

A Protection System For 3 Phase Induction Motor

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Abstract- *The monumental aim of this paper is to provide protection of Induction Motor (IM) against the probable problems like single phasing, over voltage, under voltage and overload occurring in induction motor. Induction motors are widely used because they are rugged, reliable and economical. There are various techniques used for fault finding and protection of induction motor. These include different protection equipment like contactor, circuit breaker and relay circuit. The method which uses above components is called classical method. It consists of not only electrical but also mechanical dynamic parts. The circuit will continuously monitored the voltage, current and speed. It has been controlled by microcontroller. If any problem occur due to faulty condition that generally found in the motor, the protection scheme which is implemented in the system will monitored the induction motor performance for normal and abnormal condition. The induction motor will get protection from these faults by the implemented protection scheme and all the condition will display over the LCD display.*

Keywords- Induction Motor, Over current, Over temperature, Over voltage, Protection system, Single phasing.

I. INTRODUCTION

Induction motors are the workhorse for the industry because of its versatility, ruggedness and low manufacturing cost. Induction motors are reliable motors and they have flexible control on speed. The protection of induction motor is therefore an captive issue for researchers. The main objective of the work is to make cheap and reliable protection system for three phase induction motor. The motor failures are mainly divided into three groups: electrical, mechanical and environmental[1]. Due to mechanical stresses overheating occurs in the motor and this will result in the rotor bearings' wear and tear. As the load increases motor draws heavy currents. Because of this, there is increase in temperature. Failure in the motor due to electrical stress arises because of function of various faults like single phasing and overloading etc. The origin of overvoltage and overcurrent may be manmade or natural. The probable causes for overcurrent incorporate short circuits, overload and incorrect design. When faulty condition or abnormal condition arises, motor should stop. Three phase induction motor generally suffers from overvoltage, undervoltage, overcurrent, overheating,

single phasing and phase reversal problems. In this work, the technology utilized is arduino microcontroller based protection system. The circuit will protect the induction motor from various faults mentioned above and this will happen by taking full control of the motor by the circuit. The motor should be protected from the high starting current. For this purpose, there are various methods available such reduced voltage, rotor resistance, DOL, star-delta starter, auto transformer, soft starter etc. For protection of motor from above mentioned faults, different protection equipments like relay, circuit breaker, contactors and various drives are implemented.

II. IMPORTANCE OF MOTOR PROTECTION

There are various faults which occurs in the three phase induction motor like single phasing, over voltage, over current and phase reversal etc. According to the fault occur in the system, motor winding get heated which leads to insulation failure. This can reduce the life time of motor. When variation in induction motor parameter above certain limit occurs, fault gets generated in the motor. When motor is running in continuous duty, it is necessary to protect the motor from expected faults. Generally induction motors are directly connected through the supply. If supply voltage contains sg and swell, this will affect the performance of three phase induction motor. In some cases winding is singed. Due to any wrong connection, phase sequence (RYB) is reversed, then motor start to rotate in opposite direction. If due to some reasons, one phase of the motor gets disconnected. The motor will continue to run from the active two phase supply. This is called single phasing. If single phasing occurs in the circuit, then moot will continue to run with vibrations. Also the speed gets reduced. Due to under voltage, motor attempts to use the same power to meet the load. As a result there is increase in current to keep the power same. Motor get overheated and concluded in short out as the insulation fails. Due to overvoltage, parts of circuit can be damaged. Over-current leads to excessive generation of heat and the risk of fire or damage to the equipment arises. Hence there should be good protecting system for induction motor.

III. BLOCK DIAGRAM

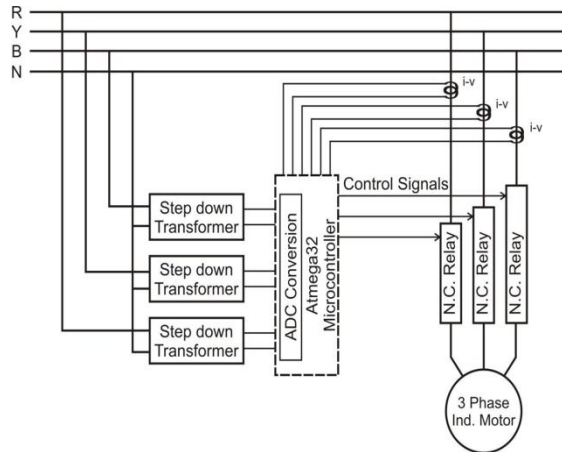


Fig.1 .Block diagram of Protection Technique for 3 Phase Induction motor

A. Step down transformer unit

There are three numbers of 240V/6V center tapped step down transformer present in the circuit. Measurement of phase voltages is done by using these transformers. To rectify the low voltage signal center tapped rectifier circuit has been used and to reduce the ripples in dc output capacitors are used. The resistor has been used for discharging of capacitors and these are connected in parallel with the circuit. The output calibration is done across potentiometer as per the requirement of microcontroller. The dc input variation of the microcontroller is proportional to the supply voltage variation. There may be some normal fluctuation in the power system which can exist for few cycles, and tripping of motor for these fluctuations is not required [1]. The value of resistor which is connected across the capacitor is decided according to the above considerations. The three phases of supply given to the motor have been used by three sets of setup as described above.

B. I-V converter unit

In individual phases, three i-v converters of 20A/20V are used for over current protection of three phase induction motor. The primary for these converters is the wire for supply terminals of the motor. The magnetic flux developed around the phase wires induces voltage on secondary side of the converters if the motor is in running condition. This induced voltage is fed to the microcontroller as an input with the help of ADC port. If the motor is running in the healthy condition the calibration of these voltages is done with rated current value and programmed into the microcontroller. The starting current of the motor is normally 6-8 times higher than the

running condition [2], hence time delay has been provided. For different types of motors this delay time is increased.

C. Relay unit with MOSFET

Working of Relay: In this protection scheme implemented relays can pass 7A current at 300V AC without damage to that relay. The minimum voltage required to operate the relay is 6V. The MOSFET is connected between battery and relay which is connected across the battery. The supply is fed to the relay for its operation when the MOSFET receives high signal from the microcontroller. Normally the relay is in closed condition but it opens when it is energized. There are three relays connected in same configuration in three phases for its operation. From the same pin of microcontroller high signal is fed to the all MOSFETs. This enhances the reliability of the whole protection scheme.

Working of MOSFET: The output power from the microcontroller is not sufficient to operate the relay and to energize it. Hence the purpose of using MOSFET is to use as a controlled switch and for energization of the relay a separate dc source has been used. The same circuitry of protection scheme can be used for controlling higher ratings of relay. So the use of MOSFET in the design makes the protection system more versatile for various ranges of ratings of three phase induction motor.

D. Battery

In this operation the supply to the relays is given through the battery. We don't need power all the time because relays are in closed mode. But when fault is occurred, the relay is energized by the power supplied from the battery. The Ah rating of the battery is decided according to the power requirement of the relay. The batteries can be replaced during the running of the motor without affecting the whole protection system. Rechargeable batteries can be used, also the batteries connected with the rectifier can be used.

IV. FAULT DIAGNOSIS OF 3 PHASE INDUCTION MOTOR

A. Overvoltage Protection

In overvoltage protection system of three phase induction motor, protects the motor from overvoltage, the voltage which is higher than the rated voltage. Circuit of overvoltage protection consists of comparator which compares two voltages one is supply and another one is drop across the variable resistance. When the voltage drop across the variable resistance is higher than specified value then comparator

generates signals. This signal is fed to microcontroller and microcontroller takes the appropriate action as shown in Fig.2

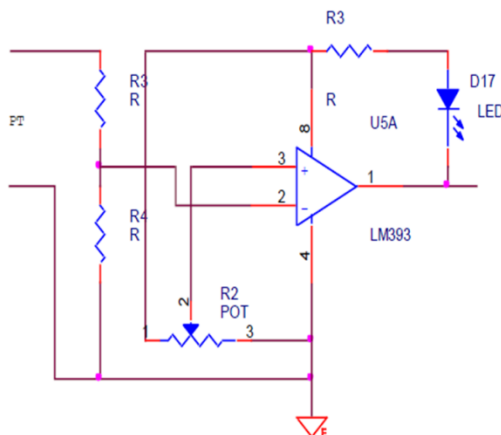


Fig.2. circuit diagram of overvoltage protection

B. Single Phasing

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

C. Phase Reversal

Phase reversal problem occurs in motor when the supply phase is reversed due to wrong connection(except than RYB) due to phase reversal motor starts running in anticlockwise (opposite direction from normal) would cause operation and safety problem. Most of three phases motor run opposite phases. This type of protection is used in application like elevators where it would be damaging or dangerous for the motor to run in reverse. Generally when motor is connected with the important application then type of protection being much more important. When the load is

connected with motor then reversal of phase means Direction of rotation is changed. It could cause serious problem therefore much more care is required to protect the motor form such type of fault. The overheating protection system is placed to turn the motor off when excessive heat is generated within the motor. This protection system rested the motor cools to safe operating temperature. Direction by which switching the connection of any two of three although the motor having shut down because it tripped the thermal limit in inconvenient.

V. CONCLUSION

In this project we concluded that the Protection of three phase induction motor from over 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.

VI. ACKNOWLEDGEMENT

I take this opportunity to express my gratitude to my guide Miss. Aparna. Yennam and co-guide Mrs. Shweta Desai, Assistant Professor, Electrical Engineering department (EE), who has been constant source of guide and inspiration in preparing this paper. I am thankful to everyone who helped me directly or indirectly for the co-operation and support.

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