Induction Motor Protection using Micro Controller

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Abstract

Main aim of this paper is to protect the three phase Induction motors from various faults using microcontroller. The circuit will take the full control of the motor and it will protect the motor from several faults such us over voltage and under voltage and the circuit will switch on the motor under safety conditions. This also protects induction motor from single phasing which is also a major fault. The circuit was fully controlled by the microcontroller and the microcontroller will continuously monitors the voltages of the three phases and if the voltage goes abnormal then it will switch off the motor until they are normal.
Keywords: Microcontroller, over and under voltage protection, single phasing protection

I. INTRODUCTION

Using microcontroller, we can able to start and stop the three phase Induction motor automatically and the circuit will take full control of the motor and it will protect the motor from several faults such as over voltage and under voltage and the circuit will switch on the motor under safety conditions. This also protects Induction motor from single phasing which is also a major fault. It is not only protecting motor from transient voltages, it also switch on the motor automatically when power comes without manual requirement and off the motor after predetermined time.

This motor is manually monitoring is difficult at the time of fault so automatic protection of induction motor has such an importance. Here dual comparator to compare over/under voltages with the present voltage and send signal to microcontroller if the voltage goes beyond the range is used.

Here we are also using LM393 dual comparator. Addition to this we are using two switches one for auto on and another one for auto off. Here the motor will run automatically when auto on is set and it will start the motor automatically after a particular time if off is set.

The main block diagram of automatic voltage control of Induction motor using microcontroller is shown in fig:

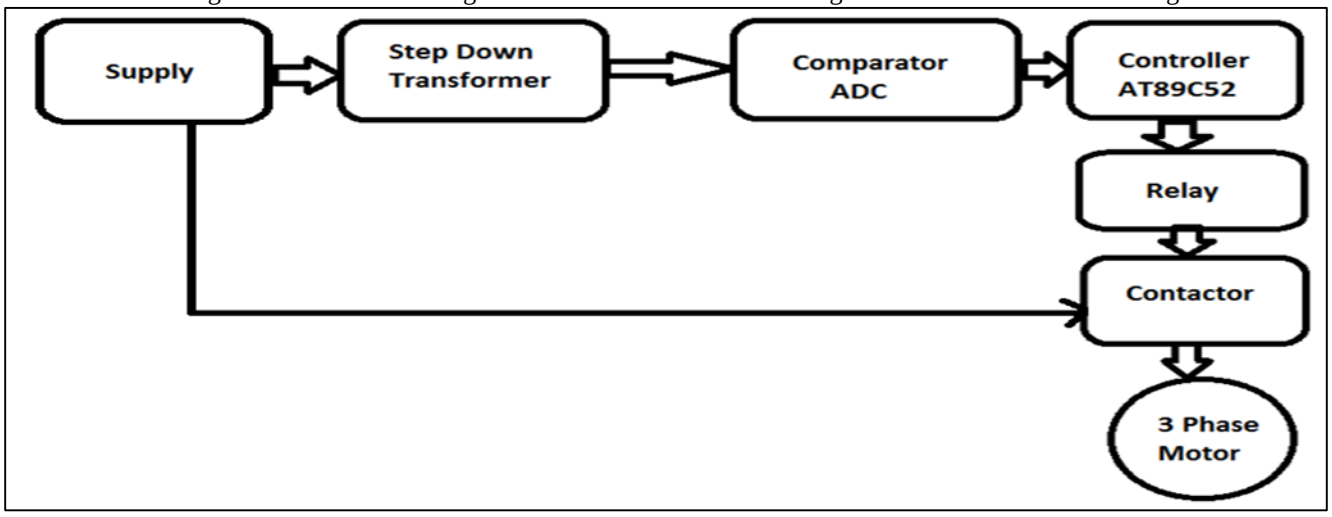

Fig. 1: Block diagram of automatic voltage control of IM using microcontroller

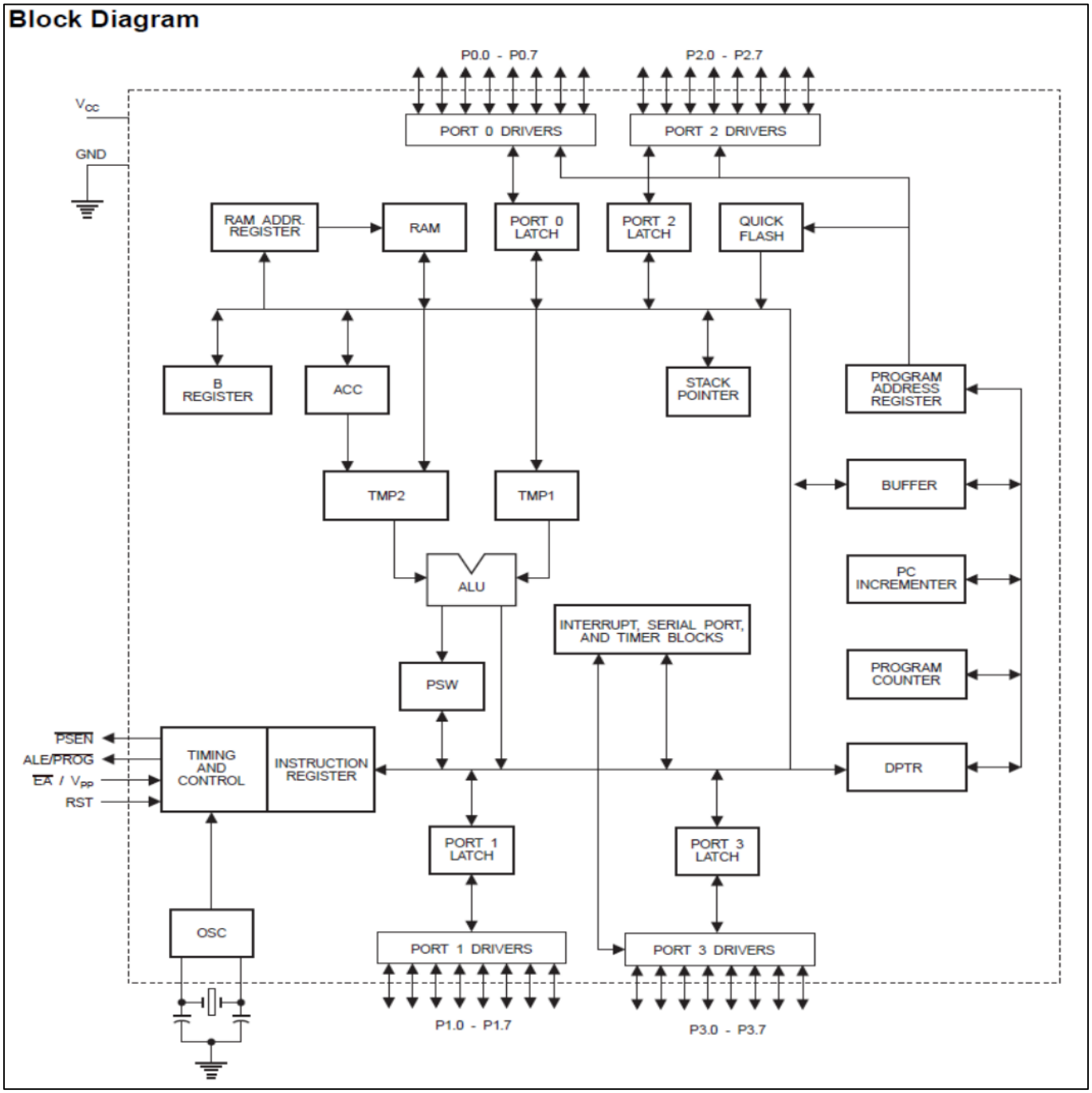

Fig. 2: Block diagram

II. WORKING PRINCIPLE

Whenever over/under voltages occurs then the dual comparator LM393 will predict and sends the signal to the microcontroller .The dual comparator LM393 is initially set to the range between 180V to 260V, if the voltage goes beyond the specified range it will send the signal to the microcontroller .According to the program written into the microcontroller AT89c52 and it will send the signal to the relay, and then relay stops the motor.

The circuit was fully controlled by the microcontroller and the microcontroller will continuously monitors the voltages of the three phases and if the voltage goes abnormal then it will switch off the motor until they are normal. All the conditions are displayed it over the LCD display.

Auto ON and Auto OFF switches are push to on switches, which will be ON only until they are held at pressed state once they are released the switch gets opened. The function of auto switch is that when it is pressed and released the motor is turned off after providing a delay which is dictated by the positioning of the rotary switch. The physical functioning of the auto on switch is

that once the auto on switch is set and if the supply is provided and also voltages are in normal condition then the motor start automatically.

A. Over/Under Voltage Detector:

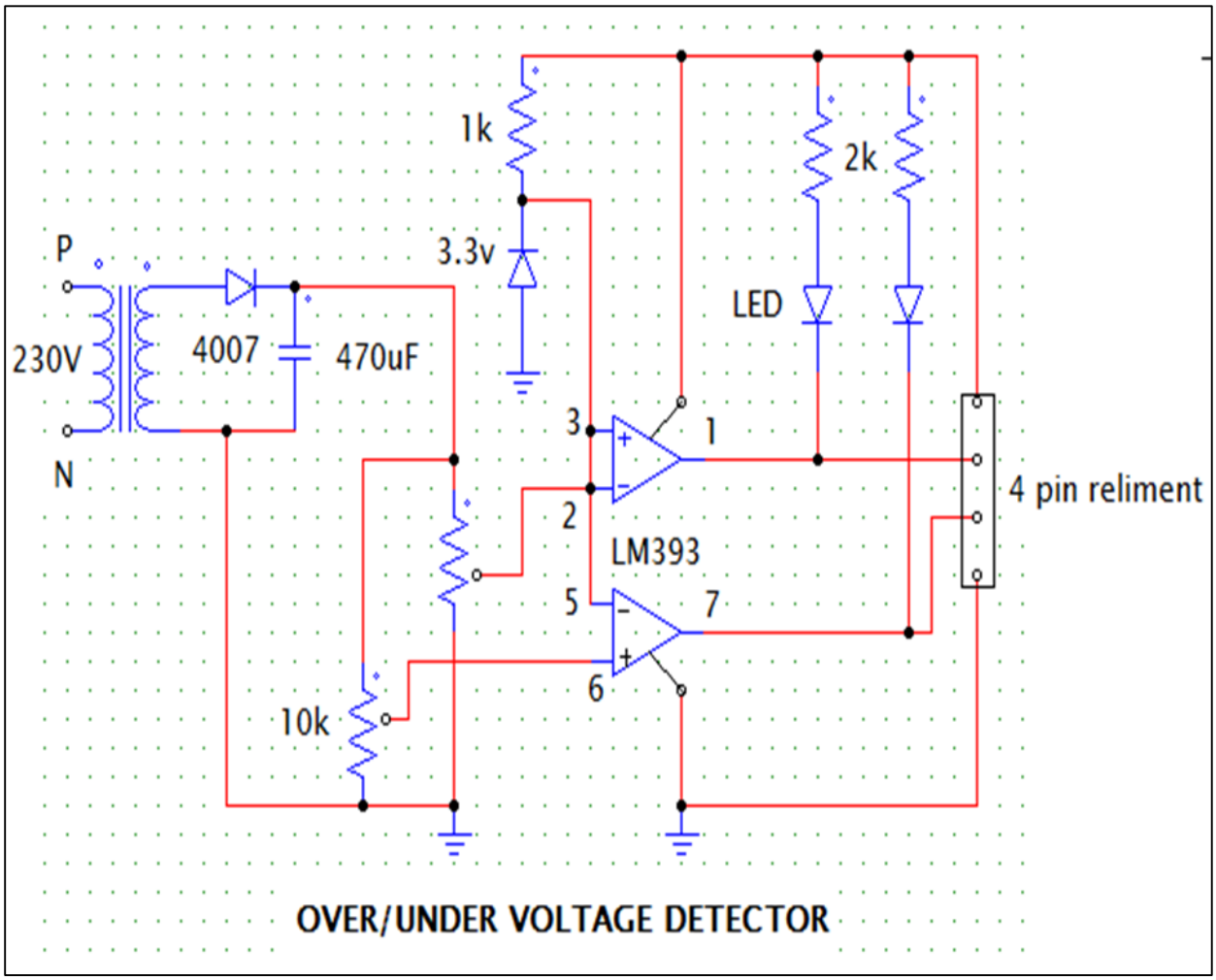

Fig. 3: Over/Under Voltage Detector

Three current transformers are used to sense the current drawn by the motor. The secondary of the current transformers are connected to a half wave rectifier using a 4007 diode. This voltage is filtered by a RC filter comprising of a capacitor of 10uF and a resistor of 10k. This filtered voltage is provided to the base of a NPN transistor BC547 whose output from its collector is fed to the first transistor of a differential pair comprising of two BC547s. The output of all the three transistors is ORed in such a fashion. Thus the voltage produced at the collector of each. Transistor is the measure of the current drawn by that corresponding phase. When the current flowing through the primary of the current transformer increases, the voltage at the collector of the transistors also increases. The second transistor of the differential pair is connected to a preset via a 4.7V zener diode. The setting of this preset sets the tripping current from each phase. The ORing of the over current transistors makes sure that the system is tripped even if one of the phase draws over current. This arrangement also makes single phasing detection possible with this circuit. The collector of the differential pair is used to trigger the microcontroller in the case of over current or over load.

B. Single Phasing Detector:

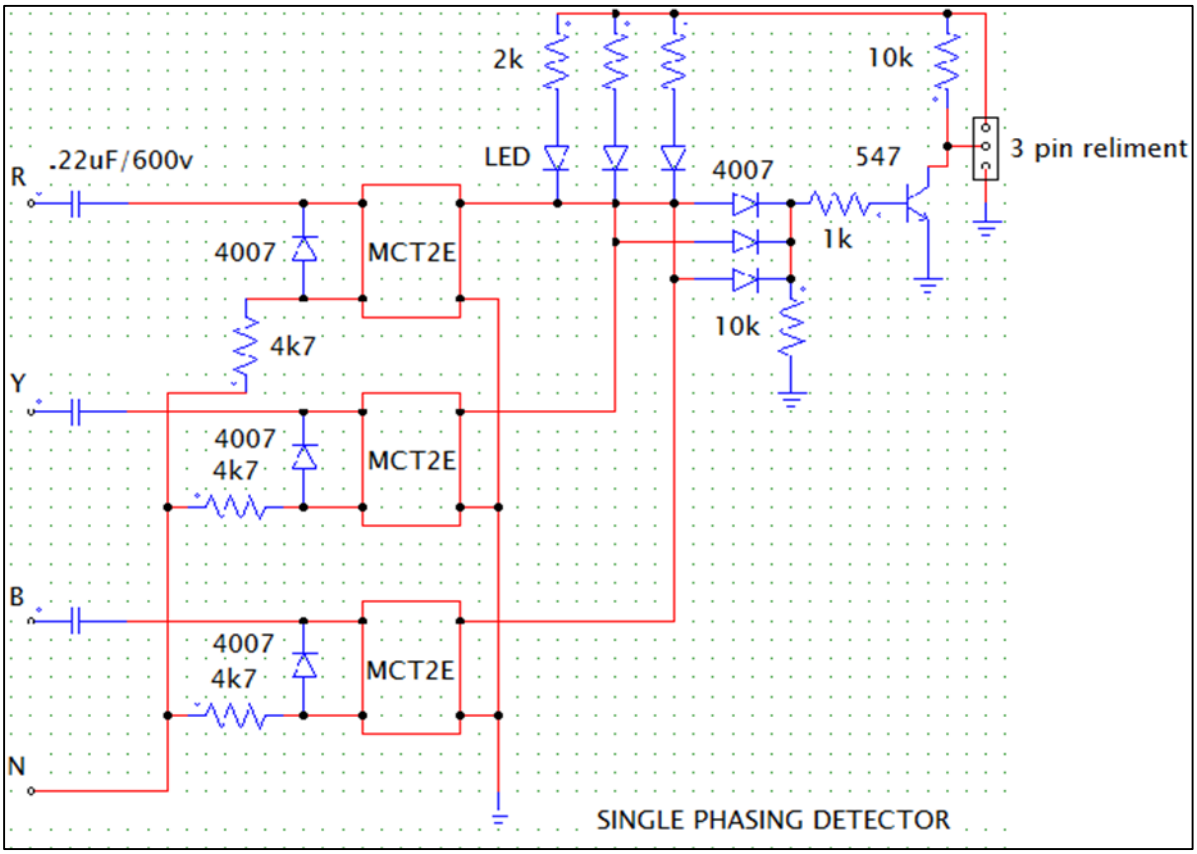

Fig. 4: Single phasing Detector

C. The Main Controller Section:

This is the main section of the entire circuit. The controller used here is the 89s52 from Atmel. The controller is based on the very famous 8051 core. The basic 8051 had a 4kB rom and a 128 byte RAM. The 52 chip which is an advanced version of the earlier one has 8kB of ROM and 256 byte of RAM. It also has an extra timer. Being an s device is supports faster clock frequencies than the c devices and is an ISP (in system programmable) chip owing to its 5V programming voltage as compared to the 12V on the C devices. Here it has been connected in a standard fashion with pins 40 and 20 being the positive and negative supply respectively. The programming voltage pin (31) has also been connected to the +Vcc. The clock generator crystal is connected between the pin 18 and 19 of the controller. Two 22pf capacitors are connected to the pins of crystal to ground. These capacitors provide the necessary ground path to the higher harmonics of the crystal and they also provide the starting kick for the starting of the internal oscillator. A power on reset network has been connected in the form of an RC network to the reset pin (9) of the controller. This network consists of a capacitor of 10uF connected from pin 9 to the positive supply and a 10k resistor from pin 9 to ground. This is done because the reset pin in 8051 architecture has to be normally held low and is to be bought high to reset the cpu. When the power to the circuit is switched on, the capacitor initially has no charge on it, thus as soon as power is switched on it initially acts like a short circuit. This high charging current of the capacitor produces a positive pulse on the resistor which directly appears on the reset pin, which resets the controller. As soon as the capacitor is charged to the supply voltage (here +5V) which will happen after the elapse of one time constant corresponding to the value of the RC network, the resistor will pull down the reset pin to ground and the system will be ready. A manual reset pin is also provided parallel to the capacitor thus if need arises to do so, reset can be achieved by depressing this switch.

All the stop signals available from the various sensors are used to interrupt the micro controller at its int0 (pin 12) pin. The relay that controls the motor contactor coil is connected to the output of the controller. As the controller output is very low and is not able to source the current that will drive a relay, a Darlington pair is formed by two npn transistors. This pair will boost the output to the required amount so as to drive the relay.

D. Simulated circuit in Protetus:

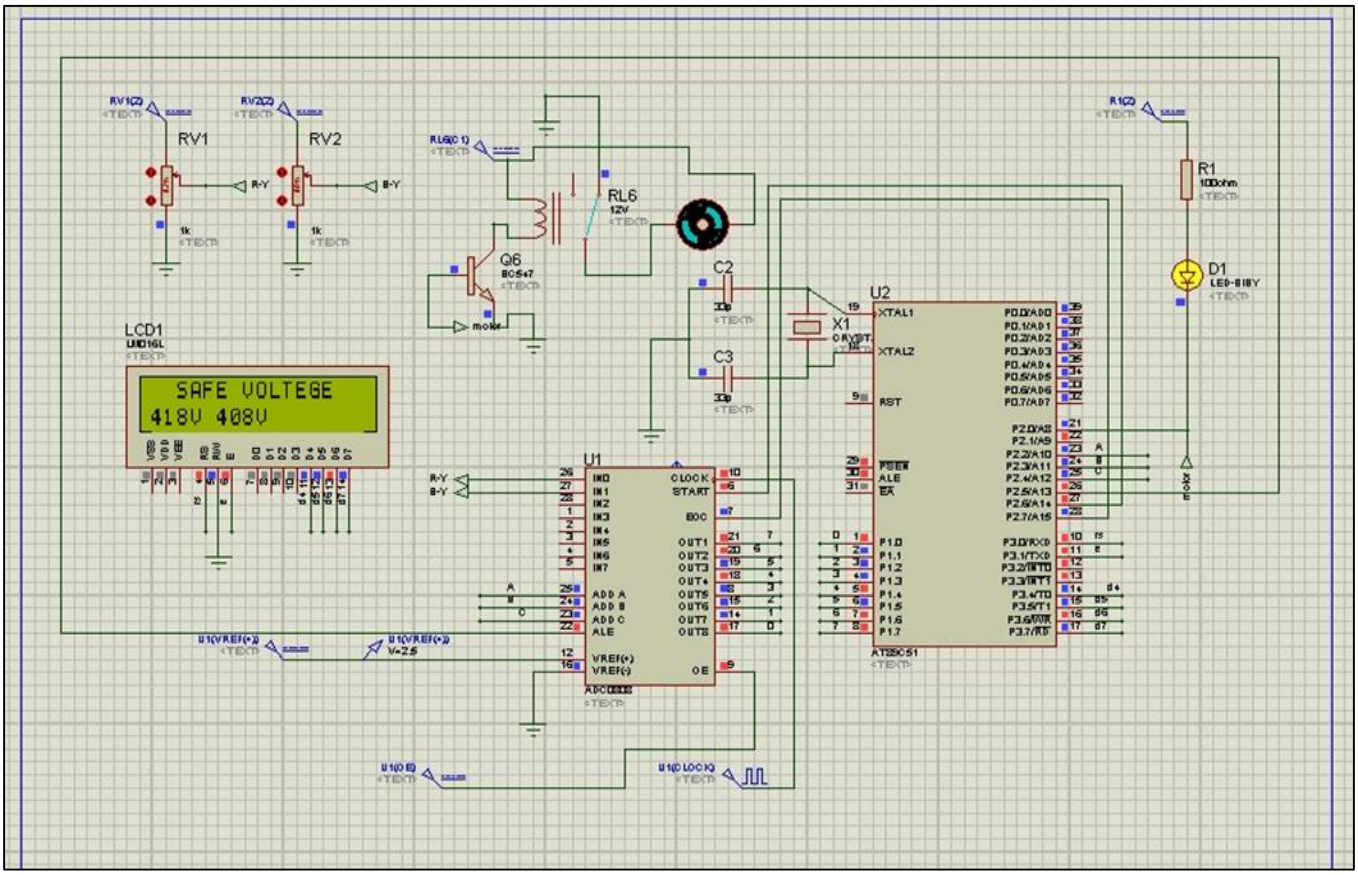

Fig. 5: Simulated circuit in Protetus

This project can be used with the three phase Induction motor. The circuit will take full control of the motor and it will protect the motor from several faults such as over voltage and under voltages and the circuit will switch on the motor under safety conditions.

REFERENCES

[1] Z. Alex, H. M. Kimber, and R. Komp, "Renewable energy village power system for remote and Impoverished Himamayan villages in Nepal" Proceeding in International Conference on Renewable Energy for Developing Countries, 2006

[2] B. Singh, S. S. Murthy, and S. Gupta, "Analysis and design of electronic load controller for self-excited induction generators," IEEE Transactions on Energy Conversion, vol. 21, no. 1, pp. 285- 293, March 2006

[3] T. F. Chan, K. A. Nigim, and L. L. Lai, "Voltage and frequency of self-excited slip-ring induction generators," IEEE Transactions on Energy Conversion ,vol.19, no.1, pp. 81-87, March 2004