3. In delta condition after the timer operates the lamps would glow with full intensity indicating full supply voltage of 440volts. The timer comprises of a 555 timer in mono-stable mode the output of which is fed to a Power GTO for changing the mains supply from 3 phase star to delta. 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. This starter is used in an attempt to reduce the starting current fed to the motor during start as a way of dwindling the disorder and intervention on the electrical supply.

The Star/Delta (Wye/Delta) starter is one of the low cost electromechanical reduced voltage starters. Voltage during starting of the motor with windings connected in star configuration is 230V across each winding; this reduces the torque by a factor of three. Voltage during running the motor with windings connected in delta configuration is 400V across each winding. One major disadvantage of the star delta starting is the reduction in the starting torque from 1038



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Nm to 343 Nm ( by approximately 67% ). The reason for these 67% changes become clear when we examine the phase voltage on the motor. We see that the phase voltage when the motor is connected in Delta is 380 Volt. When the motor is however connected in Star, the Phase Voltage will be 219.3 Volt. When the motor is started in the star connection, the phase voltage of the motor is reduced by a factor of 3.

## II. RELATED WORK

### A. Design of Gate Turn Off Switch for Pulsed Power Application

The Design Of A Gate-Turn-OFF (GTO) Switch For Pulsed Power Application indicates A Gate-Turn-OFF (GTO) thyristor switch and its gate drive circuit have been developed as a replacement for the thyatron switch used in the positron converter solenoid lens power supply at the Advanced Photon Source (APS) to deliver a current pulse of 6000 A at 60-Hz repetition rate. This paper discusses the characteristics of the GTOs under consideration, the gate drive circuit, and some test results In the APS linac, a solenoid coil placed downstream of the tungsten target focuses the positron beam. A current pulse goes through the solenoid coil to produce the focusing magnetic field. The current pulse is generated by a resonant pulse generating circuit. The switch closes to discharge a capacitor bank into the solenoid coil to produce the required current.

### B. Automatic Star Delta Starter for Low Power Three Phase Induction Motors

The project is designed to provide low voltage start to induction motors. This is achieved by using star to delta conversion. Star/Delta starters are probably the most common reduced voltage starters in the 50Hz industrial motor world. Star delta is used in an attempt to reduce the start current applied to the motor. Thereafter, full load current is applied to the motor. The Star/Delta starter is generally manufactured from three contactors; and electromechanical timer and a thermal overload for operating a 3 phase motor at 440 volt at ac mains supply 50 Hz. A thyristorised star/delta switch is proposed as a soft starter and energy saver for delta connected induction motor drives. A Gate-Turn-OFF (GTO) thyristor switch and its gate drive circuit have been developed as a replacement for the relay contact switch. 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 Power GTOs in star mode  $\_rst$  and then to delta mode by an electronically adjustable timer. A set of Power GTOs are used to shift the motor connections from star to delta with a timedelay

### C. Star Delta Starting and Dual Voltage Motor

In our efforts to assist our valued customers, we often answer customers technical questions. Two such questions are answered in this paper: Firstly: What is the application and use of Star-Delta starting Secondly: What does it mean when a motors rating plate lists two different supply Voltages Traditionally each motor was custom designed for its specific application. Unfortunately competition, market pressures and cheap imports forced suppliers of electrical motors to standardise on designs and constructions, to change the manufacturing cycle to high volume production lines. Governing bodies like IEC, NEMA, and SABS compiled standards to assist both the end users, as well as the manufacturers to ensure similar constructions between different manufacturers. These standards aim to define specific performance values, construction types and rating classes. For the most part these specifications succeeded in this regard! Sadly it also relieved the end user of much of his responsibility to understand the application, usage, and design of the electric motor and the load it drives..

## III. PROPOSED METHODOLOGY

We design “soft switch starter” using GTO and microcontroller.” in which The Gate turn off thyristor (GTO) is a four layer PNP power semiconductor switching device that can be turned on by a short pulse of gate current and can be turned off by a reverse gate pulse. This has three terminals namely Anode (A), Cathode (K) and Gate (G). The two-way arrow convention on the gate lead distinguishes the GTO from the conventional thyristor. The Fig (a) shows the block diagram of an “soft switch starter”.

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## A. Block Diagram

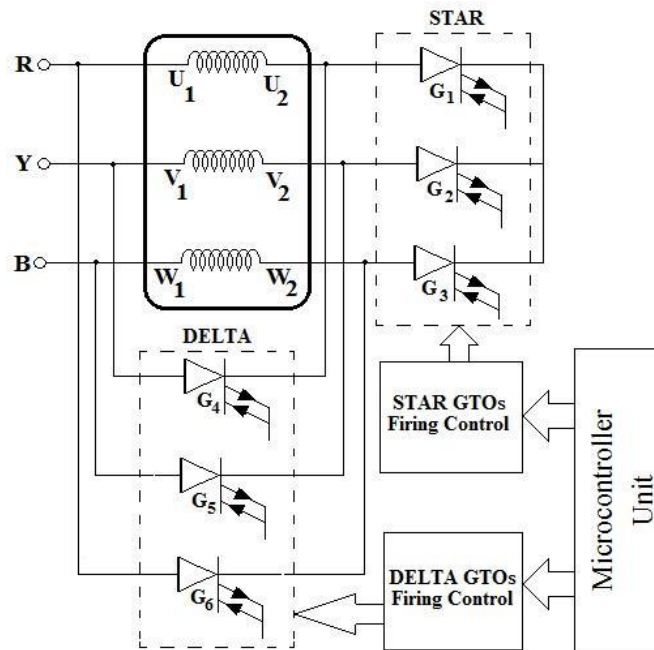


Fig Block Diagram

## B. Block Diagram Description

In this project six GTOs used are G1, G2, G3, G4, G5 and G6. During STAR connection GTOs G1, G2, G3 are connected to the terminal U1, V1, W1 and G4, G5, G6 are connected U2, V2, W2 and to neutral. During DELTA connection GTOs G1, G2, G3 are connected to the terminal U1, V1, W1 and G4, G5, G6 are connected U2, V2, W2 and to U1, V1, W1. During Delta all the six GTOs are utilized. When the main is switched on, after a time delay of 2 seconds the microcontroller provides gate signal of +5V to turn ON the GTOs G1, G2 and G3. The motor starts running in STAR connection. Later after a time interval of 20s the microcontroller switches OFF the STAR GTOs by providing -12V, then the microcontroller switches ON the DELTA GTOs by providing +5V to the gate of GTO G4, G5 and G6. Therefore the motor is now operated in delta connection.

## IV. RESULTS AND DISCUSSION

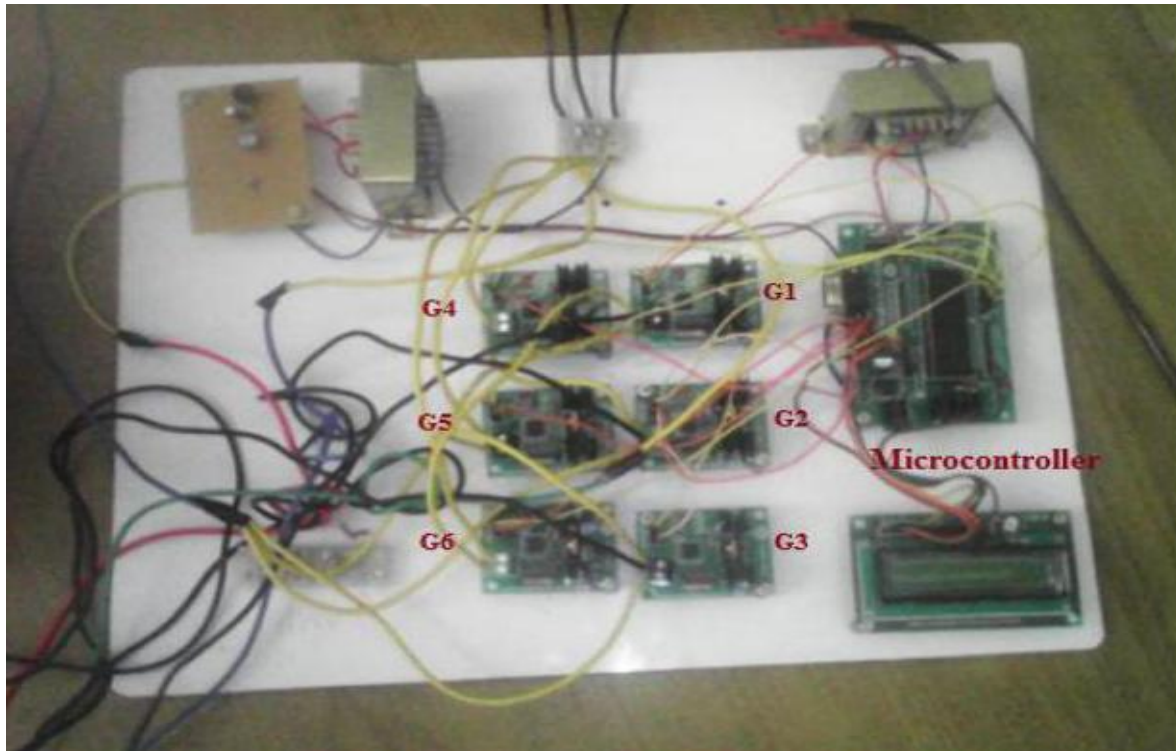
Soft switch starter for 3-phase induction motor project was implemented and tested. GTO is used for the purpose of soft switching so that the starter works. The project was successfully completed.

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**Fig Working Model**

## V. CONCLUSION

An automatic voltage fluctuation protector system has been implemented for protection of induction motor. The assembly unit is very compact and portable. The cost of constructing this project is relatively low as compared to its function. It can be easily commercialized. The GTO can be replaced with SCR for high power ratings. By changing the gate triggering, power converter can also be incorporated. The parameters can be monitored and controlled easily while using semiconductor switches.

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