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Protection of Induction Motor

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ABSTRACT

This paper tends to develop for protection of three phase induction motor from single phasing, phase reversal, over voltage and under voltage. Induction motors are one of the most commonly utilized motor types in industry. These motors are extremely tough, dependable, and durable. They are, nevertheless, susceptible to malfunctions, just like any other equipment. A motor failure can cause a complete production line to be shut down, resulting in costly downtime. As a result, having a stable situation is crucial. There is a monitoring and problem diagnosis system in place to keep an eye on the machine's health at all times. As a result, there is a very high level of trustworthiness. With ever-increasing expectations for dependability and efficiency, The area of induction motor defect diagnosis is becoming increasingly important. Early motor defect detection and condition monitoring can improve machine performance, reduce damage, extend the machine's usable life, reduce spare parts inventories, prevent unexpected breakdowns, and guarantee that maintenance schedules are followed. The advancement of science and technology has resulted in several changes in people's lifestyles. The most up-to-date technology is employed. Robots, space research, medical devices, cars, military, and education are only a few examples of applications. In this case an attempt is made to construct a fault detection and protection system based on a microcontroller. When a dangerous state is discovered, the job of verifying all the parameters of the industrial unit and controlling it falls to you. The primary purpose behind the development of this issue is to ensure the safety of industrial motors, pumps, and lift motors, among other things. If one of the three phases is absent, or if the motor's temperature during operation exceeds the threshold value, the motor will stop instantly. Three single phase transformers are connected to a three-phase power supply in the system. The matching transformer stops supplying electricity to the system if any of the phases is unavailable. The network As a result, one of the four relays is turned off. Because one of the four relays is not energized, the system is unplugged.

Keyword *Induction Motor, Protection under Voltage , Over Voltage , and Over Temperature etc….*

3. Introduction

An induction motor is an AC electric motor that gets its electric current in the rotor from the magnetic field of the stator windings. Induction motors with three phases are the most common AC electric motors in almost every industry. This is due to its durability, dependability, and versatility because of its variable speed uses; it is both cost-effective and useful. The three-phase process because all or part of the energy is transferred from stator to rotor, induction motors do not require mechanical commutation, separated excitation, or self-excitation. It is critical for businesses to avoid unplanned shutdowns. This activity necessitates continuous monitoring of the induction motor in order to detect defects early on. The maintenance engineers can conduct the appropriate repair procedures as fast as feasible if these defects are detected in advance. Overloading, single phasing, unbalanced supply voltage, and locked rotor are the most common external issues that an induction motor encounters Under/over voltage, rotor, phase reversal, ground faults, and rotor ,the three phase induction motor, on the other hand, has some flaws that diminish its performance device. Some of the most often occurring flaws.

3.1 Necessity

Electrical failures account for 37% of all faults. Overvoltage, under voltage, phase reversal, unbalanced voltage, single phasing, and earth faults are only a few examples. Mechanical failures account for 31% of all faults. For example, rotor winding failure, stator winding failure, and bearing failure, to name a few bearing flaws. Environmental Faults account for 15% of all faults. External moisture contamination, machine vibration, and so on. Under voltage, overvoltage, overheating, single phasing, and phase reversal are all common problems with three phase induction motors. When a three-phase induction motor receives a higher voltage than it is rated for, the motor becomes overheated. When the supply voltage is lower than the rated voltage, the voltage drop across the resistance is bigger than it safeguards the motor from this failure in our project. When the supply voltage is lower than the specified value, the voltage drop across the resistance is lower, and the motor fails to start. When the supply is only one phase, this is known as a single phasing problem, and the supply voltage falls below the rated value, causing the motor to stop.

2. SCHEMES FOR FAILURE DETECTION AND PROTECTION

The employment of electromechanical relays to safeguard the motor against defects began the history of fault monitoring and fault isolation (Elmore, 2004). However, because to the mechanical parts involved, these electromechanical relays are sluggish to operate, consume a lot of power, and require regular maintenance. The development of semiconductors technology 2 had a positive impact on the field of induction motor protection, and electromechanical relays were substituted. Solid state relays are preferred because they operate at a quicker pace, consume less power, are less expensive to manufacture, and give more functionality, reliability. Induction motors were made possible by the development of microprocessor technology in the late 1970s relays that safeguard (IEEE, 1997). These relays enable software programs to integrate protection logic. Different types of induction motor protection schemes are discussed.

3. METHODOLOGICAL APPROACH

The 3-phase AC motor is protected from single phasing and overheating with this method. When one of the phases fails, the system detects it and quickly shuts off the motor, which is powered by the mains. All three phases are rectified, filtered, and controlled before being fed into an operational amplifier, which compares the supply voltage to a predetermined voltage. If one of the phases is missing, the Op-amp input is zeroed out, resulting in low logic for the transistor, which further de-energizes the relay. As a result, the main relay is switched off, and the motor's power is cut off. Similarly, when the motor temperature surpasses a particular threshold, the operational amplifier output

De-energizes the appropriate relay, as well as the main relay. Induction motor single phasing problems and over-temperature circumstances can be avoided in this method.

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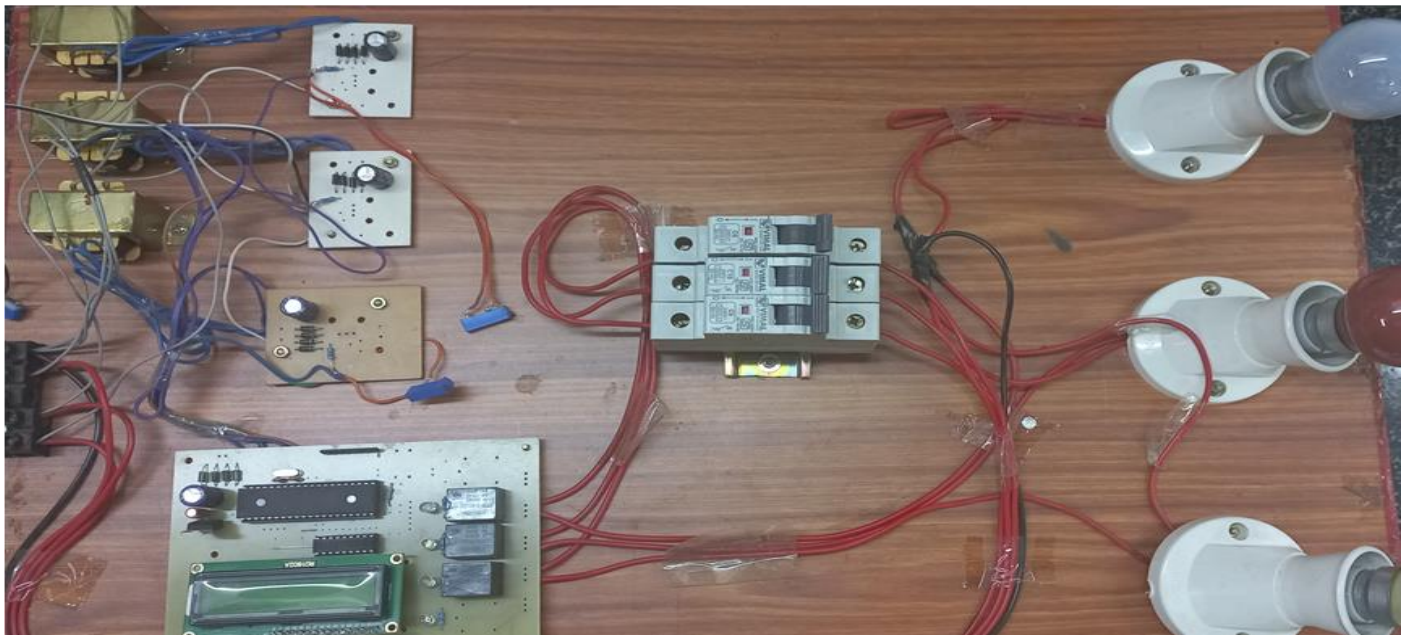
Fig -1 Protection System.



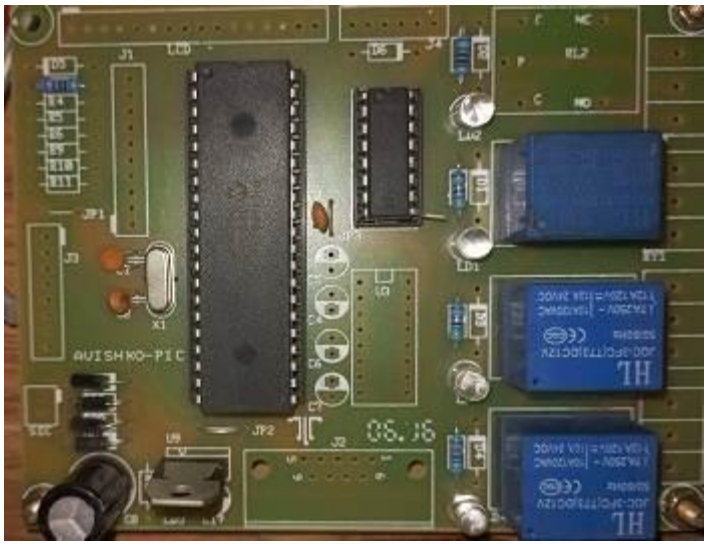


Fig -2 Circuit Diagram for Relay.

3.1 PROTECTION FROM OVER VOLTAGE FOR INDUCTION MOTOR

The three phase induction motor's over voltage safety system protects the motor from over voltage, or voltage that is higher than the rated voltage. In a schematic diagram, It consists of a comparator that protects against overvoltage. Two voltages are compared The first is supply, and the second is drop across. The resistance that varies When the voltage across the wires drops, it's called a voltage drop. If the variable resistance exceeds a specific threshold, The signal is generated by the comparator. This information is sent to Microcontroller.as indicated in the diagram below:

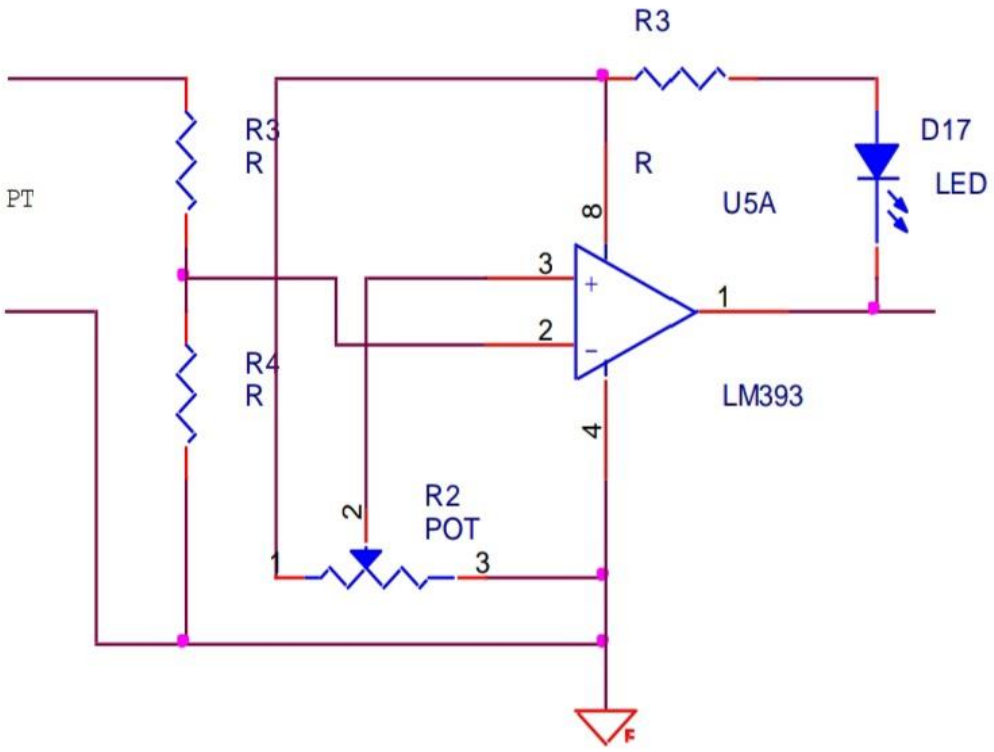


Fig -2 Circuit Diagram Overvoltage Protection.

3.2 PROTECTION FROM UNDER VOLTAGE FOR INDUCTION MOTOR

Introduction related your research work Introduction related your research work Introduction related your Under voltage protection is provided by a three-phase induction motor's under voltage protection.
When the supply system has a lower voltage than the induction motor's rated voltage, the motor is protected by the under voltage protection portion of the protective supply. Single phasing is effective. It works on the same principle as overvoltage, but it additionally includes a comparator that compares two voltages: one from the supply and the other from the voltage drop across the variable resistance. This signal is sent to the microcontroller when the voltage drop across the variable resistance is less than the required value, and the microcontroller stops the motor from running in the event of running and fails to start in the case of starting. As illustrated in fig.3, preset is used to set the required value. This circuit works in the same way as overvoltage protection does, with the exception that the value is preset. In this scenario, the set value is the smallest possible, but in the case of an overvoltage, the set value is determined by a preset resister. When the voltage drop across the Resister is greater than the preset settings, the signal is considered to be faulty List

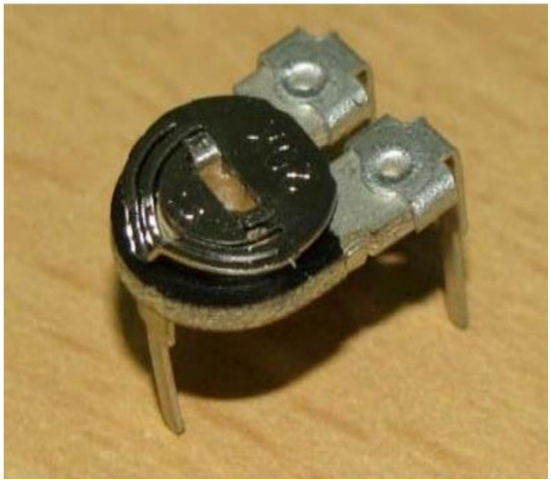
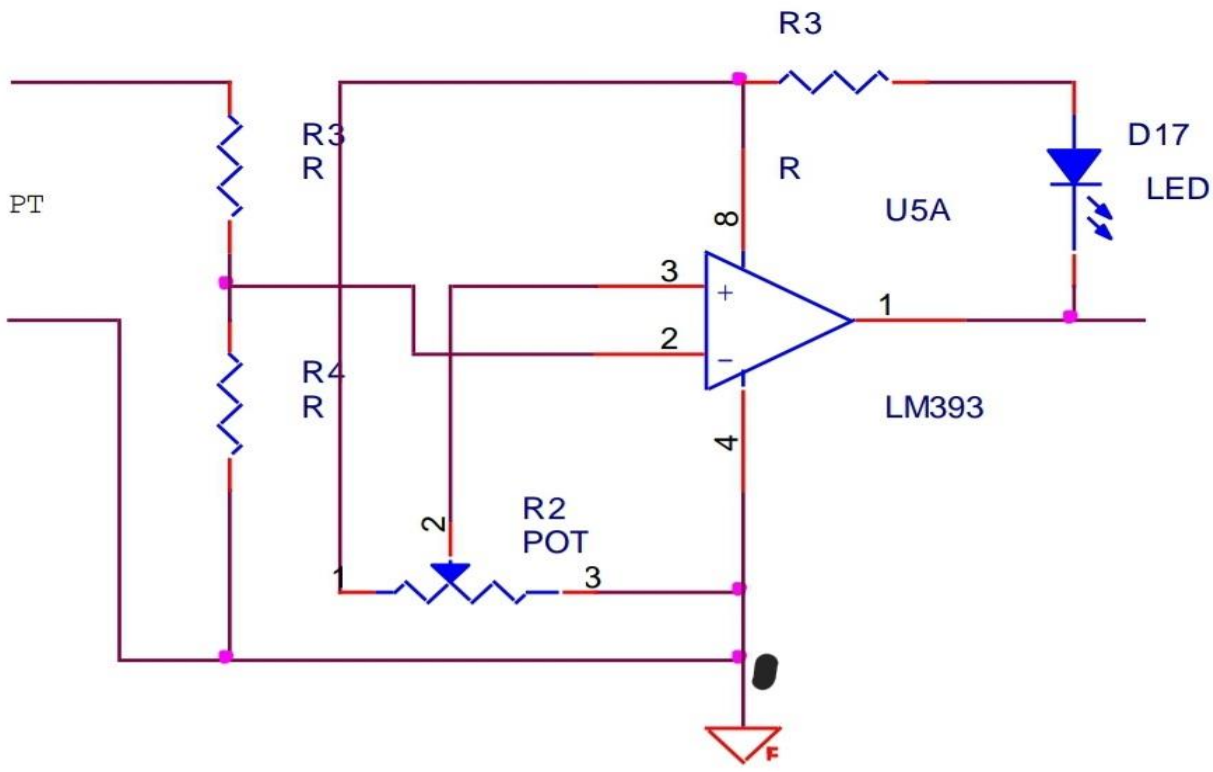


Fig -3 Preset to Set value.

3.3 SINGLE PHASING

If the other two phases of a three-phase induction motor are faulty, only one protection of the motor section begins to work. Single phase supply voltage is usually less than a particular value. The motor will not start at this voltage level. Comparator that compares single phasing supply voltage to the prescribed voltage and transmits signal to microcontroller, which generates signal that stops the motor if it is running and prevents it from starting if it is stopped. When the motor is engaged with essential functions like providing, pump driving, and crane driving, single phasing protection appears to be very important. This fig.3 depicts the extremely single phasing state in a three phase induction motor. When one phase fails and the motor is powered solely by the other phases, this is known as single phasing. Single phasing can be caused by a variety of factors, the most obvious of which are a louder than usual humming from the motor and a shaft that vibrates slightly while turning. As a result of a variety of factors. A damaged wire that isn't bowed.

Fig 4. Circuit Diagram Single Phasing.



3.4 THERMAL PROTECTION

Overheating prevention for motors refers to safeguarding the motor's winding from overheating. Overloading a motor causes it to overheat, and when a bearing seizes, something stops the motor shaft from turning. A failure to start a motor may be caused by a variety of factors. A defective start in the motor's winding is the cause. The LM 35 sensor is used to detect the presence of heat. The comparator inputs are connected to this sensor. With the assistance of a sensor that detects the temperature of .If the temperature of the winding surpasses a certain threshold, the comparator transmits a signal. As indicated in fig.5, send a signal to the microcontroller, provides information to microcontrollers.

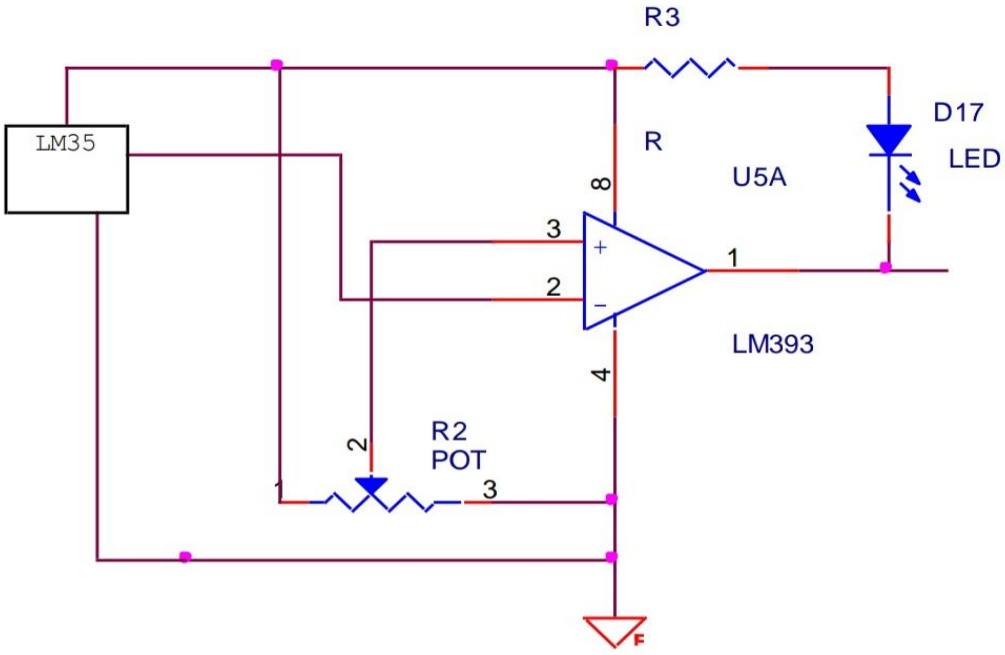


Fig 5. Diagram of overheating protection

3.5 Block Diagram:

Below Figure depicts the system's block diagram. The PIC16F877A microcontroller is utilized with programming code that controls the entire system based on its properties. The relay function is driven by a single relay drive. All five controlling warring units are used as input for the microcontroller, and a power supply is also employed to give power to the microcontroller. As a result of the input provided by the various sections of protection, the microcontroller functions.

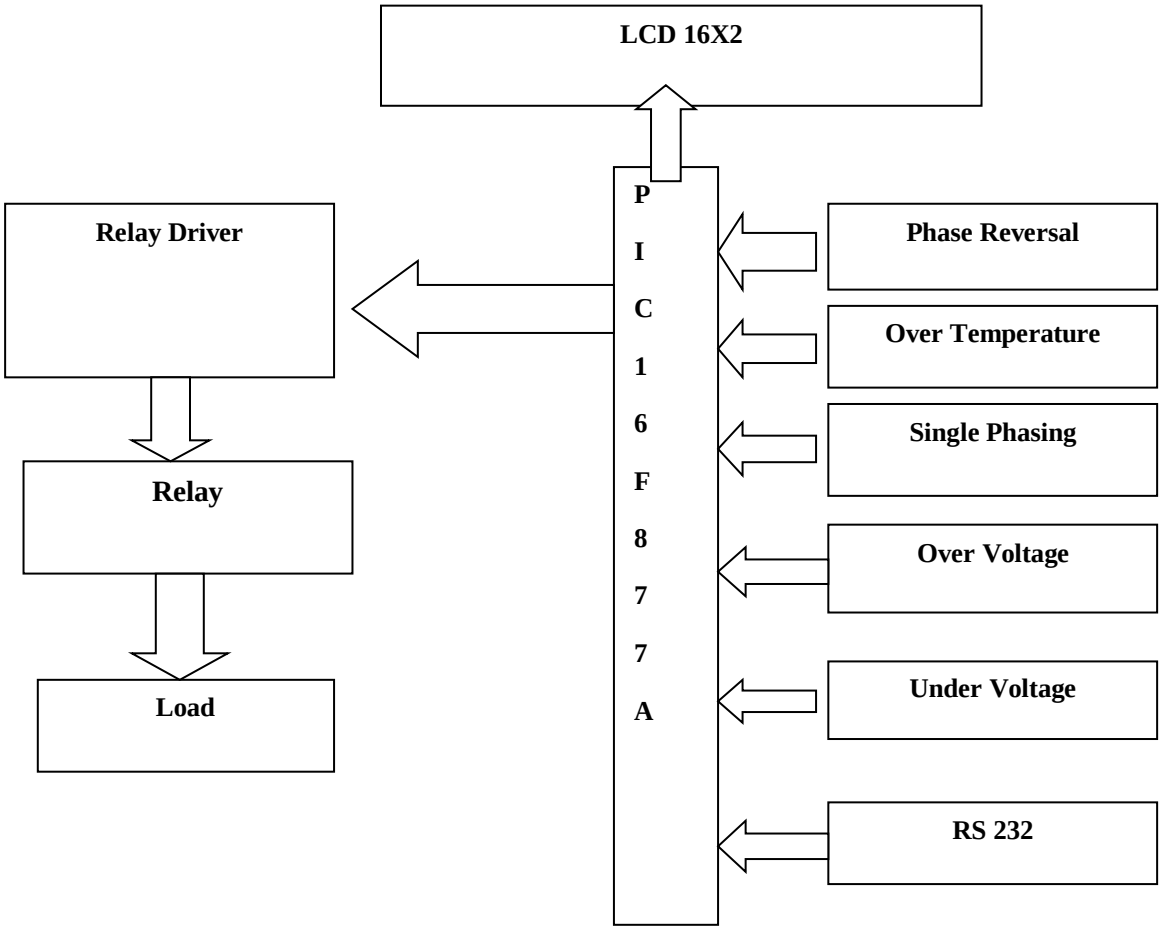


Fig 6. Diagram of overheating protection

4. CONCLUSIONS

Overvoltage, under voltage, single phasing, overheating, and phase reversal protection for three phase induction motors ensures smooth operation and increases motor lifetime and efficiency. Typically, these failures occur when the supply system's rating is exceeded. In a three-phase process these failures do not occur while the induction motor is operating at rated voltage, current, and load. Concentrate on keeping the supply voltage below the prescribed limit for smooth motor operation. The load driven by the motor must also be within the prescribed limits.

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