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DESIGN AND IMPLEMENTATION OF 3-Φ PHASE FAULT ANALYSIS WITH AUTO RESET AT TEMPORARY FAULT AND TRIP AT PERMANENT FAULT

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ABSTRACT

Our project implements a technique of automatic tripping mechanism for 3-phase supply system. The output of project reset automatically in event of temporary fault while it remains in trip condition in case of permanent fault. In an Electrical system, 70% fault occurs in transmission line are transient, where as 30% fault are permanent. The fault might be L-G (Line to ground), L-L (Line to Line), and 3L (three Lines) which can affect the power system. In this project, PIC16F877A microcontroller is used to instruct relay for tripping mechanism. When the fault occur GSM (Global system for mobile communication) send message to registered number and GPS (Global positioning system) shows the exact fault location. In this PROTEUS software is used to design the power supply units and its simulation is done. 3-ϕ induction motor is connected as a load , fault created manually and detected through relay tripping mechanism. Lastly concluded which type of fault is detected and its severityt.

Keywords: PIC16F877A microcontroller, Precision rectifier, CT, PT, Relay, Contactor and 3-ϕ induction motor.

I. INTRODUCTION

Induction Motors (IM's) are used as actuators in many industrial processes. Although IM's are reliable, they are subjectedto 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 IM's are generally provided by some combination of mechanical and electrical monitoring equipment. 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 PIC; these electrical parameters have been displayed on a screen. 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. In this paper, we introduce a new method for protection of three phase devices using a PIC microcontroller. Automatic fault recovery result in auto reset to temporary fault and trip to permanent fault

II. FAULT IN THREE PHASE SYSTEM AND THEIR CAUSES

A. Over voltage

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. Under voltage

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.

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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 pre-described 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

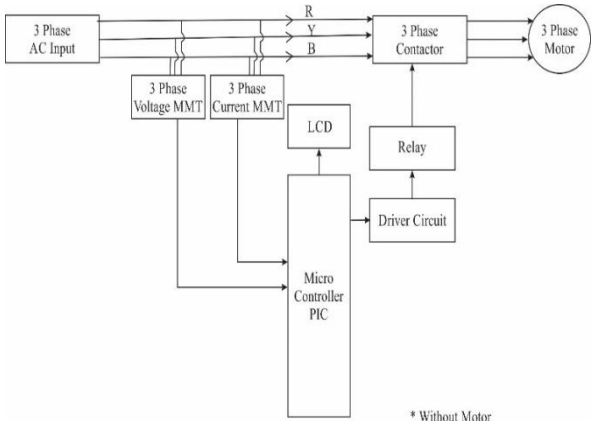
single phasing refers to a condition where in one of the phase of the 3 phase motor is cut off. This is caused becauseof one of the three phases blown in the local or loss of phase from the utility. Single phasing causes negative phase sequence components in the voltage. Negative phase sequence causes heating of motor and consequently motor failure. Following are the effects of single phasing:

- Due to single phasing, the current in the other two phase increases and it is approx. 2.4 times greater than the normal current.
- The motor becomes noisy and starts vibrating due to uneven torque produced in the motor.
- A fatal shock can be experienced by the operator due to melted windings caused by overheating.

III. OVERVIEW OF DESIGN

The circuit uses standard power supply comprising of a step-down transformer from 230V to 9V,± 15V and 8diodes forming bridge rectifiers that delivers pulsating dc which is then filtered by an electrolytic capacitor of about 1000µF. The filtered dc being unregulated, IC LM7805 is used to get 5V DC constant and IC LM7812, IC LM7912 to get ±12V.A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw (changeover) switch contacts. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

IV. BLOCK DIAGRAM



It consist of

- Power supply
  - ❖ Transformer
  - ❖ Rectifier
  - ❖ Voltage Regulator
- PIC Microcontroller (16F877A)
- LCD display
- Relay and Relay driver

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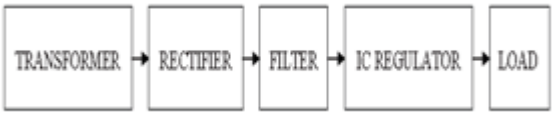
- Current Measurement
- Voltage Measurement
- OP-AMP

A. Power supply



The ac voltage, typically 220V RMS, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies. This voltage regulation is usually obtained using one of the popular voltage regulator IC units. Here are the simulation & hardware design of Power supply units as shown in **fig.1(a),fig.1(b)&fig.1(c)** of 5V power supply.

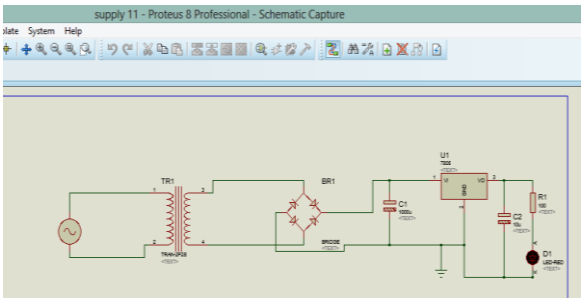


fig.1(a)Simulation of 5V power supply

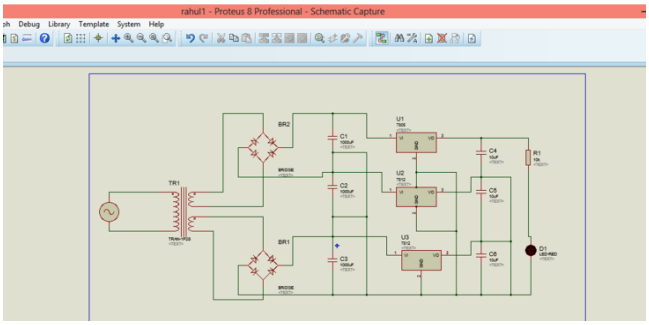


fig.1(b)Simulation of 12V power supply

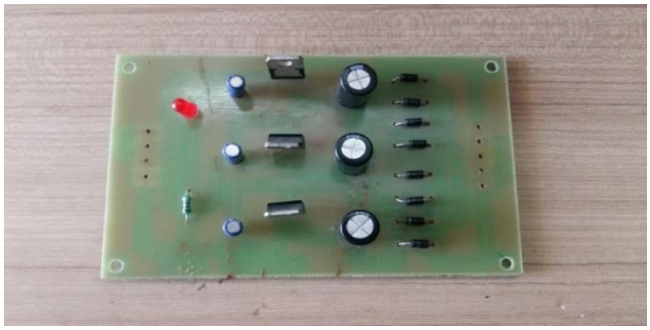


fig.1(c)Hardware design of power supply

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B. Microcontroller (pic16f877a)-

The PIC micro-controller PIC16f877a is one of the most renowned micro-controllers in the industry.One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output as shown in **fig.2.**

fig.2Microcontroller IC

C. LCD display-

LCD stands for liquid crystal display they are used to show status of the product or provide interface for input or selecting some process. In an (m*n) LCD
m-denotes number of columns and n- represents number of rows.

- Eight(8) data pins D0-D7
- Vcc (Apply +5 volt here)
- Gnd (Ground this pin)
- Rc (Register select)
- Rw (read - write)
- En (Enable)
- V0 (Set LCD contrast)

D. Current transformer-

When current in a circuit is too high to directly apply to measuring instruments, a current transformer produces a reduced current accurately proportional to the current in the circuit, which can be conveniently connected to measuring and recording instruments. A current transformer also isolates the measuring instruments from what may be very high voltage in the monitored circuit. In the circuit we have used air core transformer for the measurement of current and also to give input to the OPAMP Air core transformer with ratio 250:1 is used with current rating of 15 amps.

E. Potential transformer

Voltage transformers (VT), also called potential transformers (PT), are a type of instrument transformer. The PT is typically described by its voltage ratio from primary to secondary. The potential transformer used is of the ratio 220:9V.

F. RELAY-

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions. The relays used in the circuit are single pole double throw relay with rating of 12volt dc. The relays are used as switch to add capacitors in the circuits sequentially. The relays circuit is combined with BC547 NPN bipolar transistors which are used as switch to add and pull capacitors off the circuit as shown in **fig.3**

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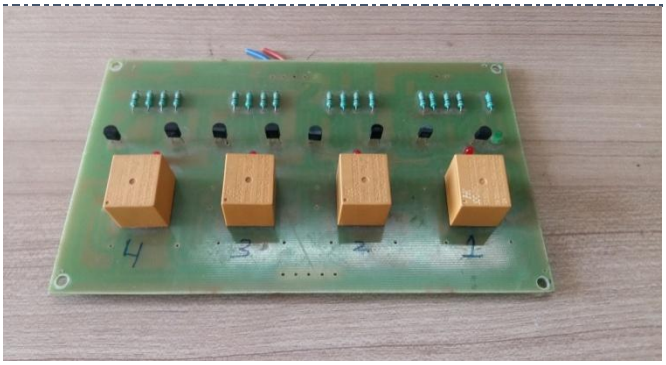


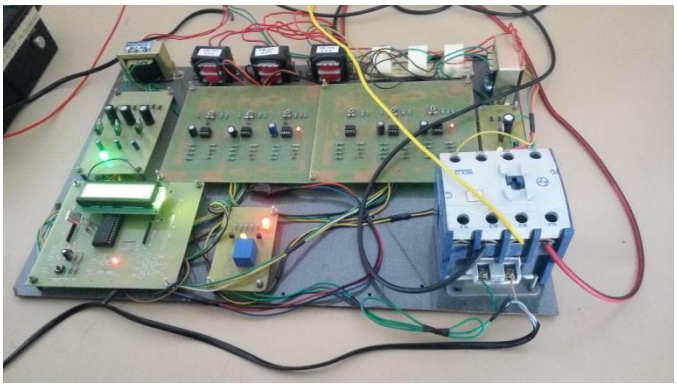
fig.3Relay unit

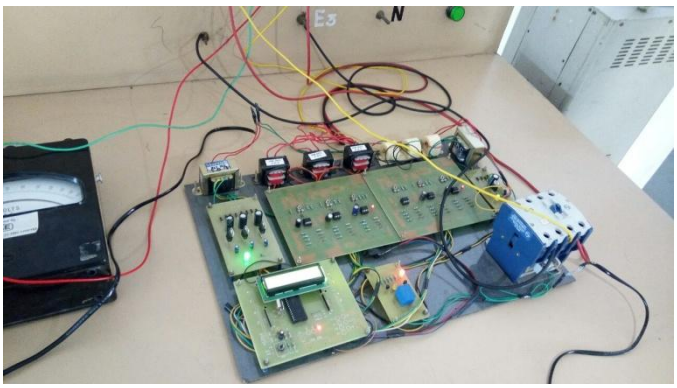
G. OPAMP -

OP-AMP stands for operational amplifier. An inductive load requires a magnetic field to operate and in creating such a magnetic field causes the current to be out of phase with the voltage (the current lags the voltage). An inductive loadrequires a magnetic field to operate and in creating such a magnetic field causes the current to be out of phase with the voltage (the current lags the voltage).

V. COMPLETE HARDWARE DESIGN

Hardware design once it is implemented the result will be obtain with load i.e. auto reset at temporary fault and trip at permanent fault. The PCB is operated at 3 phase load and recovery is possible within fraction of seconds and finally we come to know that the circuit can be implemented at large scale.





VI. CONCLUSION

Three phase devices are used in the industries for various purposes, so it is very essential to protect them from various faults. From the above study we can conclude that this methodology gives the perfect solution for protecting the three phase devices from getting damage from the faults such as undervoltage, overvoltage, overcurrent and line faults.

VII. REFERENCES

[1] S. J. Patil, S. S. Patil, P. D. Patil, " Fault Detection and Correction of 3 Phase Induction Motor" , International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) volume 3, Issue 8, August 2014.

[2] N. B. Shaikh, S.S. Dhamal, S.S. Hadpe& K.P. Varade, " Online Offsite Condition Monitoring Of Three Phase Induction Motor by Using GSM Technology" , International Journal of Emerging Technology and Advanced Engineering Website:www.ijetae.com (ISSN 2250-2459), ISO 9001:2008 Certified Journal, Volume 3, Issue 4, April 2013)

[3] A Nadh, N. lakshmiPrabha and Dr.N.Stalin, Embedded " System Integrated into a Communication system for the Monitoring of Induction Motor Parameters" . Global Advance Research Journal of Engineering and Innovation (ISSN: 2315:5124) Vol 2(10)pp. 276-283, November, 2013 [4] Fail Safe Monitoring and Clock Frequency Switching Using the PIC16F684, website: www.microchip.com

[4] D. P. Kothari and I. J. Nagrath, Modern Power System Analysis, Tata McGraw Hill Education private Limited

[5] www.marineinsight.com/marine-electrical/ single phasing in electrical motors causes effect and protection method