IJIREEICE

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 4, April 2016

Fault Monitoring and Protection of Three Phase Devices

Lokesh Heda[1], Pritesh Bhutada[2], Rinkesh Thakur[3], Piyush Bhattad[4], Vinita Singh[5]

Department of Electronics Engineering, RCOEM Nagpur, Nagpur University, Maharashtra, India[1,2,3,4]

Abstract: This paper focuses on monitoring and protection of three phase devices using PIC microcontroller and RF transmitter and receiver. Large scale industries very often face the problems of overvoltage, undervoltage, overcurrent, overheating, and earth fault in 3 phases. Hence in order to avoid above mentioned faults, we can protect our 3 phase devices by using various methods. One of the classical approaches is to use contactors, voltage and current relays. But this method is not so popular these days because of the advance features of computers and microcontrollers. The system which we have proposed is a microcontroller based hardware system which will keep track of parameter such as overvoltage, undervoltage, over temperature, earth fault and single phasing. The system is also interfaced using RF module to computer software which will continuously display the values of the parameters. This system is capable to auto restart itself as the parameters recovers.

Keywords: PIC microcontroller, faults, CC2500, overtemperature, singlephasing, monitoring, overvoltage, undervoltage, earth fault.

I. INTRODUCTION

A power supply has always been a priority area for the engineers and researchers working for the development of industries. They had came up with 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 and CC2500 eliminates the use of additional sensors. Experimental results shows that microcontroller based hardware system provides high accuracy as well as safe and visual environment compare to the traditional mechanical based systems. In this paper, we introduce a new method for protection of three phase devices using a PIC microcontroller. With the help of microcontroller, we are continuously monitoring the parameter for protecting the load from undesired values of the parameter. We are also providing self diagnosis which will tell us problem has occurred by which parameter and if the parameter recovers its specified value then system will auto reset itself.

Moreover voltages, currents, earth fault, and fluctuations in temperature of the device are monitored and warning messages pops up on computer screen. This system mainly focuses on the protection of three phase devices using PIC microcontroller. Several electrical problems occurs in three phase supply like over/under voltage, overload, open circuit, unbalanced voltage, single phasing and earth faults. Due to these faults, the load across the three phase supply will not operate appropriately. To protect the device from the faults at initial stage, embedded controller is developed.

II. FAULTS IN THE 3 PH DEVICES AND THEIR CAUSES

A. *Overvoltage*: 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. *Undervoltage*: 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.

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 predescribed 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 because of 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:

IJIREEICE
ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 4, April 2016

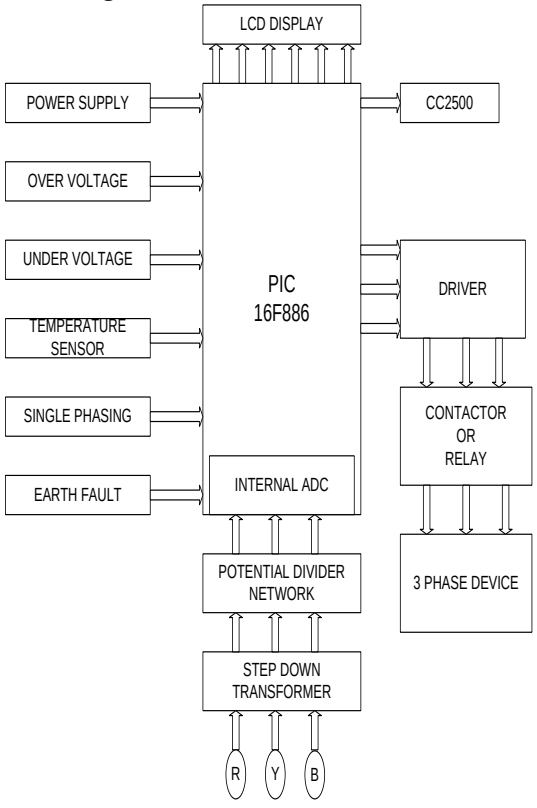
a. Due to single phasing, the current in the other two phase increases and it is approx. 2.4 times greater than the normal current.
b. The motor becomes noisy and starts vibrating due to uneven torque produced in the motor.
c. A fatal shock can be experienced by the operator due to melted windings caused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

III. CC2500 RF TX-RX

The CC2500 is a low cost 2.4 GHz transceiver designed for very low power wireless applications. The circuit is intended for the 2400-2483.5 MHz ISM (Industrial, Scientific, and Medical) and SRD (short Range Device) Frequency band. The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate up to 500K Baud. CC2500 provides extensive hardware support for packet handling, data buffer, burst transmissions, clear channel assessment, link quality indication, and wake-on-radio. CC2500 will transfer the real time values sensed by the microcontroller on the display which will be in the control room.

IV. METHODOLOGY FOLLOWED

A. Block Diagram



B. Operation

The figure above shows the block diagram of proposed system which includes RF transceiver, microcontroller, sensor, transformer, and relay. The complete interfacing is as shown in the figure below. The three phase supply is connected to the transformer which converts 230V AC to 6V DC which is further decreased by potential divider network and given to microcontroller. The microcontroller takes these instantaneous voltages and compares it with the predefined voltage range which is stored in the controller. If the voltage goes above or below the predefined voltage range then the microcontroller will trip of f the load from the supply. Similarly if the temperature goes above the predefined set value then also the load is tripped off from the supply. We are also protecting the load from earth fault. The main feature of our project is that we are going to display the R Y B phase fault along with the temperature and earth fault on the LCD display as well as on the laptop with the help of wireless module.

V. RESULTS

CASE 1: Overheating, when the temperature of the load increases above 45 degree, then the load is disconnected from the supply and fault is displayed on the LCD as well as computer screen.

Fig1.1 Fault displayed on LCD

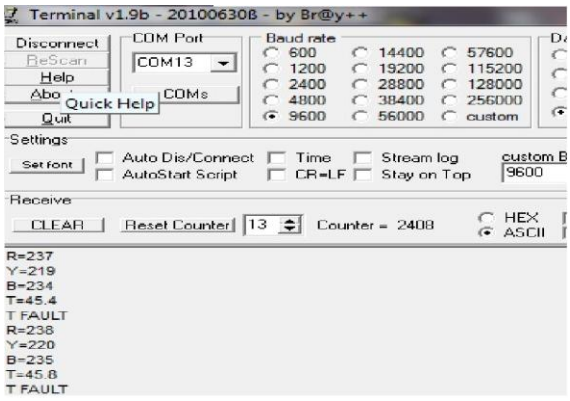


Fig 1.2 Fault displayed on computer screen

CASE 2: Undervoltage, when the voltage of any phase goes below 180V, then the load is disconnected from the supply and fault is displayed on the LCD as well as computer screen.

Fig 2.1 Fault displayed on LCD

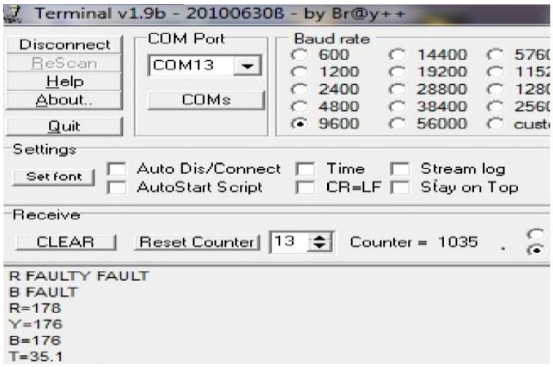


Fig 2.2 Fault displayed on computer screen

IJIREEICE

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 4, Issue 4, April 2016

CASE 3: Overvoltage, when the voltage of any phase exceeds 280v, then the load is disconnected from the supply and fault is displayed on the LCD as well as computer screen.

Fig 3.1: Fault displayed on LCD

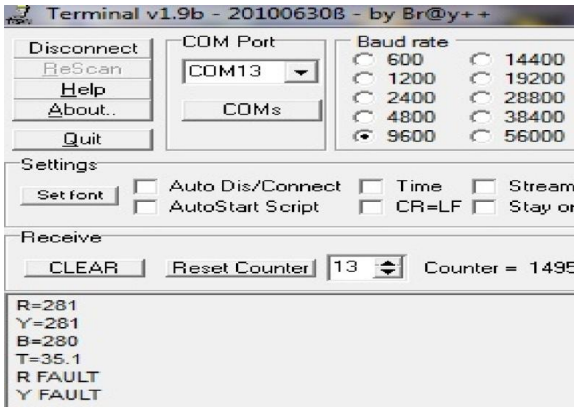


Fig 3.2 Fault displayed on computer screen

CASE 4: Earth fault, it arises when short circuit occurs between any phase and ground, here earth fault has occurred on B phase so its voltage has become zero.

Fig 4.1: Fault displayed on LCD

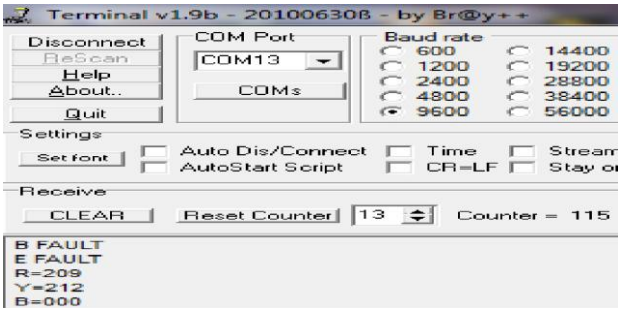


Fig 4.2 Fault displayed on computer screen

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, overheating and earth fault etc.

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. lakshmi Prabha 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

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

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