

Single Phase Preventing of Three Phase Induction Motor

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Abstract - This paper is to develop for protection of three phase induction motor from single phasing or phase reversal or over voltage and under voltage. Because of this electrical fault the winding of motor get heated which causes to lead insulation failure and thus reduce the life time of motor. This fault is generated in induction motor due to variation in induction motor parameters. When three phase induction motor operates continuously, it is our need to protect the motor from these anticipated faults. Three phase induction motor directly connected through the supply, if the supply voltage has sag and swell due to fault the performance of motor is affected and in some cases winding is burned out..

Keywords - Single Phase, Induction Motor, electrical fault.

I. INTRODUCTION

In recent days the use of three-phase induction motor is increasing tremendously. Number of places are there in industries and outside industries where induction motors are used. Three-phase induction motor generally suffers from some disturbances we term it faults. Some out of these disturbances are under voltage, overvoltage, overheating, and single phasing problems. When the three phase Induction motor supply with higher voltage than rated then induction motor starts overheated. In our project a variable resistance is used, when supply voltage is lower than rated then it is called under voltage fault. Variable resistance is used to set a reference value with which we can compare the actual voltage value. When supply voltage is higher than reference voltage it is considered as over voltage fault. When supply is only one phase or any of the three phases is not available, this is single phasing problem and supply voltage fall the rated or reference and motor fails to start. In the case of overheating of motor winding a LM sensor is used which sense the temperature of winding if it is exceed the specified limit then once again motor fails to start or may give other problems. It is highly desired that 3 phase induction motor works freely from these all types of faults.

Various studies have shown that anywhere from 50%, to as high as 80%, of faults in three phase appliance are due to failure in any phase or because of inadequate voltage level. Three phase appliances generally suffer from under voltage, overvoltage or tripping of any phase. It is of paramount importance to monitor the availability of the

three-phase supply and switch with the availability of all phases of the supply with certain time delay in order to avoid surges and momentary fluctuations. We have designed this model to detect this faults when occurs on motor and protect the motor from this faults by operating relay and contactor switch.[1]

Classical monitoring techniques for three-phase induction motors are generally provided by some combination of mechanical and electrical devices such as timers, contactors, voltage relays, current relays, earth fault relay etc. These techniques are very

II. TYPES OF FAULTS

1. Single phasing:

It occurs when one phase of the three-phase supply is open. Single-phasing condition is the worst case of voltage unbalance. If a three-phase motor is running with the single phase condition, it will attempt to deliver its full horsepower of the load. The motor continuously trying to drive the load, until the motor burns out or until the properly sized overload elements make the motor off. [3]

Causes:Open winding in motor, any open circuit in any phase anywhere between the secondary of the transformer and the motor, primary fuse open.

Effects:The effects of single phasing on three-phase motor vary with service conditions and motor thermal capacities. When single-phased, the motor temperature rise is greater than the increase in current.

2. Under Voltage

Causes:The under voltage occurs when a reduced supply voltage with a rated mechanical load on the motor.

Effects: Increased currents, excess heating of machine, Stator and Rotor losses increase.

3. Over Voltage

Causes: Any one of the line voltage is greater than 110% of rated value, over voltage fault occur.

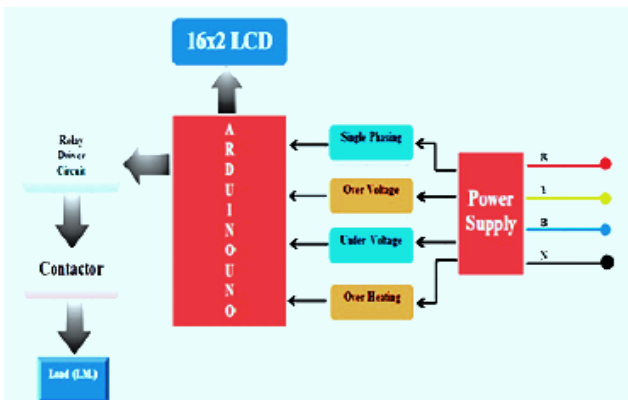
Effects: Harmful effects on machine insulation, burning of insulation, deterioration of insulating properties.

4. Overload Condition

Causes: When there is increase in mechanical load on the motor beyond the rated value, the overload situation occurs. Due to high load torque, motor begins to draw more current.

III. PROPOSED METHODOLOGY

This is the block diagram for complete protective system. Each circuit for separate fault protection *i.e.* single phasing, phase reversal, over temperature, over voltage, and under voltage are designed. Outputs of these circuits are given to Arduino unit. Programming for Arduino is done so that in the event of any of above mentioned faults occurs, that fault name will be displayed on LCD along with this operate command will be given to the contactor switch. Contactor switch will be connected to the load and power supply is provided to the Arduino unit and all other circuits. In this way the fault on three phase induction motor is detected as well as motor is isolated from supply in faulty condition to avoid any damage to motor or to avoid spreading of fault in healthy sections of system.



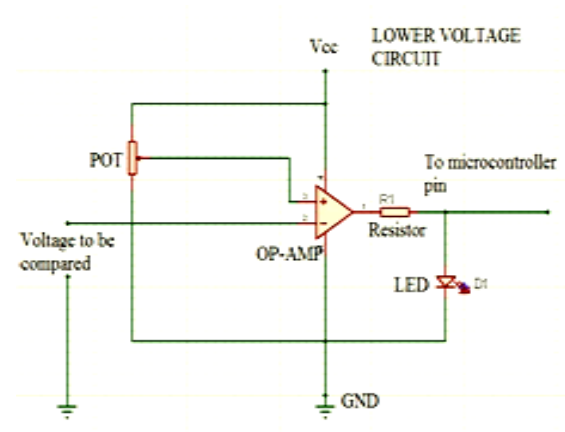
3.1 Block diagram complete protective system

1. Under Voltage

In under voltage protection of three phase induction motor provides the protection 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. Single phasing works. 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 resistance. When voltage drop across the variable resistance is lower than specified value, this signal sends to microcontroller and microcontroller stop the operation of motor in the case of running and fails to operate in case of starting. Preset is used to set the specified value.[1][3]

We have chosen a reference value of voltage which is considered as desired voltage at motor terminals. When voltage across motor terminal drops below this value then

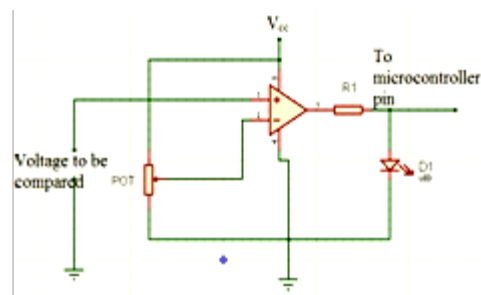
that condition is called under voltage condition. Generally a drop of 10% of rated voltage is considered as under voltage. When voltage across motor terminal will be 10% less than that of rated voltage then motor will suffer from under voltage condition and it is protected from such failure by using the system that we described in earlier chapter.



3.2 Under Voltage Protection Circuit

2. Over Voltage

Overheating protection of motor means protect the motor from overheating of its winding. This overheating in motor is generally caused by overloading of motor, bearing seizes up something locked the motor shaft from turning. Motor simply fails to starts properly, a failure to start of motor may cause by faulty start in winding in motor. For sensing the heat LM 35 sensor is used for this purpose. This sensor is connected to comparator inputs. With the help of sensor which sense the temperature of winding & its temperature exceeds to some particular level the comparator sends this signal to microcontroller.[2]



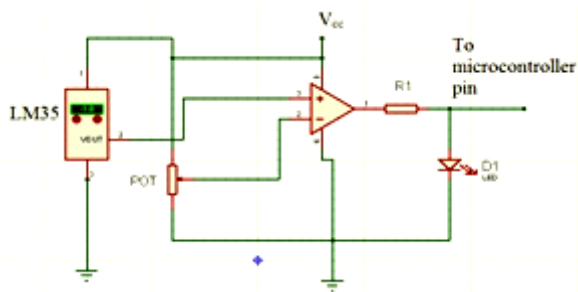
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3. Over Temperature

Overheating protection of motor means protect the motor from overheating of its winding. This overheating in motor is generally caused by overloading of motor, bearing seizes up something locked the motor shaft from turning. Motor simply fails to starts properly, a failure to start of motor may cause by faulty start in winding in motor. For sensing

the heat LM 35 sensor is used for this purpose. This sensor is connected to comparator inputs. With the help of sensor which sense the temperature of winding & its temperature exceeds to some particular level then comparator sends this signal to microcontroller.[5][2]

As shown in figure given below we have a temperature sensor LM 35. With the help of this sensor we are able to sense the surrounding temperature and it also converts that temperature into voltage. This gives output voltage proportional to the temperature. We have set a reference temperature value and voltage proportional to that value will be reference voltage. When actual and reference values differ from each other output of comparator will be HIGH. This will be given to input pin of Arduino. When Arduino get HIGH input it will send HIGH at its output pin to disconnect motor from supply with the help of contactor switch.



3.4 Over Temperature Protection Circuit

4. Single Phasing Circuit

In single phasing protection to 3 phase induction motor, if other two phases is faulted and only one protection of motor section starts functioning. 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 which stop the motor if motor is running and does not allow to motor start in case of standstill. [7]

As shown in figure we are setting a reference value of voltage with this value we compare actual voltage and standard reference value of voltage, by using comparator IC LM324. When one of the three phases is disconnected due some fault then it is called single phasing condition and this leads too many problems in induction motor. Thus by comparison of voltages, as stated earlier we can detect the unavailability of any of three phases and can protect motor from single phasing by disconnecting it from supply.[4]

Sometimes single phasing protection looking much motor important when the motor is tight which important function like furnishing, pump driving and crane driving

etc. This fig.4 show the typical single phasing condition in three phase induction motor where one phase break down and motor is only supplied by remaining phases which is equivalent to single phasing condition. Single phasing occurs as a result of several possibilities. A loose wire, a bad connection, bad starter contacts, overload relay problems, a bad breaker, a blown fuse, and other things can cause this destructive condition. Obvious signs are a louder than normal humming from the motor and/or a shaft that vibrates rather than rotating.

This protection is same as that of under voltage and over voltage protections. Only this circuit will be activated if one of the phases out of three phases is unavailable. Output of circuit will be HIGH. LEDs will glow if that particular phase is unavailable. And when output of single phasing circuit will be HIGH, the LED connected in its output will be lighting. When output becomes HIGH it will disconnect motor from supply

IV. FUTURE SCOPES

As this system is used for protection of all three phase induction motors, now a days and also in future it will be very demanding in all applications where induction motor is used. Every good system is subjected to certain limitations; these limitations can be overcome by making some improvements in the system.[5]

1. We can add GSM to this system, this helps to give message on mobile phone about the occurrence of fault. Due to this amendment in system it is possible to supervise motor from anywhere.
2. Similar to under or over voltage, current sensing element can also be added in this system, which also helps to reduce over temperature on motor.
3. Phase reversal protection can also be provided just as other types of protection.

V. RESULT AND CONCLUSION

Protection of three phase induction motor from over voltage, under voltage, single phasing, and overheating and phase reversal 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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