

# Design and Analysis for Soft Starter of Induction Motor by AC-PWM

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**Abstract**— Soft starters of induction motors are used in large number of applications such as blowers, fans, mixers, crushers, grinders, pumps and many other modern industrial applications. Voltage controller is the basic part of soft starter which is controlled to adjust the inrush current and developed torque. This paper presents a soft starter which is based upon soft starter of induction motor by AC pulse width modulation method the presented implementation gives satisfactory and promising results with PWM based controller. The presented approach can be used with off-line training as well as with on-line training and hence can solve the problem of on-line computation of firing angle.

**Key words:** Induction Motor, Soft Starter, Microcontroller, Crystal Oscillator, Voltage Regulator ,LCD

## I. INTRODUCTION

Induction motor is the most widely used motor in industry. The control of speed, torque and inrush current can enhance the performance of not only the motor but also of the system containing it. Performance of an induction motor is adjusted with the help of soft starter which is basically the AC voltage controller and is a part of every modern small induction-motor drive A soft starter provides smooth acceleration which reduces the mechanical stress due to high starting torque and increases the life and reliability of the equipment connected with the shaft of motor Stresses on electrical supply are also reduced due to voltage and inrush current control: burn-out conditions are eliminated with the help of soft starters as well Start/stop mechanism and speed is varied with the help of a soft starter which basically adjusts the firing angles of thyristers At start the developed torque of an induction motor has pulsations in it which can be removed by the proper selection of the firing angles of the thyristers as the torque developed is directly proportional to square of the applied voltage Researchers have suggested different control Strategies for the soft starting of induction motors. Reference provides the control with the help of artificial neural networks by controlling the firing angle but there is no feedback or estimation of the finally developed torque, speed and other parameters. The soft starter presented here showed very good performance when compared with other existing neural network based soft starter. It has also reduced cost with respect to rotor rheostat stater,primary resistance starter, auto transformer starter, star delta starter based implemented soft starters.

## II. SOFT STARTER

The soft starter controls the voltage applied to a motor by controlling the pulses applied to the gate of the thyristers The thyristers shown are fired in a particular sequence at appropriate time. The firing angle control is provided in different ways; as in our case with pulse width modulation. The motor which was controlled with the help of soft starter was modeled in hardware implementation. The circuit diagram shown in fig (1) and tested for different conditions with different types of motors: it showed satisfactory results as the starting torque and current were very close to the desired values. The inrush current, voltage dips in the system, speed and torque pulsations were recorded for each condition.

A number of techniques have been developed to reduce the impact of the start-up process for induction motors. These approaches can be grouped as: a) electromechanical, b) solid-state Variable Frequency Drive (VFD) and recently Introduced d) serial voltage injection.

### A. Soft Starters provide the following benefits

Reduced stresses and wear on the mechanics of the system, reduced starting currents, Minimize voltage dips on the supply Lowered Peak demand charges, Eliminate belt slippage on fans, and Smooth acceleration of motor / load.

## III. HARDWARE CIRCUIT

To implement the hardware circuit for this soft starter we have used this circuit diagram as under in fig (1) in this circuit we are using various other circuit which is further connected to the micro controller at the different pins according to use.

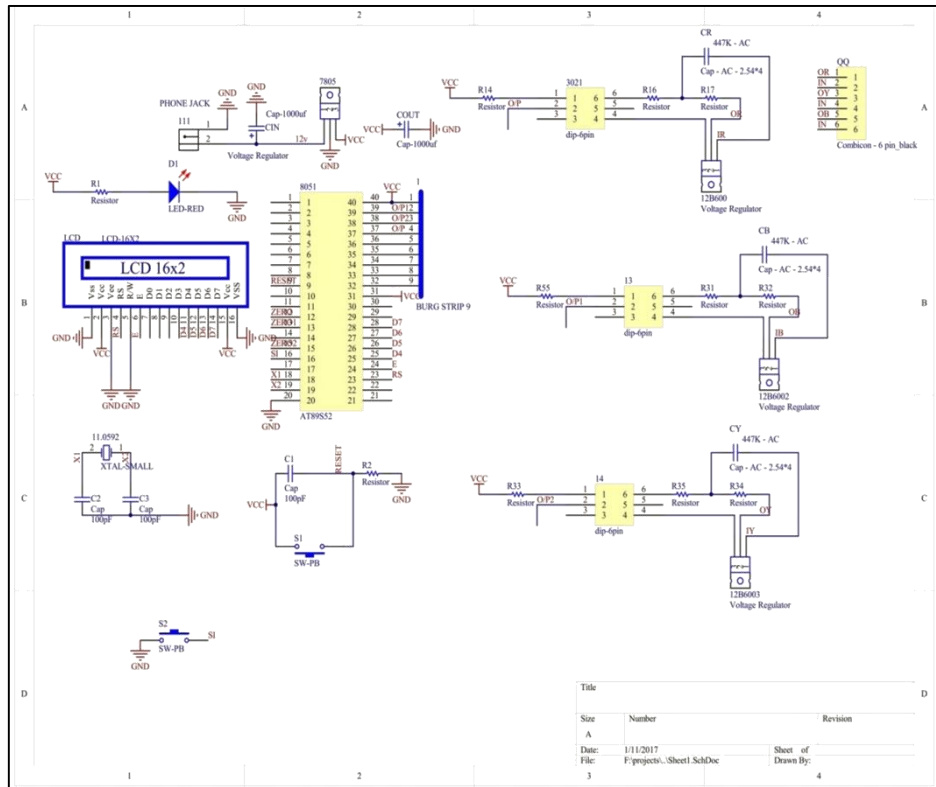


Fig. 1: Hardware circuit for soft start of induction motor using microcontroller.

From the above fig we can see that there are various components that are connected to the microcontroller which is AT89S52,

Which having various other circuits connected to it. Also we are having four different voltage regulator circuits to control voltage to different hardware components. Also we have LCD 16X 2 circuits having connected to microcontroller.

Also we have induction motor driven circuit which is made up of resistors ( $2.4\Omega \times 3$ ) and capacitor ( $1000\mu\text{f}$ ) and mosfet (12B6003). There is also crystal oscillator circuit is present which provide the operating frequency to controller. By using all these different circuits we are implement the hardware circuit for soft star induction motor

#### IV. DRIVER CIRCUIT

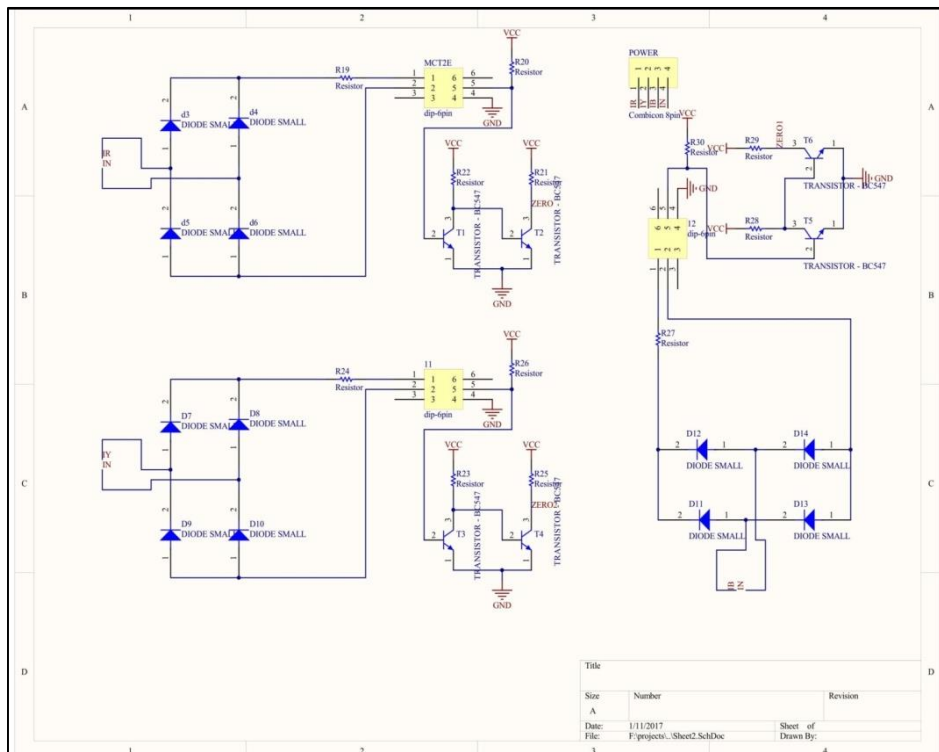


Fig. 2: Transistor circuit and zero crossing detector circuit used in hardware implementation.

From the above fig (2) we can see the transistors circuit which having important role in working of hardware circuit .

It consist of four diode connected antiparallel with each other and resistor also connected between the dip -6 pin and then goes to microcontroller ,transistor which is used here is BC547.

On the other hand we have zero cross circuit which is made up of different resistors and transistor .

Here we are used

- four diode ,
- two transistor (BC547) ,
- four resistor (2.54Ω X4),
- Combination 6 pin (MCT2E) type for power.

## V. PCB CIRCUIT

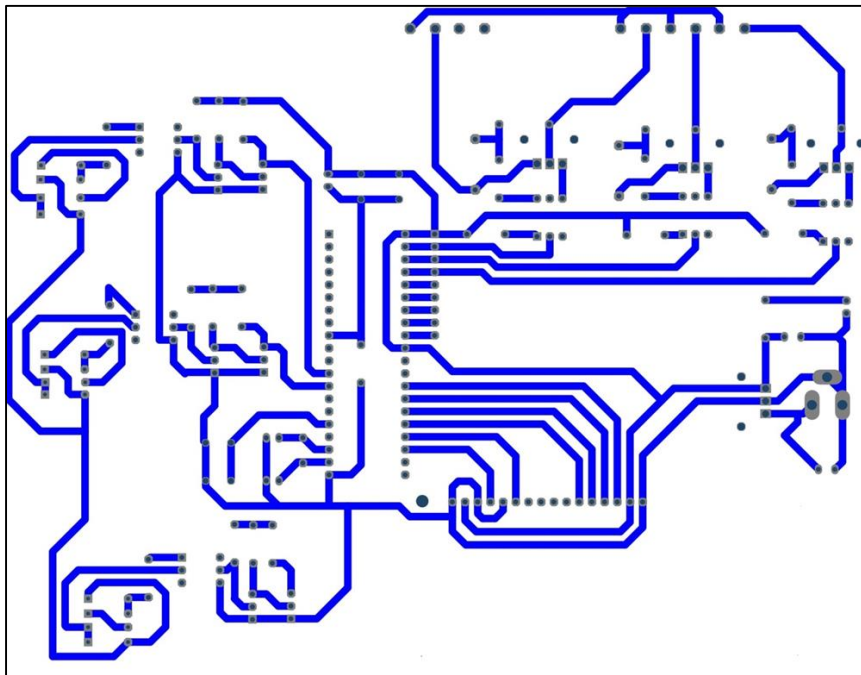


Fig. 3: PCB circuit used in hardware

The above fig shows the PCB circuit used in the hardware implementation for this project. This circuit is made by using Altium software according to the circuit diagram.

## VI. CONCLUSION

In this paper the proposed technique with results has shown that this soft starting method by pulse width modulation (PWM) works properly with accuracy. Reliability of this method is very high for the starting conditions of the induction motor as this method is operate within the fractions of seconds when induction motor is started. This method is fully automated and will not produce any harmonics by using this method we can improve the life of the machines The PWM method proposed in this paper is first integrated innovation that absorbs advantages of auto-transformer start method and Magnetic control method.

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