



e-ISSN:2582-7219



# INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

Volume 5, Issue 7, July 2022



INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 7.54



6381 907 438



6381 907 438



ijmrset@gmail.com



www.ijmrset.com



# Fully Automated Intelligent Starter for Induction Motor Protection with Industrial Applications

R.Rajkumar<sup>1</sup>, M.Tamilselvan<sup>2</sup>, M.Vallarasu<sup>3</sup>, S.Ramkumar<sup>4</sup>, E.Saran<sup>5</sup>, P.Vithyapathi<sup>6</sup>,  
M.Swathisriranjani<sup>7</sup>, V.Deepika<sup>8</sup>

UG Student, Department of Electrical and Electronics Engineering, Muthayammal Engineering College,  
Tamil Nadu, India<sup>1,2,3,4,5,6</sup>

Assistant Professor, Department of Electrical and Electronics Engineering, Muthayammal Engineering College,  
Tamil Nadu, India<sup>7,8</sup>

**ABSTRACT:** The induction motor is the most common type of electrical motor used in industry and it is used in elevators, escalators, pumps, fans, conveyors belts etc. This paper represents to design the intelligent starter to start the motor with out man power, protect the motor from high voltage and over current. Automatic star delta starter is equipment/appliance reduces starting current and starting torque. Automatic star delta starter design normally integrates three contactors, an overload relay or circuit breaker, and a timer for setting the time in the star position (starting position). For the star delta starter, a motor must be in delta connected position during a normal run and the main purpose is used for automatically start the motor. When the motor is at idle, it just is like the short-circuited transformer at secondary side because all the rotor bars are connected together to form a closed path. This will draw a large current flow through the rotor bars. So when the motor is start, stator draws high current which is 8-10 times that of the rated current. This proposed work of GSM module SIM900A is used to message via mobile during the motor ON or OFF condition. The performance of the proposed method is evaluated through simulation using MATLAB/ simulink software.

**KEYWORDS:** Contactors, Timer, Over Load Relay, GSM module.

## I.INTRODUCTION

An induction motor (also known as an asynchronous motor) is a commonly used AC electric motor. In an induction motor, the electric current in the rotor needed to produce torque is obtained via electromagnetic induction from the rotating magnetic field of the stator winding. The rotor of an induction motor can be a squirrel cage rotor or wound type rotor. The device which is used to limit the starting current and reduce the starting torque is called Starter. It reduces the starting current to a safe value. Due to the wide variety characteristics of the induction motor, it plays the premier role in the industrial sector. Some of those are self starting, rugged construction, high efficiency, good power factor and ease of control, etc. Squirrel cage type of induction motors are mostly used widely than the other types. When the motor is at idle, it just look like short circuited transformer at secondary side because all the rotor bars are connected together to form a closed path. This will turn a large current flow through the rotor bars. So when the motor is started, stator draws the high current which is 8-10times that of the motor rated current. Before starring the motor, it is necessary reduce the voltage applied to the motor. The project is designed to provide low voltage start to induction motors. This is achieved by using star to delta conversion. A set of relays are used to shift the motor connections from star to delta with a time delay. 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 then after sometime full load current is applied to the motor. Since in star connection current is same in different phases while line voltage is the root three times the phase voltage. After a period, the windings are reconfigured as delta and the motor runs normally. The star delta starter is generally obtained from three contactors. Electromechanical timer and a thermal overload relay for operating a 3-phase motor at 440 volts at ac mains supply of 50 Hz. The project is designed to start a 3 phase motor at 440 volt AC mains supply 50 Hz with a set of 12 volt relays in star mode and then to delta



mode by an electronically adjustable timer. A set of relays are used to shift the motor connections from star to delta with a time delay. Automatically start the motor without man power.

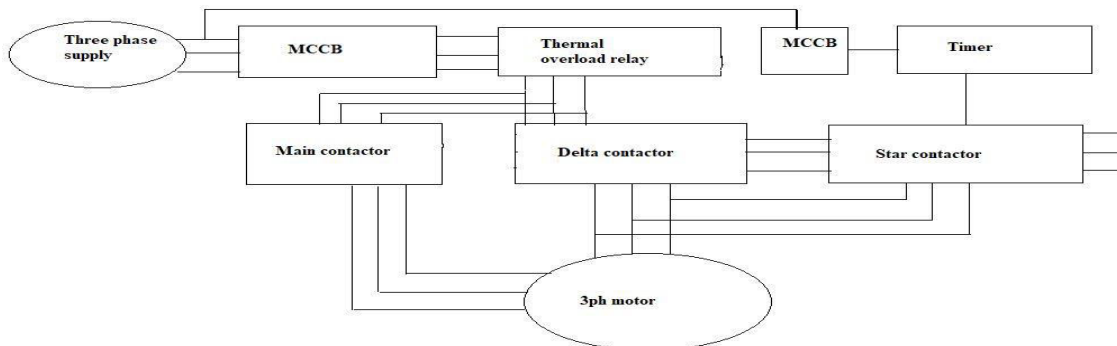
**II.EXISTING METHOD**

**Star -Delta Starter**

The star delta starter can only be used with a motor, which is rated for connection in delta operation at the required line voltage, and has both ends each of the three windings available individually. the winding in a star connection Under this connection, the voltage across each winding is 1/(3) of line voltage and so the current flowing in each winding is also reduced by this amount .The resultant current flowing from the supply is reduced by a factor of 1/3 as is the torque. At start, the line voltage is applied to one end of each of three windings, with the other end bridged together, effectively connecting. The resultant current flowing from the supply is reduced by a factor of 1/3 as is the torque.

**Star or Y-connected system**

When three coils or windings, placed 120° apart, are connected together at a common point as shown in below figure, they form star or Y-connected circuit. The common point is called the Neutral or Star point. The current flowing through each coil is called phase current and that flowing through main line is called line current. It can be seen in figure that each phase or coil is connected series with its respective main line. When only three main lines are drawn, it is said to be a 3-phase, 3-wire system. Often a neutral line is also drawn from the neutral point. In this case the system is called a 3-phase, 4 wire system.



**Figure1. Existing Method of Intelligent Starter**

**Delta Or Mesh Connected Circuit**

In delta connection no neutral point is available. With this connection only three-phase, three wire systems is possible. In delta or Mesh connection each coil or phase is connected across two main lines. Therefore in delta connection, line voltage is equal to phase voltage. Two different values of supply voltage cannot be obtained with this connection. In a delta connected system line current is equal to  $\sqrt{3}$  times phase current.

**III.PROPOSED METHOD**

In this proposed work, there are three states of Star-Delta starters, a). Star Connected State, b). Open State, and c). Delta Connected State. During starting time Main and Star Contactors remain closed and complete Circuit. In Star Connected State, voltage applied is reduced to  $1/\sqrt{3}$  of the Line Voltage across each winding. As and when motor attains good rotational speed, say about 90% of full R.P.M. after few seconds, timer connected in starter disconnects Star Contactor first and then connects Delta Contactor. In Delta connected state voltage applied to windings is equal to Line Voltage. Items Required to Make Star Delta Starter Three Contactors (One Main Contactor, One Star Contactor and One Delta Contactor), Over Load Relay (orOLR) Timer, Fuse Switch Unit (or FSU), 2 Pole MCB, Fuse, Start Push Button ( NO) Stop Push Button.

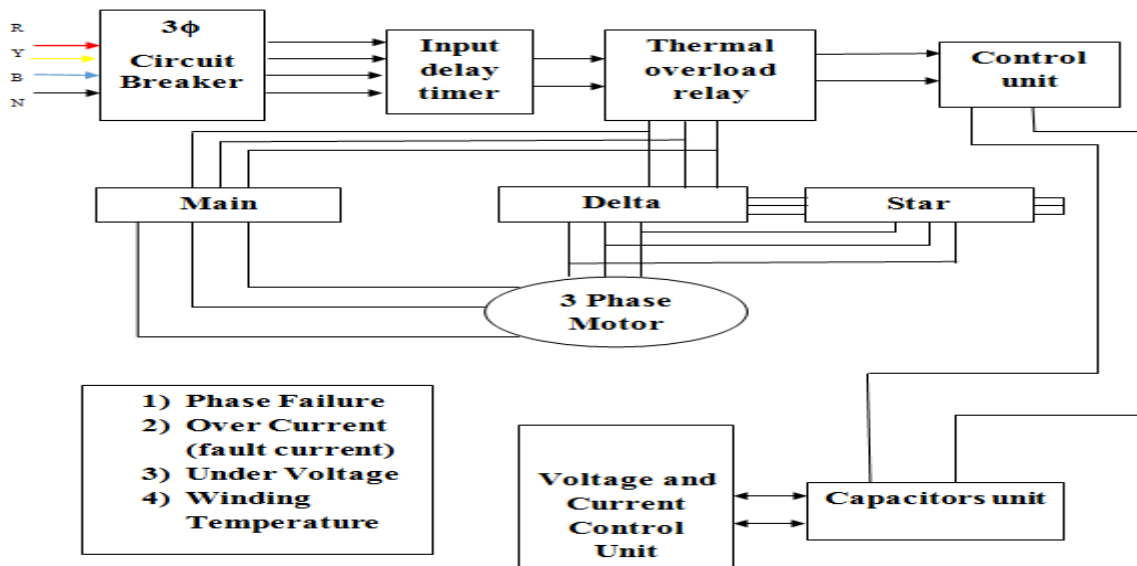


Figure 2. Proposed Block diagram of intelligent starter

#### A. Circuit Breaker

A circuit breaker is an automatically-operated electrical switch designed to protect an electrical circuit from damage caused by overload of electricity or short circuit. A circuit breakers function is to detect a fault condition and, by interrupting continuity, to immediately discontinue electrical flow.

#### B. Input Delay Timer

Input delay timer with ON-delay operation, the Timer receives an input and then an output signal is output by switching the Timer contacts after a set time delay. This name is used because there is a delay between when the input signal is received (i.e., turns ON) and when the output signal is output.

#### C. Thermal Overload Relay

Thermal overload relays are economic electromechanical protection devices for the main circuit. They offer reliable protection for motors in the event of overload or phase failure. The thermal overload relay can make up a compact starting solution together with contactors.

#### D. Contactor

A contactor is an electrical device which is used for switching an electrical circuit on or off. These contacts are in most cases normally open and provide operating power to the load when the contactor coil is energized. Contactors are most commonly used for controlling electric motors. A contactor is one of the main electrical circuit parts, which can stand on its own power control device or a part of a starter. They are used to connect and break power supply lines running through power lines or repeatedly establish and interrupt electrical power circuits.

#### E. Main Contactor

A contactor is one of the main electrical circuit parts, which can stand on its own power control device or a part of a starter. They are used to connect and break power supply lines running through power lines or repeatedly establish and interrupt electrical power circuits.

#### F. Delta Contactor

There are two contactors that are close during run, often referred to as the main contractor and the delta contactor. These are AC3 rated at 58% of the current rating of the motor. The third contactor is the star contactor and



that only carries star current while the motor is connected in star. A delta connection is a connection used in a three-phase electrical system in which three elements in series form a triangle, the supply being input and output at the three junctions. The delta connection consists of three-phase windings connected end-to-end which are 120° apart from each other electrically.

### G. Star Contactor

The star contactor 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. As per given in above figure, initially when start button pressed, timer's star point become NC and so Star contactor energizes. Now main contactor is connected through auxiliary NO from Star contactor.

The main purpose of star-delta starter is to reduce the requirement of high starting current. Normally the starting current of an induction motor is 6 to 7 times of the full load current. This will produce a large voltage drop in the line and affect other devices when a heavy rating induction motor starts. As well as for larger motor the starting current may be so high that it may damage the stator coil or even the power cables. When we apply a three phase voltage across a star connection each coil will receive a much reduced voltage ( $V_P = V_L / \sqrt{3}$ ). 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.

## IV. CONTROL METHODOLOGY

Automatic motor starter controllers are used for automatic control of three phase motor starters. These are capable of restarting the motor automatically once the power in all the three phases resumes back in healthy condition. Automatic motor starter controllers equipped with Timer System operates the motor starter with a startup time delay of 10 to 50 seconds which prevents sparking at contact points of contactors and increase the life of motor starter.

- Automatically starts the motor
- No need of Operator
- Protects motor from running in Two Phases
- Protects motor against unbalanced Voltage conditions
- Protects motor against reverse running
- Gives satisfactory results for any HP Motor
- Timer System (selected models) Overload Locking (selected models).

### GSM MODEM 900A

SIM900A Modem is built with Dual Band GSM based SIM900A modem from SIMCOM. It works on frequencies 900MHz. SIM900A can search these two bands automatically. The frequency bands can also be set by AT Commands. The baud rate is configurable from 1200-115200 through AT command. SIM900A is an ultra compact and wireless module. The Modem is coming interface, which allows you connect PC as well as microcontroller with RS232 Chip(MAX232). It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS, attend the incoming calls and ect. Through simple AT commands. This is a complete GSM module in a SMT type and made with a very powerful single-chip, allowing you to benefit from small dimensions. SIM 900A GSM Modem with serial and TTL outputs.



Figure 3:GSM MODEM 900

There is power on pins on the device, which helps to turn it on using external signals. There is two power on pins. The first one is PWRKEY which requires a LOW signal to power on/off the system. To do that, the pins require an input signal for a little bit long time. The second pin is PWRKEY\_OUT, which gets short with the PWRKEY pin and turn on/off the device.

V. SIMULATION RESULT

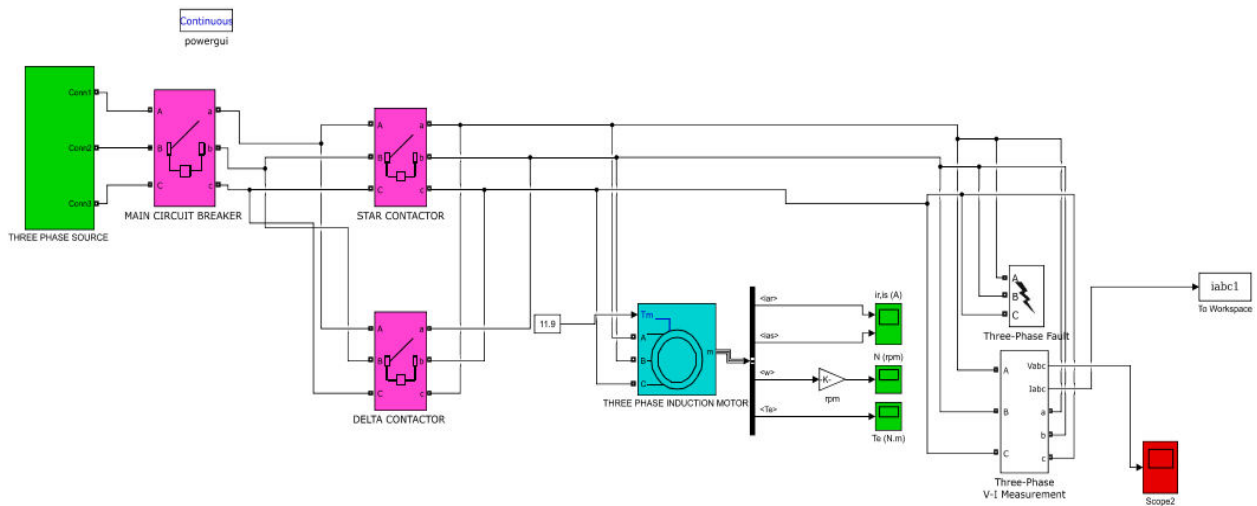


Figure 4.Software Circuit

## VI. HARDWARE DESCRIPTION

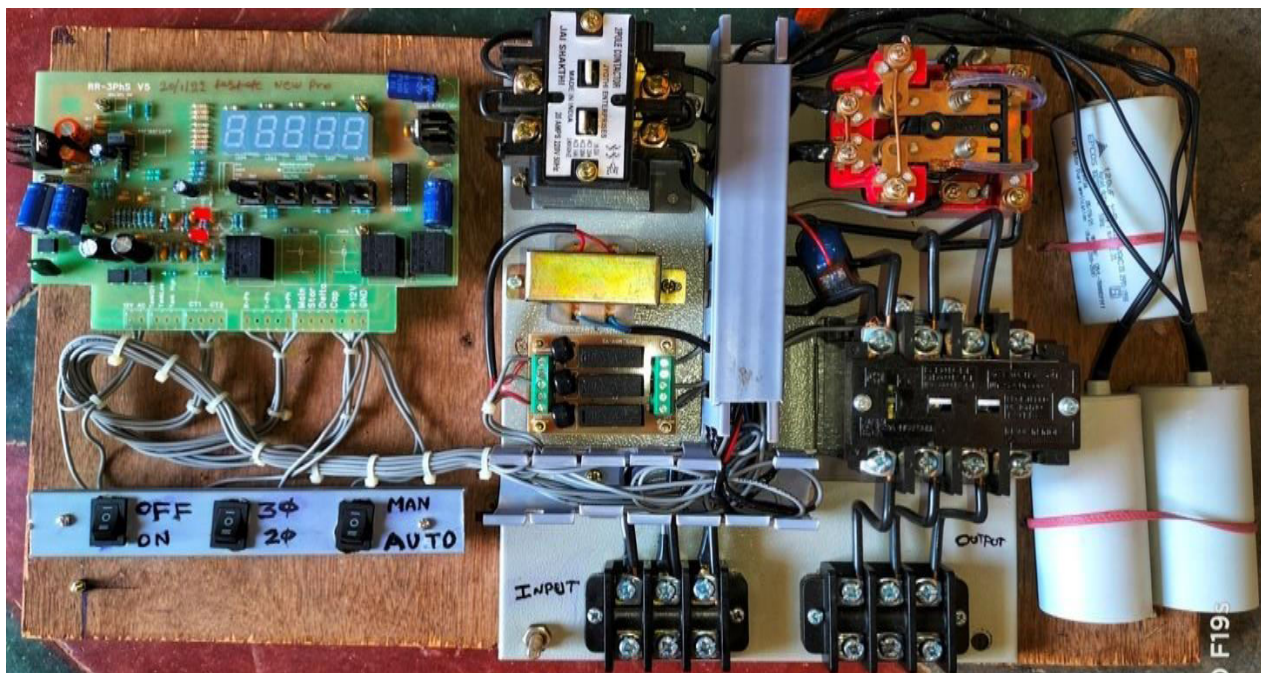


Figure 5. Hardware Implementation

## VII. CONCLUSION

In this proposed work simulation of an intelligent starter, protection of induction motor and control of induction motor from high voltage was designed and simulated. The main aim of this proposed work to design intelligent starter using GSM module (SIM900A) for the purpose of getting message via mobile during the motor ON or OFF condition and start the motor automatically without man power of starter in industrial and real time applications.

## REFERENCES

1. K. Sundareswaran and B.M. Jos, 2017. Development and Analysis of Novel Soft Starter. The simplicity of operation and smoothness in starting, Soft starters are usually expensive. [IEEE 2017], PP. 152(4).
2. Rinchen Geongmit Dorjee, Described about Monitoring and Control of a Variable Frequency Drive Using PLC Starter, Reduce harmonics, Smooth starting, Motor starting time is high. Energy Conversion, vol. 35, no. 4, pp. 1598–1518, 2019.
3. B. Sheeba Rani, S. Jayanthi and C. Yuvaraj, discussed Electronic Soft Starter for Induction Motor, International Journal of Advances in Engineering, 1(3), 135 – 140, 2015.
4. Mohamed Wasim Ansari. K. Mohanasundaram. K. Mohan. C. Fuzzy Logic based Soft Starting of Three Phase Induction Motor, International Journal of Innovative Research in Science, Engineering and Technology, Volume 3, Special Issue 2, April 2014.
5. V. Sri Kumar, V. Senthil Raja, Y. Sathish, R. Prakash, S. Saravanan, " BLDC Motor Driven Solar PV Array Fed Water Pumping System Employing Zeta Converter", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.10, Issue.10, Pp.13790-13796, 2021
6. S. Siva, V. Venkatesh, R. Vigneshwaran, C. S. Satheesh, S. Saravanan, " Automatic Solar Tracking System using MPPT with Mirror Booster", International Journal of Innovative Research in Science, Engineering and Technology, Vol.10, Issue.10, Pp.6859-6865, 2021
7. S. Prem Kumar, M. Rubeshan, V. Surya Prakash, N. Mohanantini, S. Saravanan, " Wireless Communication System



- based Automatic EB Billing and Disconnection Schemes”, International Journal of Innovative Research in Science, Engineering and Technology, Vol.10, Issue.10, Pp.6866-6871, 2021
8. R.Vijay, V.Vignesh, M.Nithyanantham, R.Raja , S.Saravanan, T.Premkumar, E.Viswanathan,” Design of Electric Vehicle Drive Using Regenerative Power”, International Journal of Innovative Research in Science, Engineering and Technology, Vol.10, Issue.10, Pp.6872-6879, 2021
  9. S.Satham Hussian, T.Surya, G.Vignesh, R.Manikandan, S.Saravanan,” Smart Communicative Covid-19 Informative and Scanning BOT”, International Journal of Innovative Research in Science, Engineering and Technology, Vol.10, Issue.10, Pp.6880-6885, 2021
  10. AVR.Vimalkanth, S.Vimal, NM.Santhoshkumar, G.Dineshkumar, S.Thamilselvan, N.Sathya, S.Saravanan,” An Intelligent Fire Fighting Robot using WSN ”, International Journal of Innovative Research in Science, Engineering and Technology, Vol.10, Issue.10, Pp.13840-13846, 2021
  11. A.Parthipan, S.Vijay, D.Sridhar, M.Swathisriranjani, S.Saravanan, S.Thamilselvan, N.Sathya,” Automatic Grinding System for Food Products Using Embedded System”, International Journal of Innovative Research in Science, Engineering and Technology, Vol.10, Issue.10, Pp.13847-13854, 2021
  12. V. Priyadharshini, V. Vijayalakshmi , S. Vidhyashri , G.Nandakumar, G.Nagarajan, S.Saravanan ,” Design and Development of Garbage Collector Robot”, International Journal of Innovative Research in Science, Engineering and Technology, Vol.10, Issue.10, Pp.13855- 13862, 2021
  13. R.Thirumarasu, V.Vallarasu, V.Vignesh, R.Sundar, R.Vinoth, T.Divya, S.Saravanan,” Smart Safety Monitoring System for Sewage Workers using Arduino”, International Journal of Innovative Research in Science, Engineering and Technology, Vol.10, Issue.10, Pp.13863-13868, 2021





**INNO SPACE**  
SJIF Scientific Journal Impact Factor  
Impact Factor  
7.54

**ISSN**

INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA



# INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH IN SCIENCE, ENGINEERING AND TECHNOLOGY

| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | [ijmrset@gmail.com](mailto:ijmrset@gmail.com) |

[www.ijmrset.com](http://www.ijmrset.com)