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POWER FACTOR CORRECTION FOR 1 PHASE INDUCTION MOTOR USING PLC

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Abstract: *This Paper Describe the power factor Improvement of a induction motor using condenser operated through PLC, by improving the power factor of induction motor the energy saving measures are automatically achieved. Power factor is the value of a system that reflects how much power is being borrowed from Power Company for the system. If power factor becomes poor than unity, then organization or industry requires more current for supplying same amount of power.as the current increases line losses also increases because of voltage drop=I^2R.Induction motor is widely used in industries due to their features like low cost, reliability, robustness. At no load induction motor has very low power factor of about 0.33 as the load goes on increasing the power factor also get improved as we go towards full load. Power factor correction serves to correct low power factor by reducing phase difference between voltage and current phasors.it is difficult to control the power factor of continuously varying load. This work is to make the system that wills correct the power factor by switching condenser bank through the PLC.*

Keywords*: Programmable logic controller (PLC), Current transformer, Relays, Condenser, SMPS, 1 phase induction motor*

1. INTRODUCTION

Power factor is the ratio of true power to apparent power. When the voltage and current phasors are identical to each other then only the power factor is unity. The ideal figure for the power factor should be unity. Because it requires a very small amount of current to transmit a given real power. To find the power of single phase circuits the product of volt and ampere must be multiplied by power factor. Ammeter and voltmeter indicate the consumption or effective value of amps and volts wattmeter indicates the true power for ex:- if wattmeter is indicating the 1600w and voltmeter. Ammeter reading shows the 2000 then the power factor is 0.80 or 80%.

AC Induction motor is largely used in industries and other residential purposes. Induction motor consumes large percentage of energy low power factor is not problems with residential consumers it is the problem of concern for industry where more than one induction motors are employed.

Power factor correction acts to improve the low power factor by keeping consumers power factor within the limit prescribed by supply company. The general method for power factor correction is use of capacitor this method is used in our project. The capacitors generate or absorbs the reactive power produced by inductive loads but adding of excessive capacitance may lead to go power factor to leading. So we are using the PLC to intelligently identify the power factor and switch the condenser bank accordingly to maintain the unity power factor.

The proposed work focuses on the implementation of PLC based power factor controller the proposed control strategy based according to measured value of phase angle between voltage and current, the design aims to correction of phase angle by initializing the continuously changing variable capacitor value via switching process.

2. BLOCK DIAGRAM OF PF CORRECTION USING PLC

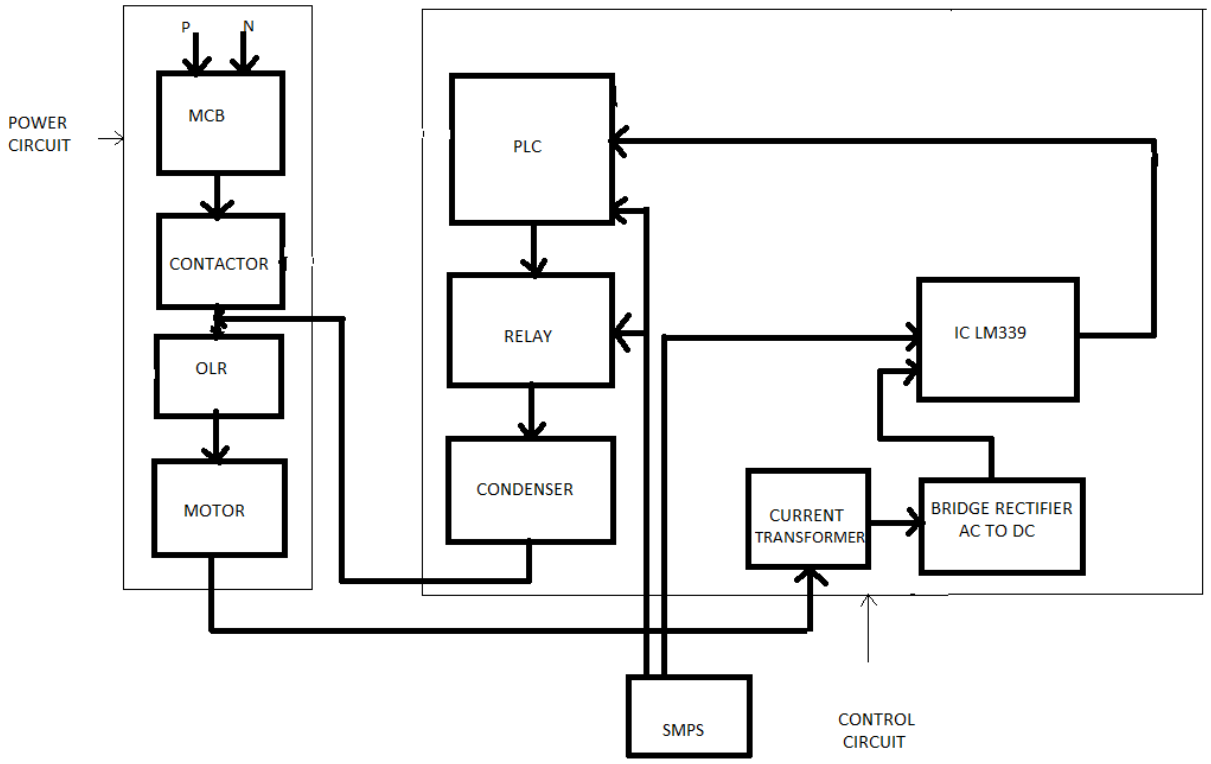


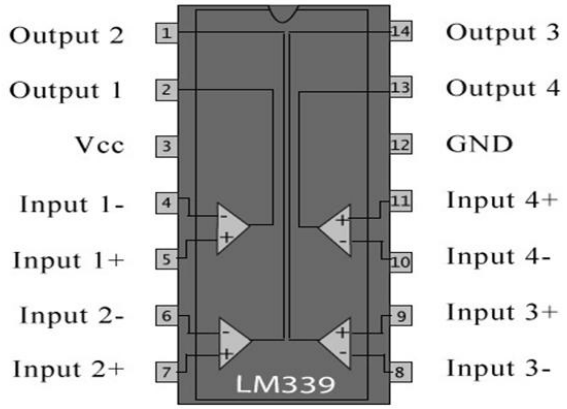
Fig.1:- Block diagram of power factor correction using PLC

The figure shows the basic block diagram PF correction using plc. It consists of a contractor, 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 consist 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 banks used are 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:** The main component of our project is IC LM339 which is nothing but comparator.



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

4.1 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 &FUTURE SCOPE

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. In a world of automation PLC is having a large use in industries so the power factor correction is also having a much importance so along with other automation process the PLC can be used significantly for correction of power factor.

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