International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 04 Issue: 05 | May -2020 ISSN: 2582-3930

# Induction Motor Speed Control using Converter

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**Abstract: Speed control of single-phase induction motors is very much essential in every motor control practices since it reduces energy consumption and noise. The aim of this paper is to control the speed of induction motor by using TRIAC and DIAC. The firing angle of TRIAC is varied and accordingly the voltage applied to the induction motor is altered and consequently speed of the induction motor is changed. Efficiency of such voltage control is very high compared to other method.**

**Keywords: Induction Motor, Speed Control, TRIAC, DIAC.**

## A. INTRODUCTION

The Alternating Current (AC) voltage converters are being generally used to drive induction motors. This practice is not that much popular as it reduces the power quality by generating harmonic contents in the supply. Integral cycle control ofthyristors and phase angle control line commutated voltage controllers are being widely usedin various application [1] [2].

The power of the single-phase induction motor is controlled by connecting the TRIAC at the input side of single phase induction motor. The power is controlled by changing the firing angle of TRIAC. This power control method has high performance and efficiency as compared to the other power control methods. In this method, firing angle and the voltage is measured at every precise moment of time and then the TRIAC is triggered at any voltage.

## B. HARDWARE

Major components used in the system are TRIAC, DIAC, Toggle switch, seven segment display and induction motor

**1) TRIAC:**A TRIAC is also a 3 terminals and 4 layer semiconductor device used to switch and control AC power in both directions of a sinusoidal waveform.

**2) DIAC:** The DIAC is a 2 terminal bidirectional diode which can be switched on or off with their polarity of the applied voltage.

TRIAC, DIACarebidirectional device which blocks the current in the OFF state, act as an open circuit switch [4].

**3) Induction Motor:**The motor operates onthe principle of electromagnetic induction hence it is called as the induction motor. In Electromagnetic induction the electromotive force is induced across the electrical conductor, when placed in a rotating magnetic field. The induction motor has two main parts 1) Rotor (moving part) & 2) Stator (stationary part,) as shown in figure1.

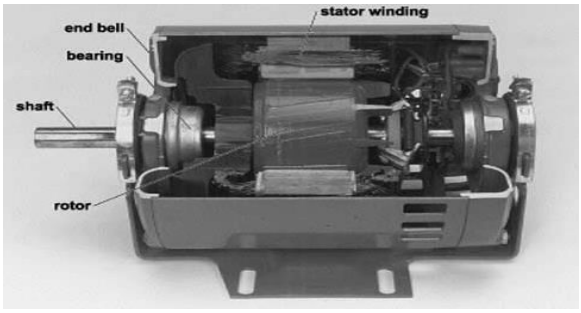


Figure 1: Cross section of Induction Motor

**4) Toggle Switch:** Toggle Switch is an electrical component used to control the flow of electric current or signal from a power supply to a device and has just two positions either ON (Open) and OFF (Closed) mechanism shown in figure 2.

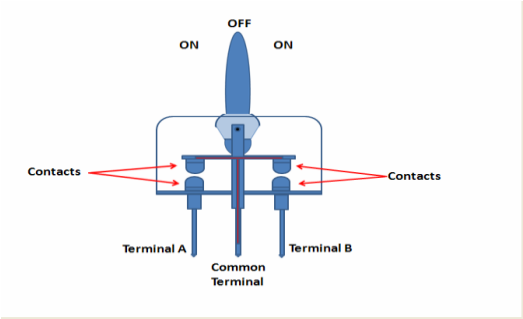


Figure 2: Toggle Switch

**5) Seven Segment Display:**Seven segment display is a device used for displaying digits and alphabet and are made up of either LEDs (Light emitting diode) or LCDs (Liquid crystal display). LED is P-N junction diode that emits the energy in the form of light while Liquid crystal displays use the properties of liquid crystal for displaying. Seven segment display helps us to see the voltage varied by the potentiometer.

## C. METHODOLOGY

The speed of a single phase induction motor is controlled by using TRIAC. We are controlling the voltage in this circuit. Here the voltage supplied to the induction motor stator terminals is controlled by TRIAC. The gate pulse of TRIAC are delayed which reduces the input voltage to the stator terminal of induction motor. We know that torque delivered by induction motor is proportional to the square of the operating voltage, so delaying the operating the voltage, the torque decrease and it result in decrease the speed of the motor [3]. The voltage control circuit consists of a TRIAC, triggering circuit, and regulated power supply unit. The power supplied to the electronic componentsis in range of 5VDC&12VDC.The triggering circuit will generate the required pulses for triggering the TRIAC, thus TRIAC will behave as intermediate component between supply and induction motorto control the speed of induction motor as per the requirement.

D. TRIGGERING CIRCUIT

The circuit includes components like: Variable resistor (P1/P2), Fixed resistor (R1/R2/R3), Capacitor(CI/C2/C3) shown in figure 3.The R-C circuit forms the triggering network.

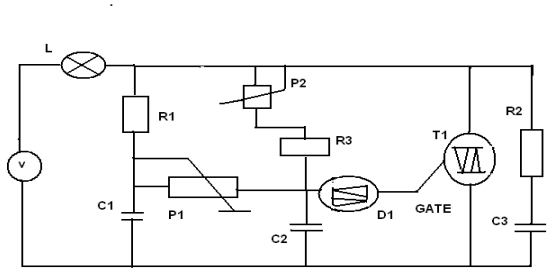


Figure 3: Circuit diagram using TRIAC

The matched DIAC-TRIAC pair are used to control AC voltage. The DIAC is used to trigger the TRIAC into conduction. Firing angle is controlled through RC circuit. The AC mains waveform is phase shifted by the RC circuit to reduce amplitude, phase delayed version of the mains waveform that appears across C3.

## E. PROCEDURE

Components are connected as per the circuit diagram. The variable resistor (potentiometer)knobare kept at minimum position, and supply of 230V AC supply is given to circuit. By varying resistance, the firing angle of TRIAC is altered and thus the voltage applied to the induction motor is changed and consequently the motor speed is changed. Observe the waveform using power scope or CRO. The voltage is measured by multi-meter and the firing angle from the waveform is noted.

## F. OBSERVATIONS

The speed of the induction motor is controlled by varying the voltage supplied to it using TRIAC and DIAC. It is alsoobserved that surges produced by the rotating motor inertia are reduced by changing the values of capacitors.
The voltage supplied is controlled by controlling the firing angle of the TRIAC where the DIAC is used to control the gate pulse of the TRIAC. The output waveforms are observed and sample wave form is shown in figure 4:

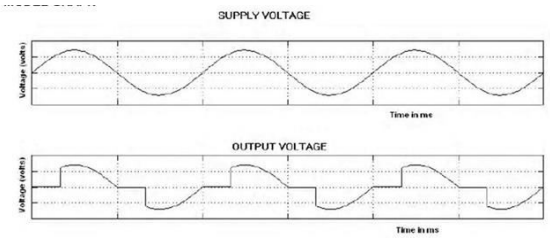


Figure 4: Output waveform of the Circuit

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