International Journal of Electrical and Electronics Research ISSN 2348-6988 (online)
Vol. 3, Issue 2, pp: (1-4), Month: April - June 2015, Available at: www.researchpublish.com

Power Factor Correction for 1 Phase Induction Motor Using PLC

[1]Sujit Desai, [2]Nikhil Lalpurwala,[3]Vinayak Salokhe,[4]Prof. Rohit katre

[1,2,3,4] KJ College Of Engineering and Management Research, Pune, India

Abstract: **This paper discusses the design, implementation and analysis of a three phase capacitor bank controller unit. Power factor correction using capacitor banks reduces reactive power consumption which will lead to minimization of losses and at the same time increases the electrical system's efficiency. Most of the industrial installations have large electrical loads which are inductive in nature, which results in a lagging power factor. Power factor is the value of a system that reflects how much power is being borrowed from the power company for the system. Many power companies regulate industrial power factors to make sure that they do not fall below a certain level and charge the customer more on their utility bills if the power factor falls below a certain level. This work is to make a system that will switch capacitor banks when the power factor drops below a certain point to avoid power company charges. PLC is used to control of switching on/off capacitor bank to improve power factor.**

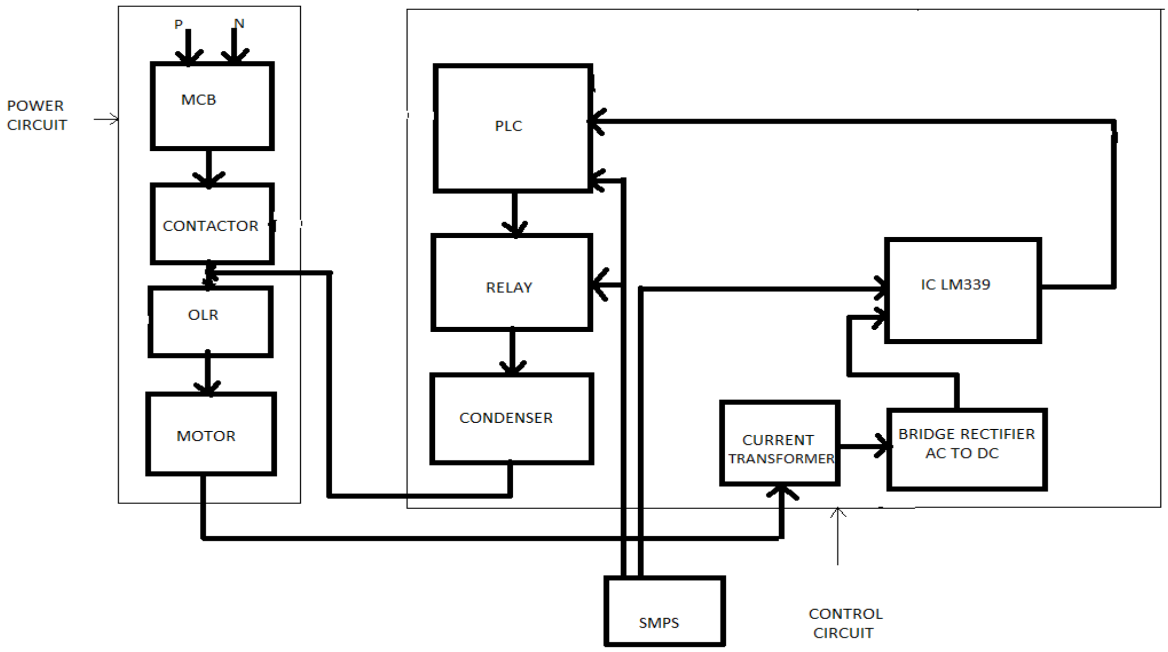
Keywords: **Programmable logic controller (PLC), Condenser, Relays, 1 Phase Induction Motor, Current Transformer.**

1. INTRODUCTION

Power factor is the ratio of true power or watts to apparent power or volt amps. They are identical only when current and voltage are in phase then the power factor is 1.0. The power in an ac circuit is very seldom equal to the direct product of the volts and amperes. In order to find the power of a single phase ac circuit the product of volts and amperes must be multiplied by the power factor. Ammeters and voltmeters indicate the effective value of amps and volts. True power or watts can be measured with a wattmeter. If the true power is 1870 watts and the volt amp reading is 2200. Than the power factor is 0.85 or 85 percent. True power divided by apparent power. The power factor is expressed in decimal or percentage. Thus power factors of 0.8 are the same as 80 percent. Low power factor is usually associated with motors and transformers. An incandescent bulb would have a power factor of close to 1.0. A one HP motor has power factor about 0.80. With low power factor loads, the current flowing through electrical system components is higher than necessary to do the required work. These results in excess heating, which can damage or shorten the life of equipment, a low power factor can also cause low-voltage conditions, resulting in dimming of lights and sluggish motor operation. Low power factor is usually not that much of a problem in residential homes. It does however become a problem in industry where multiple large motors are used. So there is a requirement to correct the power factor in industries. Generally the power factor correction capacitors are used to try to correct this problem.

Power factor correction acts to improve poor power factors by keeping a customer's power factor above the level specified by the power company. The most common method of controlling power is by the use of switching capacitor banks and was the method implemented in this project. Capacitor banks generate "negative" reactive power or absorb the reactive power produced by inductive loads. However, it is possible to add too much capacitance to the system and still incur power company charges. This occurs when the amount of capacitance added is so much greater than the inductance of the system that the power factor goes below 0.85 leading. The goal of this project was to obtain a power factor as close to one as possible or to control the system power factor within a range that will avoid any power company charges possible

2. BLOCK DIAGRAM OF PF CORRECTION USING PLC



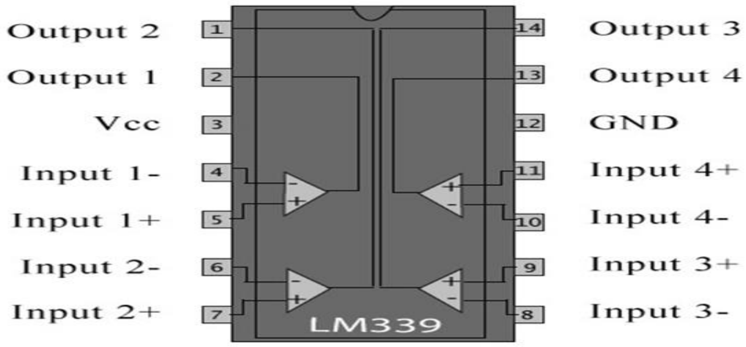
The figure shows the basic block diagram PF correction using plc. It consists of a contactor, motor load, relay, capacitors, current transformer, PLC. Contactor together with motor load forms a power circuit. Whereas PLC, relay, capacitor, C.T forms a control circuit

When motor starts through the 1 phase 230V 50HZ power supply. The current transformer is connected across the one phase to sense the current drawn by motor. Current transformer used in this circuit is 1A/1mA the output of current transformer is given to bridge rectifier which converts the AC value of voltage into DC. DC values are given to IC LM339 which is nothing but the comparator. IC LM339 consists of four outputs and four input pairs. One of this input pair provided with 24V which is reduced to some values other input is given through the output of bridge rectifier i.e. the current value measured by the current transformer which is later converted to DC value. When the two values are identical it turns on the respective output.

PLC output is given to Relays which in turn switch the capacitor bank. Input to the PLC is given through current transformer which senses the current of the load another input to PLC is manual switching push buttons so there are total 8 inputs including 4 for manual operation and 4 of C.T. Then according to programming done in PLC it gives the output to relays and relays in turn switch the capacitors. The SMPS is used to provide supply to PLC, relays. The condenser bank used is of rating 2.5,4,8,10 mFD

PLC output consists of switching of relays which turns the condenser. Stop the motor if power factor falls below predetermined value. Start capacitor 1, 2,3…….n depending on the value of Ø.

IC LM-339



Basically this LM 339 IC is nothing but the comparator having four outputs i.e pin no.-1, 2, 13, 14. This LM 339 IC works on 25v/5v dc power supply which is given at pin no.-4, 12. There are basically four inputs i.e. input 1, input 2, input3, input 4 each input having two terminals one terminal of this input is provided with 24v dc which is reduced to some value based on the value of current and other terminal of same input is given with the value of current and both values are compared and turning on the respective output.

3. ADVANTAGES

1) Reduced Utility Bills:

The power factor of a customer will become a direct or indirect factor in the utility bill. Power bills may be reduced by introducing capacitors to the facility, which can reduce the need for kVAr required from the utility

2) Electrical System Capacity:

Capacitors in a facility produce reactive energy that motors require to produce magnetizing current for induction motors and transformers. This reduces the overall current needed from the power supply. This translates into reduced loads on both transformers and feeder circuits. Reduced loads on transformers can have less maintenance, reduced breaker trips, and higher full-load capacity

3) Improved Voltage Levels:

Low voltage may be caused by a lack of reactive energy dynamic load changes. In facilities with motors, low voltage reduces motor efficiency and can cause overheating.

4. APPLICATION

Electricity industry: power factor correction of linear loads:

Power factor correction is achieved by complementing an inductive or a capacitive circuit with a (locally connected) reactance of opposite phase. For a typical phase lagging power factor load, such as a large induction motor, this would consist of a capacitor bank in the form of several parallel capacitors at the power input to the device. Instead of using a capacitor, it is possible to use an unloaded synchronous motor. This is referred to as a synchronous condenser. It is started and connected to the electrical network. It operates at full leading power factor and puts VARs onto the network as required to support a system's voltage or to maintain the system power factor at a specified level. The condenser's installation and operation are identical to large electric motors. The reactive power drawn by the synchronous motor is a function of its field excitation. Its principal advantage is the ease with which the amount of correction can Be adjusted. It behaves like an electrically variable capacitor.

5. CONCLUSION

Low power factor is not that much of problem in residential homes it does however become a problem in industry where multiple large motors are used. So there is requirement of correcting the power factor in industry. Generally the power factor correction condenser used to try to correct the problem here we used the PLC Based system for power factor correction.

By using this system we can improve lagging power factor thereby system will be safe from different disadvantage of lagging power factor by use of this system the power factor control becomes very fast and accurate than other methods & also the electric charges are also reduced.

REFERENCES

[1] E. Thornton and J. Armintor, "The fundamentals of ac electric induction motor design and application, "in Proceedings of the Twentieth International Pump Users Symposium. IEEE, 2003, pp. 95 – 106.

[2] N. Catalogue, Power Factor Correction. Electrical Engineering Products Pvt. LTD.: Industrial Switchgear and Automation Specialist (NHP), 2007

[3] V W. C. Bloomquist and W. K. Boist "Application of capacitors for pf improvement of induction motor " , A.I.E.E. Trans. PAS, pp.274 -278 1945

[4] S. R. Doradla and B. K. Patcl "A thyristor reactive power compensator for fast varying induction loads", Int. Journal of Electronics, pp.763 -777 1981

[5] W. C. Bloomquist and W. K. Boist "Application of capacitors for pf improvement of induction motor", A.I.E.E. Trans. PAS, pp.274 -278 1945

[6] T. Miller and A. O. Itrogge "Reactive compensation and the electric arc furnace", IEEE Conf. Rec. IAS Annual Meeting, pp.801 -808 1981.

[7] S. R. Doradla and B. K. Patcl "A thyristor reactive power compensator for fast varying induction loads", Int. Journal of Electronics, pp.763 -777 1981

[8] M. A. El-Shirkawi , S. S. Venkata , T. J. Williams and N. G. Butler "An adaptive p.f. Controller for three phase induction generators", IEEE Trans. PAS, vol. 104, pp.1825 -1831 1985

[9] D. Burrow and A. Wu "On-Line utility tie power factor control", Pulp and Paper Industry IEEE Technical Conference, pp.39 -44 1996

[10] A. Cali , A. Irrera , N. Leotta , N. Messina and U. Vagliasindi "Management of reactive power on a radial M.V. network using an expert system", MELECON\'96, Electro-technical Conference, vol. 3, pp.1603 -1606 1996