

# PLC Based Control for Induction Motor

**Akshay D. Meshram<sup>1</sup>, Bhavna A. Godbole<sup>2</sup>, Twinkle P. Jaminkar<sup>3</sup>, Tushar G. Lohambare<sup>4</sup>,  
Mangesh A. Kande<sup>5</sup>, Dr. R. A. Keswani<sup>6\*</sup>**

Student, Department of Electrical (Electronics & Power) Engineering, PCE, Nagpur, Maharashtra, India<sup>1-5</sup>

Associate Professor, Department of Electrical (Electronics & Power) Engineering, PCE, Nagpur, Maharashtra, India<sup>6\*</sup>

**Abstract:** The design of PLC based control for induction Motor is done for implementing automated systems in many industries. Automatic control makes use of different controllers for operating equipment such as conveyer belts, mine trolleys and other applications with minimum and less human labours. Some processes like speed control and directional control are completely automated. AC motors are used in industries for various operations because it has simple operations, more reliability and inexpensive. By providing the control in automatic mode and manual mode for the system in industry, the human work in field can be reduced and also saves their life from danger working areas of industries. This paper presents implementation of PLC based control for the 3-phase induction motor using Programmable Logic Controller (PLC) & Supervisory Control And Data Acquisition (SCADA) technologies. For the needed control and performance of the motor, all the data will be taken to a personal computer using Software's.

**Keywords:** Automatic and Manual mode, Forward and Reverse Induction Motor, PLC, SCADA.

## I. INTRODUCTION

In an induction motor, there is no electrical input to the rotor, but the current is induced into the rotor circuit. The rotor conductors carry current are placed in the stator magnetic field and therefore force is exerted upon them tending to move them at right angles to the field. When three phase AC supply is connected to the stator winding, a rotating magnetic field is established and rotates at synchronous speed. The direction of rotation of the magnetic field can be reversed by interchanging the connection to the supply of any two phases sequence of a three phase induction motor i.e any two of three phases can be changed for example the phase sequence initially kept is RYB and then to change the direction of rotation of induction motor the phase sequence can be changed to either RBY or YRB. Hence leads to the rotation of induction motor in clockwise direction or anticlockwise direction.

In this paper, the PLC based control for induction motor has been provided with two modes for the directional control of induction motor.

1: Manual Mode

2: Auto Mode

A Selective Switch is provided from where the desired mode can be chosen i.e Manual or Auto.

In Manual mode of operation the direction of induction motor is controlled with the help of two contactors in such a way that at a time only one contactors works and also the phase sequence of three phase supply to both the contactors is different so that by operating any one contactor at a time the induction motor can be operated in clockwise direction or in anticlockwise direction.

In Automatic mode of operation the directional control is achieved with the help of PLC (Programmable Logical Controller) and SCADA (Supervisory Control And Data Acquisition) software. So just by sitting in the control room and by making a communication link between the PC, PLC and SCADA software, the induction motor can be controlled and can rotate in both the directions.

## II. BLOCK DIAGRAM

Fig.1 shows the block diagram of PLC based control for induction motor. Firstly the selective switch is required to select whether to operate in Manual mode or in the Auto mode. Once the selective switch is set either in Manual or Auto mode. The supply from the main source is given to the SMPS (Switched Mode Power Supply). From the SMPS the supply is fed to PLC unit when the automatic mode of operation is selected on selective switch. With the help of SCADA, the PLC then controls the relays and then relay gives the supply to the contactors and from contactors the supply is fed to the induction motor.

When the selective switch is set on Manual mode then depending on the direction in which we want to rotate the induction motor. We need to press the Normally Open Switch then the supply is directly fed to the contactors and through contactors to the induction motor.

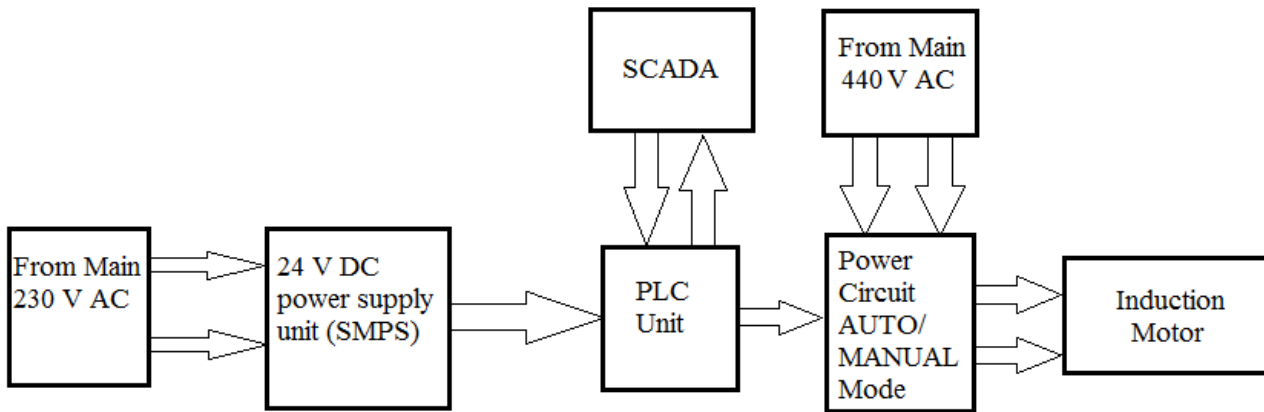


Fig. 1:- Block Diagram

**PLC (Programmable Logical Controller):** The PLC operates on the supply 24V DC coming from the SMPS during the automatic mode of operation. Thus when the signal is given to the SCADA software from the PC, it goes to PLC. It gives signal to the desired relay depending on which direction of rotation is achieved for the induction motor. Thus the relay in the power control circuit allows the 440V supply to the contactor and from contactor to the Induction motor.

**Main 440V Supply:** The 440V AC supply is directly fed to the contactors and through contactors the supply is fed directly to the induction motor. And from which contactor the supply will be fed to the motor depend on the signals given to the contactor and the incoming signal will depend upon which mode is operated Manual mode or Auto mode.

### III. HARDWARE DESIGN

The PLC based control for induction motor allows us to control the direction of induction motor. The above Fig.1 shows that how directional control of induction motor can be achieved. Fig.2 shows circuit diagram for direction control of induction motor in Manual mode and Automatic mode. Three phase 440V AC supply is fed to the contactors. In the Fig.2, it is shown that there is a requirement of two contactors in the circuit to achieve the target. The contactors are connected in parallel to each other. Both the contactors are supplied with three phase 440V AC and at a time only one contactor will operate and in this way the supply is fed to induction motor. And the direction control can be achieved as in the power control circuit it can be seen that the phase sequence in first contactor is L1-L2-L3 and that in the second contactor the phase sequence is changed to L3-L2-L1 and thus by operating any one of the contactor the induction motor direction of rotation can be controlled.

In the proposed system we have provided two modes for the direction control of induction motor.

- MANUAL MODE
- AUTOMATIC MODE

**MANUAL MODE:** For the operation of manual mode, firstly the selective switch must be set on the manual mode. There are two normally open switches to give the 440V AC supply power supply to the induction motor through the contactors. Also there is a normally close switch to stop the induction motor whenever not required.

When there is requirement of rotation of motor in clockwise direction the normally open switch with the tag of clockwise is to be pressed. By pressing the switch, the supply will be given to the contactor whose phases are in such a sequence that the motor will rotate in clockwise direction. When the motor is required to be stopped the normally closed switch shall be pressed. The normally closed switches will cut-off the supply which is going towards the induction motor. Whenever there is requirement of changing the direction of induction motor, firstly the normally closed switch must be pressed and if in case someone presses the another normally open switch which is used to change the direction of rotation of induction motor. But then also the supply will not go towards the induction motor because the interlocking is provided to the contactors. Therefore the contactors will not work simultaneously thus preventing from dead short circuit thus preventing our motor from getting damaged. In this way, the manual mode of directional control of induction motor is achieved.

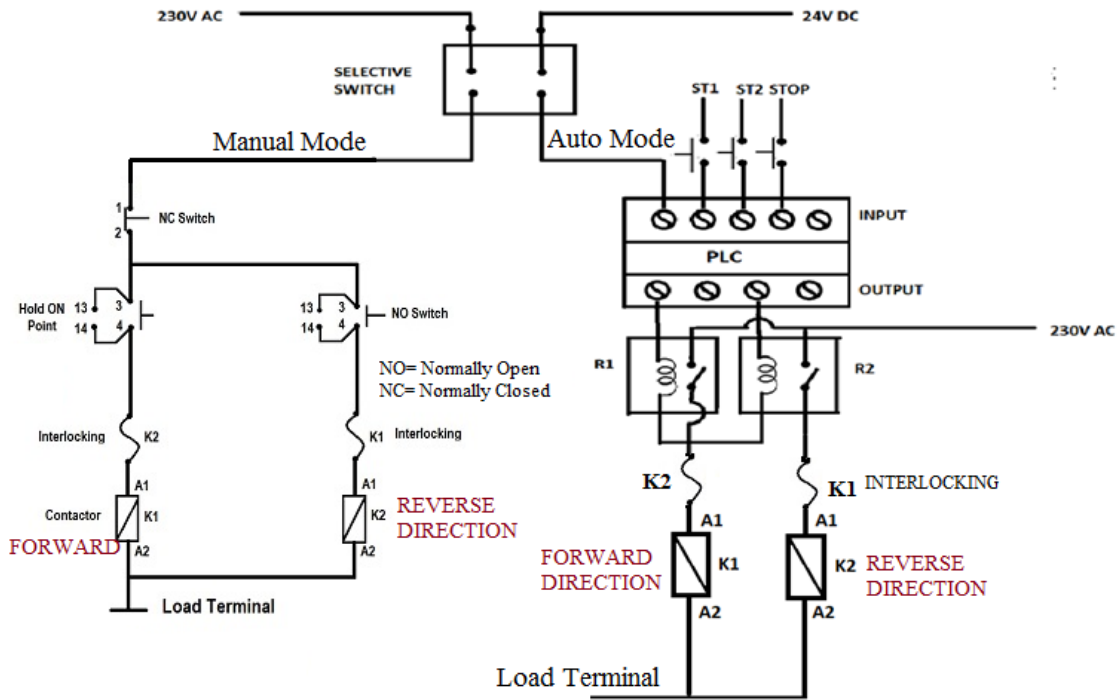


Fig.2 : Circuit Diagram for Direction Control of Induction Motor for Manual mode And Automatic Mode

**AUTOMATIC MODE:** For the operation in Automatic mode firstly the selective switch must be set on the Auto mode. During the auto mode, the 230V AC supply is given to the SMPS. During the automatic mode as the PLC is used, there is need of the 24V DC supply as the PLC works on only DC source. To operate in the automatic mode, two software of PLC are required and software of SCADA is required for programming purpose. During the auto mode, communication link is made between the PLC and Personal Computer (PC) through one of the software of PLC. Once communication is achieved between the PLC and Computer, the circuit diagram is made in software of PLC in the language Ladder Logic. Once the circuit diagram is complete in that application, inputs need to give to the components in the circuit. Then using SCADA software, PLC is programmed and then it is ready to run. To operate the motor in a clockwise direction, the button for clockwise direction is pressed and viceversa. If by mistake, the motor is running in clockwise direction and the button of anticlockwise direction is clicked there will be no effect on the system as interlocking has been provided. In this way, through Automatic mode the user can control the induction motor just by sitting in control room and just by a single click the motor can be operated.

**IV. POWER CONTROL CIRCUIT**

Fig.3 shows power control circuit indicating connection of 3 phase induction motor with both the contactors and with the supply line. With the operation of the contactors, the phase sequence is changed to control the direction of induction motor in clockwise as well as anticlockwise direction.

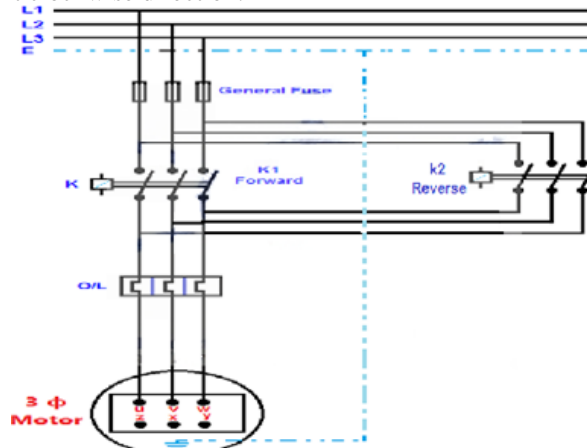


Fig.3: Power control circuit

**V. WORKING OF THE SYSTEM**

A prototype model is implemented for directional control of the induction motor in two modes manual mode or automatic mode. In the manual mode, the appropriate switch must be pressed in which the desired direction of rotation of induction motor is required. To change the direction of the rotation of induction motor, stop the motor and press the second switch to change the direction.

In the automatic mode of operation, once the programming in SCADA is completed then click on the runtime option or system comes online. The pressing of the switch will rotate in the direction required. In this way the system can be operated in manual mode or automatic mode as per requirements. Fig. 4 shows the indications obtained on experimental circuit and SCADA display in the automatic mode for clockwise.

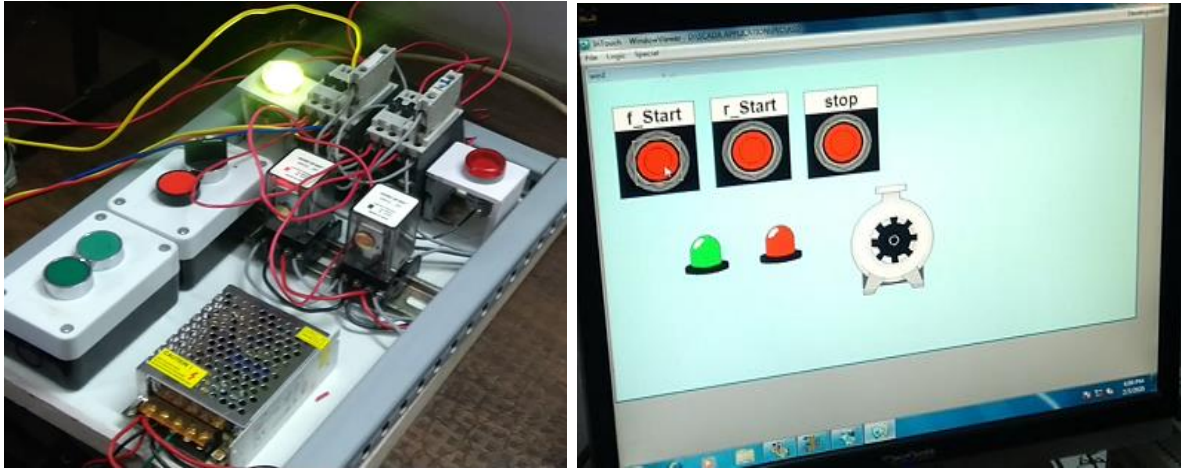


Fig.4: Automatic mode clockwise directional control

**VI. CONCLUSION**

In this system through the two modes provided for the directional control of induction motor. Through the automatic mode provided in the system the motor is controlled automatically and the work becomes easier. The direction control of induction motor is required anywhere the control method discussed can be applied wherever the three phase induction motor is used.

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