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# Speed Control of Single Phase Induction Motor Using Solid State Relay

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ABSTRACT

Single phase induction motor has been used widely in discipline industry and household where a simple motor starter can't let vary speed in starting and also running with mechanical load. This paper introduces a method for controlling the speed of an AC single phase induction motor by considering the combination of solid state relay along with Global System of Mobile (GSM). Single phase induction motor speed control is achieved by making use of Micro controller. A single phase induction motor adjustable speed control is implemented with hardware setup and software program.

Keywords: Ardunio Microcontroller, Bridge rectifier, GSM Modem, Induction Motor, Solid state relay, Liquid crystal display and Transformer.

## 1. INTRODUCTION

The characteristics of single phase induction motors are identical to 3-phase induction motors except that single phase induction motor has no inherent starting torque and some special arrangements have to be made for making itself starting [3]. It follows that during starting period the single phase induction motor must be converted to a type which is not a single phase induction motor in the sense in which the term is ordinarily used and it becomes a true single phase induction motor when it is running and after the speed and torque have been raised to a point beyond which the additional device may be dispensed with [10]. For these reasons, it is necessary to distinguish clearly between the starting period when the motor is not a single phase induction motor and the normal running condition when it is a single phase induction motor [8]. The starting device adds to the cost of the motor and also requires more space. For the same output a 1-phase motor is about 30% larger than a corresponding 3-phase motor.

***Relay**:* A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contractor [9]. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays". When an electric current is passed through the coil it generates a magnetic field that activates the armature, and the consequent movement of the movable contact either makes or breaks a connection with a fixed contact. If the set of contacts was closed when the relay was de-energized, then the movement opens the contacts and breaks the connection, and vice versa if the contacts were open. When the current to the coil is switched off, the armature is returned by a force, approximately half as strong as the magnetic force, to its relaxed position. Usually this force is provided by a spring, but gravity is also used commonly in industrial motor starters. Most relays are manufactured to operate quickly. In a low-voltage application this reduces noise; in a high voltage or current application it reduces arcing. When we say that a relay "operates," we mean that it either closes or opens its contacts-whichever is the required action under the circumstances. Most relays have a "control spring," or are restrained by gravity, so that they assume a given position when completely de-energized; a contact that is closed under this condition is called a "closed" contact, and one that is open is called an "open" contact. This is standard state relay observe the o/p of nomenclature, but it can be this experiment (i.e. voltage control & V\F control etc.) quite confusing and awkward to use.

| Components Used | Specifications |
|---|---|
| Induction Motor | Speed 6500r.p.m, Voltage 230V |
| G.S.M | 900A |
| Solid State Relay | 12V, 10AMPS |
| Transistor | BC540 |
| Transformer | 230V Step Down<br>1A, Output 12V, 1A |
| Capacitor | 1000µf |
| Arduino Microcontroller | Atmega328p |

## 2. SCOPE AND OBJECTIVE OF THE PROJECT

The present project aims to designing the speed control technique of 1-Ø induction motor using solid state relay observe the o/p of this experiment & compare with modern Implemented techniques (i.e. voltage control & V/F control etc.) By using Arduino microcontroller & GSM modem

observe the o/p variation of the techniques knowing the results &comparing with other Implemented techniques.

## 3. BLOCK DIAGRAM

The above circuit is the block diagram of proposed system that is speed control of single phase induction motor using solid state relay.

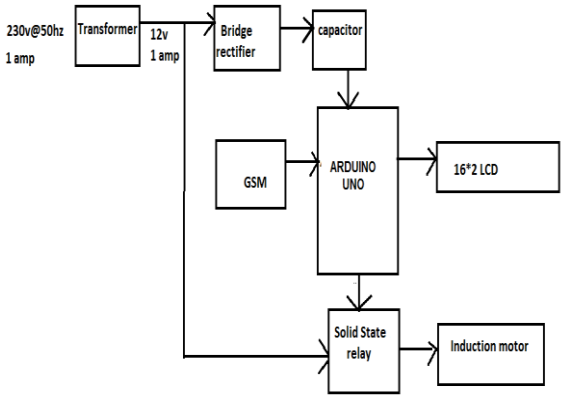



Fig.1: Block diagram

## 4. METHODOLOGY & OPERATION

Initially, 230VA.C supply is given to a step-down transformer and the output of transformer is given to a bridge rectifier. This D.C voltage is given to Arduino micro controller. The Arduino micro controller considered has two inputs and two outputs to control the speed of induction motor. Inputs to the micro controller are first one is D.C supply and the other input is from GSM modem. The required speed of induction motor is sent to the GSM modem in which a SIM card was inserted [1].

The given set speed to GSM modem acts as primary input [5]. A specific program corresponding to speed control of induction motor was dumped in microcontroller [2].Whenever the primary input is given to micro controller based upon the programming the speed of induction motor is controlled by means of a solid state relay [7].

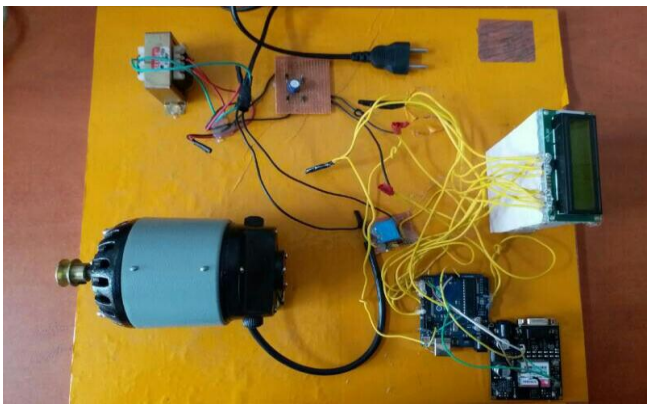


Fig.2: Hardware kit for speed control speed control of single phase induction motor using solid state relay

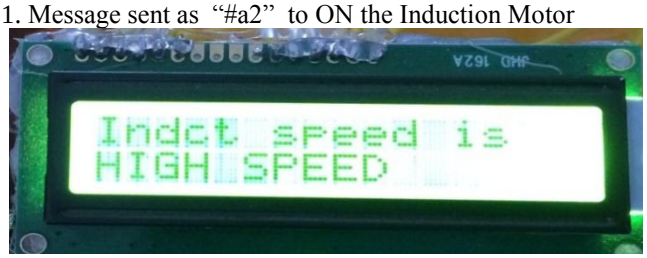
## 5. OPERATION OF SOLID STATE RELAY

Operation of an SSR based on a single MOSFET, or multiple MOSFETs in a paralleled array, can work well for DC loads [6]. MOSFETs have an inherent substrate diode that conducts in the reverse direction, so a single MOSFET cannot block current in both directions. For AC (bi-directional) operation two MOSFETs are arranged back-to-back with their source pins tied together. Their drain pins are connected to either side of the output .The substrate diodes are alternately reverse biased to block current when the relay is off. When the relay is on, the common source is always riding on the instantaneous signal level and both gates are biased positive relative to the source by the photo-diode .It is common to provide access to the common source so that multiple MOSFETs can be wired in parallel if switching a DC load. Usually a network is provided to speed the turn-off of the MOSFET when the control input is removed. In AC circuits, SCR or TRIAC, relays inherently switch off at the points of zero load current. The circuit will never be interrupted in the middle of a sine wave peak, preventing the large transient voltages that would otherwise occur due to the sudden collapse of the magnetic field around the inductance.

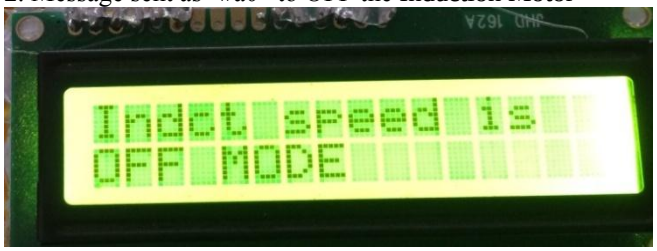
This feature is called zero-crossover switching. Parameters of SSRs are characterized by a number of parameters including the required activating input voltage, current, output voltage and current, whether it is AC or DC, voltage dropper resistance affecting output current ,thermal resistance, and thermal and electrical parameters for safe operating area (according to thermal resistance when repeatedly switching large currents). Advantages over mechanical relays .Most of the relative advantages of solid state and electromechanical relays are common to all solid-state as against electromechanical devices.

## 6. RESULTS

1. Message sent as "#a2" to ON the Induction Motor

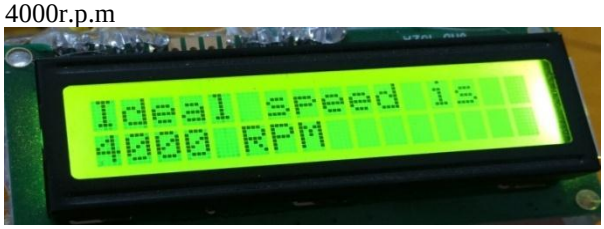



2. Message sent as "#a0" to OFF the Induction Motor




3. Message sent as #a1 to set the speed of Induction Motor to 2000r.p.m

4. Message sent as #a0b0 to set the speed of Induction Motor to 4000r.p.m




## 7. Conclusion and Future Scope

The speed control of single phase induction motor is achieved by using solid state relay. Various speeds like 2000r.p.m, 4000r.p.m and 6000r.p.m is achieved from remote location using GSM module [4]. In this project, relay is used to obtain the pulse width modulation as well as speed can be controlled. The cost is low where the reliability is high. The speed control methods of induction motor can also be used for power electronic devices like SCR, IGBT, DIODE, TRIAC, PWM techniques. The project can also be extended by using DTMF technology we can increase or decrease the motor speed control.

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