# PROTECTION OF THREE PHASE INDUCTION MOTOR AGAINST VARIOUS ABNORMAL CONDITIONS

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## ABSTRACT

*The main aim of this paper is to protect an Induction motor(IM) against various faults like Over voltage, Over current, Under voltage, Single phasing. The Protection of motor from such faults is very important, because faults can decreases its efficiency. IMs can be protected using some components, such as timers, contactors, voltage, and current relays. We are using the microcontroller based circuit for fault detection and it will protect the motor from several faults.*

**Keyword:** *IM, Under voltage, Single Phasing, Over Current, Over voltage.*

## [1] INTRODUCTION

Ac Induction Motors (IMs) are used as actuators in many industrial processes. Although IMs are reliable, they are subjected to some undesirable stresses, causing faults resulting in failure. Monitoring of an IM is a fast emerging technology for the detection of initial faults. It avoids unexpected failure of an industrial process. Monitoring techniques can be classified as the conventional and the digital techniques. Classical monitoring techniques for three-phase IMs are generally provided by some combination of mechanical and electrical monitoring equipment. Mechanical forms of motor sensing are also limited in ability to detect electrical faults, such as stator insulation failures. In addition, the mechanical parts of the equipment can cause problems in the course of operation and can reduce the life and efficiency of a system.

It is well known that IM monitoring has been studied by many researchers and reviewed in a number of works. Reviews about various stator faults and their causes, and detection techniques, latest trends, and diagnosis methods supported by the artificial intelligence, PLC, the computer, and other techniques in monitoring and protection technologies have been presented. In other works, ball bearing failures, speed ripple effect, air gap eccentricity, broken rotor bars, shaft speed oscillation, damaged bearings, unbalanced voltage, inter turn faults, stator winding temperature and PLC-based digital protectors have been recently studied subjects. In these papers, while one or two variables were considered together to protect the IMs, the variables of the motor were not considered altogether. This might cause difficulties in protection. A computer based protection system has been introduced. Measurements of the voltages, currents & temperatures were achieved and transferred to the computer for final protection decision. In this paper, although all the variables of the motor were considered, usage of an analog-to-digital conversion (ADC) card increases the cost and the size of the system. The solutions of various faults of the phase currents, the phase voltages and the winding temperatures of an IM occurring in operation have been achieved with the help of the PLC; these electrical parameters have been displayed on a screen.

A power supply has always been a priority area for the engineers and researchers working for the development of industries. They had came up with some condition monitoring methods like vibration monitoring, thermal monitoring, chemical monitoring all these monitoring methods requires specialized tool and sensors which were quite expensive, whereas parametric monitoring using microcontroller eliminates the use of additional sensors. Experimental results shows that microcontroller based hardware system provides high accuracy as well as safe and visual environment compare to the traditional mechanical based systems. In this paper, we introduce a new method

for protection of three phase devices using a PIC microcontroller(16F877A). With the help of microcontroller, we are continuously monitoring the parameter for protecting the load from undesired values of the parameter. We are also providing self diagnosis which will tell us problem has occurred by which parameter and if the parameter recovers its specified value then system will auto reset itself.

## FAULTS IN THE 3 PH DEVICES AND THEIR CAUSES

A. *Overvoltage*: An overvoltage is a situation which occurs when the system voltage rises over 110% of the nominal voltage ratings Overvoltage is caused due to several reasons such as sudden reduction in loads, switching of transient loads, lightning strikes, failure of control equipment such as voltage regulators, neutral displacement. This situation of overvoltage causes damage to components connected to the supply which may further lead to heating, over flash, insulation failure and may destroy electronic components.

B. *Undervoltage*: Normally undervoltage occurs when the voltage supplying the drive is too low. The obvious cause that can be incurred is that the incoming supply is low or not the specified one. For example, a 460V drive powered by 220V will cause the situation called under voltage.

C. *Earth fault*: An earth fault is a condition which occurs when the current carrying conductor or live part gets connected to the earth. System at the load end in this case is disconnected from the source in case of radial power flow.

D. *Overheating*: As the name explains, when the temperature of equipment exceeds the predescribed limit, an overheating problem occurs. Overheating is caused if the equipment overloads above its rated capacity and due to short circuit faults such as single line to ground fault, line to line fault etc. This overheating may leads to burning of winding of equipment and may severely damage to electrical system.

E. *Single phasing*: single phasing refers to a condition where in one of the phase of the 3 phase motor is cut off. This is caused because of one of the three phases blown in the local or loss of phase from the utility. Single phasing causes negative phase sequence components in the voltage. Negative phase sequence causes heating of motor and consequently motor failure. Following are the effects of single phasing:
a. Due to single phasing, the current in the other two phase increases and it is approx. 2.4 times greater than the normal current.
b. The motor becomes noisy and starts vibrating due to uneven torque produced in the motor.
c. A fatal shock can be experienced by the operator due to melted windings caused by overheating.

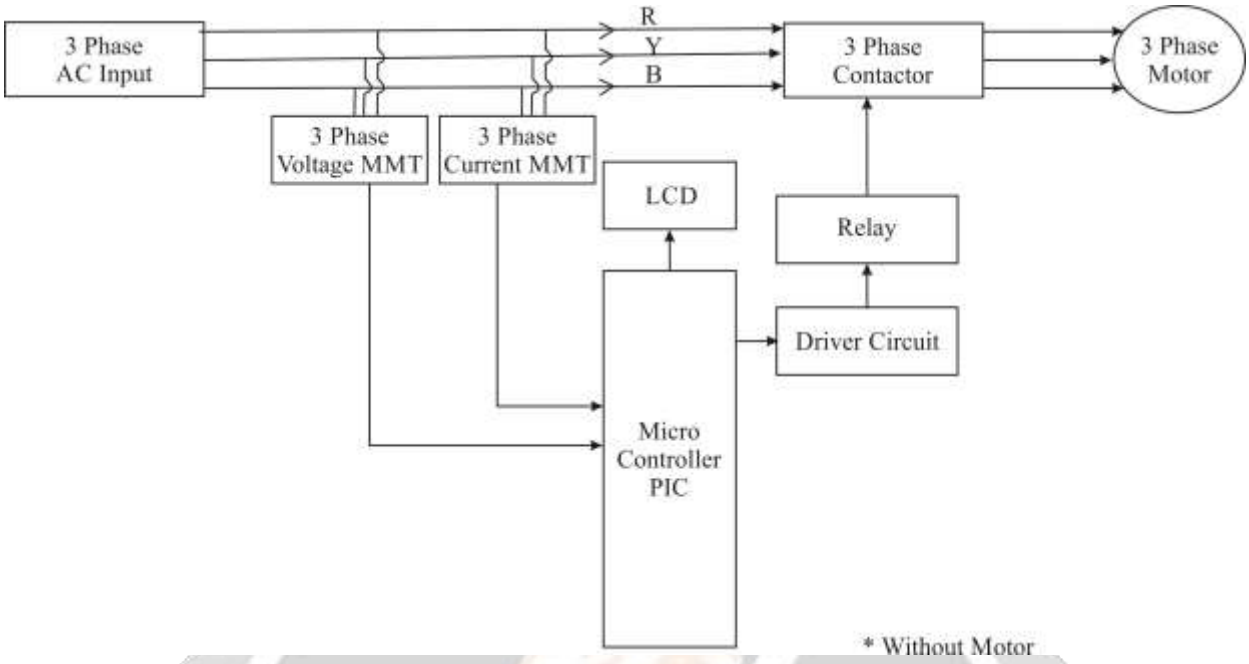
## EXISTING SYSTEM:

- IMs can be protected using some components, such as timers, contactors, voltage, and current relays. This method is known as the classical method that is very basic and involves mechanical dynamic parts. Computer and programmable integrated circuit (PIC) based protection methods have eliminated most of the mechanical components.
- However, the computer-based protection method requires an analog-to-digital conversion (ADC) card, and the PIC-based protection method does not visualize the electrical parameters measured**.**

## PROPOSED SYSTEM:

- The voltage and the current values of the motor, and the problems occurred in the system, are monitored and warning messages are shown on the LCD. If any fault occurs then motor will be tripped.

## [2]BLOCK DIAGRAM:




**Description:**

In under voltage protection of 3 phase induction motor protects the motor from the under voltage. When supply system has low voltage than the rated of induction motor then under voltage protection section of protection supply is provided to motor. It has same concept as overvoltage it also has comparator which compare two voltage one form supply and another from the voltage drop across the variable résistance. When voltage drop across the variable resistance is lower than specified value, this signal sends to microcontroller through ADC. If the input voltage becomes over then automatically both contactors will be trips. The contactors are connected through relay driver & relay circuit. Relay driver is used for to increasing the current handling capacity of incoming signals from microcontroller unit and microcontroller stop the operation of motor in the case of running and fails to operate in case of starting.

In single phasing protection for 3 phase induction motor system, if any one of the phases is faulted then automatically trips both the contactors. Generally in single phase supply voltage is lower value than specified value. On this value of voltage motor is unable to start. Comparator which compares single phasing supply voltage and rated specified voltage, and single sends to microcontroller and microcontroller generates single and contactor will be trip through relay drive which stop the motor if motor is running and does not allow to motor start in case of standstill. Single phasing occurs as a result of several possibilities. As a loose wire, a bad connection, bad starter contacts, overload relay problems, a bad breaker, a blown fuse etc.

Over-current protection of motor means protect the motor, if load is exceed than specified value. This over current in motor is generally caused by overloading of motor, bearing seizes up something locked the motor shaft from turning. Each phase current is sensed by using current transformer and if current level exceeds its rated value then comparator sends signal to microcontroller to stop the motor.

LCD is used for display of all LCD faults and message to user.

## [3] RESULT

1. **Hardware system:**

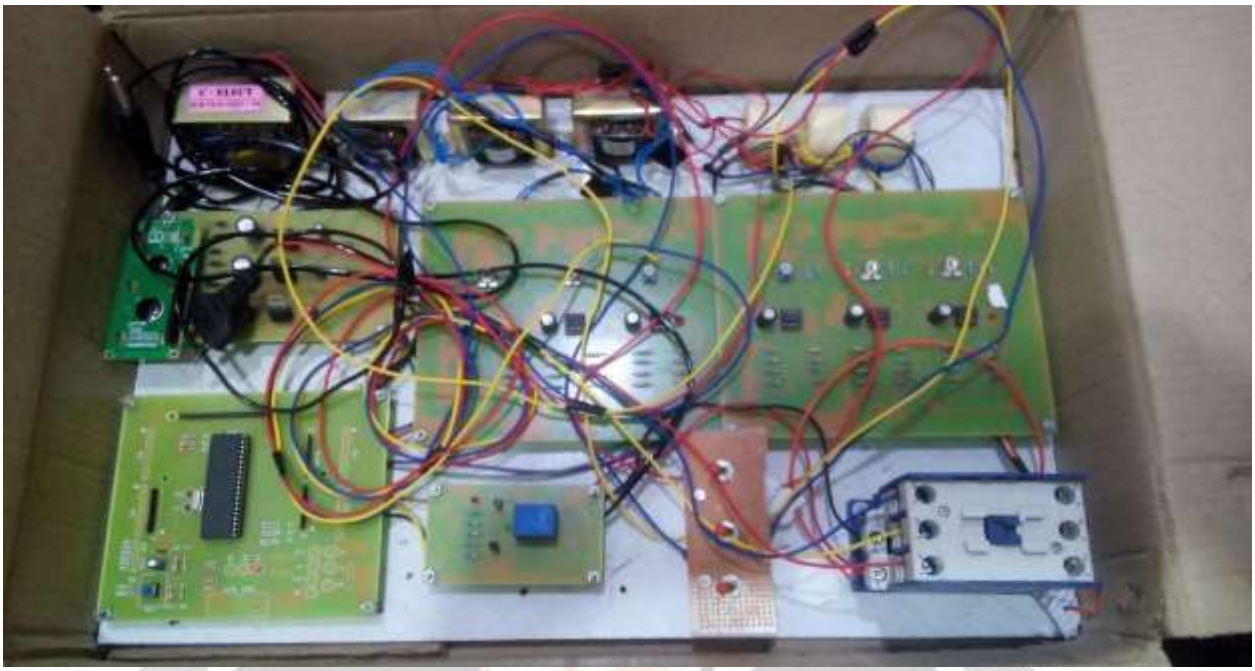


Fig.1 shows the complete hardware system

## 2. Results on LCD:

- **Under voltage:**

If supply voltage of motor is less than 180 degree then fault under voltage is detected and motor stop running.


Figure 2: Under voltage display on LCD

- **Single phasing:**

If R phase of Induction Motor is open then signal phase problem is detected and motor stop running.


Figure 3: R phase abnormal display on LCD

If Y phase of Induction Motor is open then single phase problem is detected and motor stop to running.


Figure 4: Y phase abnormal display on LCD

If B phase of Induction Motor is open then single phase problem is detected and motor stop to running.


Figure 5: B phase abnormal display on LCD

- **Over current:**
  If load is increased, then over-current problem is detected and motor stop to running.


Figure 6: over-current display on LCD

## [4] CONCLUSION

Protection of three phase induction motor from under voltage, single phasing, over current and over voltage provide the smooth running of motor improves its lifetime and efficiency. Generally these faults generated when supply system is violating its rating. In three phase induction motor when running at rated voltage, current and load these faults are not generated. For smooth running of motor generally concentration on supply voltage under the prescribe limit and load which is driven by the motor should also be under the specified limit.

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