International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 04 | April - 2022 Impact Factor: 7.185 ISSN: 2582-3930

AUTOMATIC POWER FACTOR CORRECTION USING ATMEGA328 MICROCONTROLLER

Pooja Verma[1], Veena Adil[1], Ajit Singh[1], Gulshan Kumar Sahu[1]
Devanand Bhonsle[2], Tanu Rizvi[3]
1.Student, 2.Sr. Assistant Professor, 3. Assistant Professor
Department of Electrical Engineering

Shri Shankaracharya Technical Campus, Bhilai (C.G.), India

Abstract: In the era of technical revolution and industrialization importance of power is known by everyone. power in any system can be improved by reducing the Power losses. Due to industrialization and urbanization the use of inductive load is increased resulting dwindling efficiency of system. Hence it is required to improve power factor by using any relevant technique.

This research paper represents the effective way of improvement of power factor using atmeg328 microcontroller with very low cost and easy to construct. In this thesis small rated capacitor are connected parallel to each other. A power factor is set up as reference which acts as standard value in microcontroller below which the system works.

Keywords: capacitor, atmega328 microcontroller, relay, current sensor, voltage sensor, power factor.

1.Introduction

At present load are mostly inductive load, this current drawn results in large phase angle detection between current and voltage of source which causes lagging power factor and results circulation of reactive current, causing power loss, unstable power supply, hike in electricity bill etc.

In order to reduce electricity bills and improve stability of the transmission and distribution system, power factor should be near about unity.

Power factor is improved by using :-

• synchronous condenser

• phase-advancer

• capacitor bank

Capacitor bank doesn't require any additional supply as required in synchronous motor hence are usually used in substation, domestic uses, industries etc. Increasing KVA rating of equipment makes equipment larger and expensive.

Current distortion at different power are-

1) Low:- 20%<THDI

2)Medium:- 20%<THDI<50%

3)High:- THDI>50%

2. Power Factor correction Theory

The Power factor Correction is a method used to increase power factor of a power supply. The power supplied produces current in low, large magnitude pulses without power factor correction. The pulses can be eased by using active and passive methods. Thus input RMS current and apparent input power reduces and power factor increases.

The Power factor correction forms the input current in order to increase the real power from the AC supply. The electrical equipment imitate a pure resistor in a load, therefore the reactive power will be zero and the voltage and current waveforms intend the same wave and same phase with one another. But due to the reactive components in a main part of circuits, that is every time power lag that leads to the power factor.

In an ideal system, all the power produced from the AC mains is operated in useful work. That's why it is only possible when the current in phase with the output voltage. The two phase varies between the energy from the AC, therefore it does not perform useful work.

The power generating company produces more power than demand for the useful power and once it's used they are lost. This means more investments in generation, control, distribution and transmission. The costs are reached on to the consumer in addition to present of the global warming.

Power factor correction improves the power factor of the electrical system such as the power supply towards unity and however it does not reach to close 0.95 which is acceptable for the most utilization.

There are two method of power factor for power supplies:

1) Passive PFC

2) Active PFC

1 Passive Power Factor Correction

The Passive power factor correction method is used for small supplies about 100W or less than 100W. This correction uses low pass harmonic filter at the AC input with capacitor and inductor. This components can be sufficiently small while providing an economical and efficient power factor correction. The Passive Pfcs are simple, hard and solid for lower power demand.

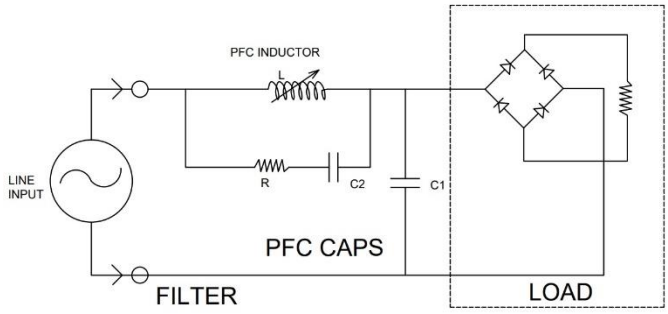


Figure: A Passive PFC

2 Active Power Factor Correction

The Active Pfc method are used for power supplies which is greater than 100W. This method provides a brighter and less considerable for more efficient correction. A Active Pfc includes control circuit that measures the input current and voltage and then adjusts the duty cycle and switching time to secure that the input voltage and current are in phase. These gives an automatic correction of the input voltage and then resulting power factor which is greater than 0.95. The Active Pfc operates an extensive range of input voltages So, it's more complex and costly which required more components.

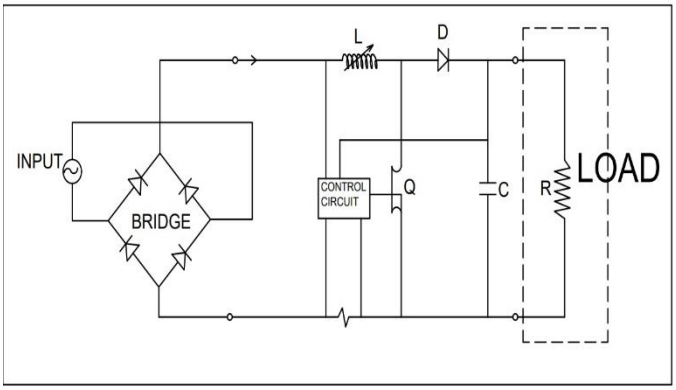


Figure: A Active PFC

3.Static Capacitor

Static Capacitor gives leading current which approximately the lagging component of load current. Thus power factor of load is enhanced. This Capacitors are located in a huge inductive load to improve system and its efficiency. In this way we see that if we increase the voltage it causes damage of the system. Here we acquire a single phase inductive load which proceeds a lagging current and power factor cosθ. Here a Capacitor is arranged parallely with load. Then the current is flowing in capacitor which leads 90° from the voltage supply. In phasor diagram as shown above we see that the angle of θ Is less than angle of θ. Therefore cosθ Is less than cosθ. Consequently, the power factor is enhance by capacitor.

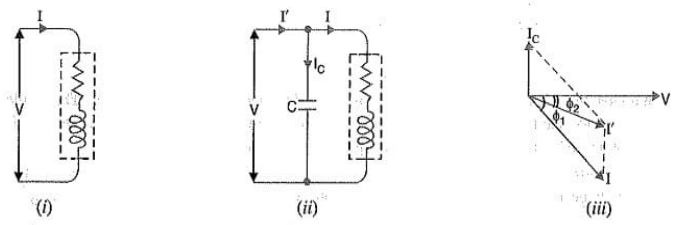


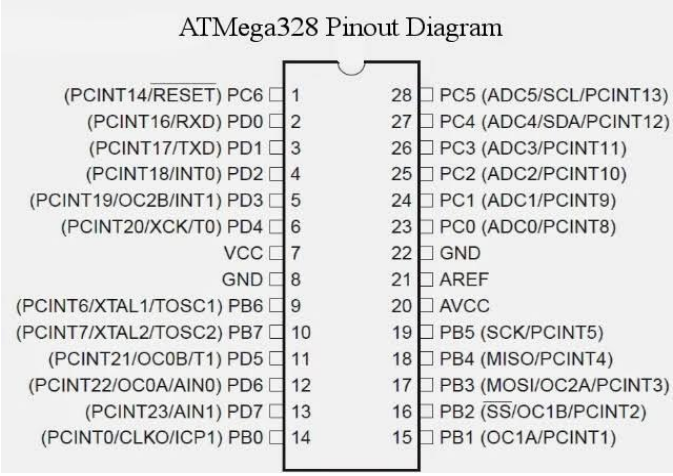
Figure: (i) RL circuit (ii) RLC circuit (iii) Phasor diagram

4.Relay

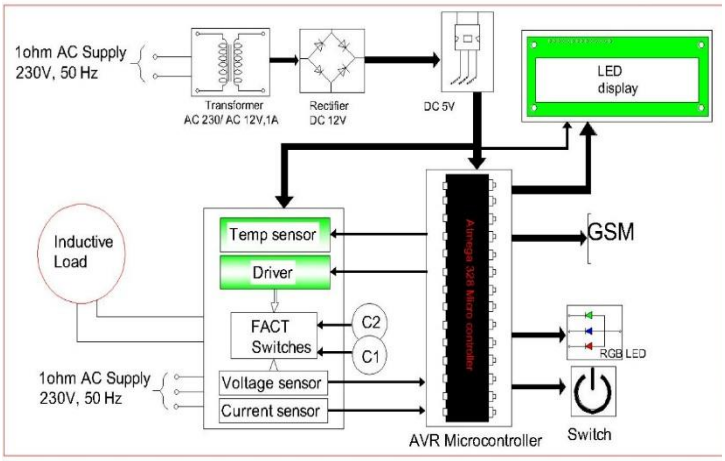
Relay is used to control small voltage to high voltage or we can say that relay is a electrical switch used for ON and OFF. Here different circuits can be controlled through one signal. If we flow current through relay coil it produces a magnetic field which changes the switch contacts.

5.Atmega328 Microcontroller

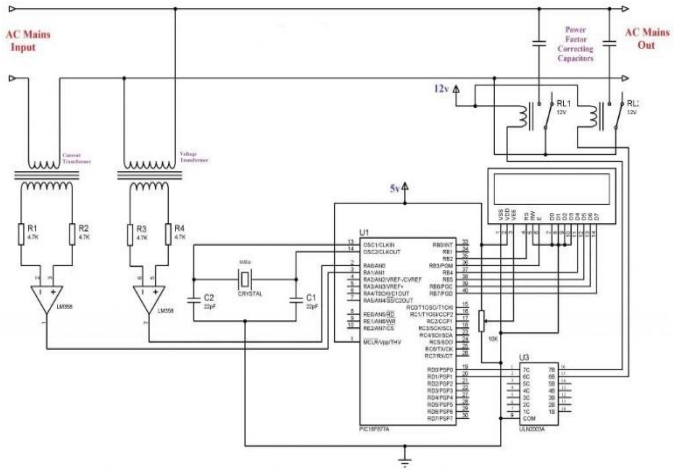
Atmega328 is a single - chip microcontroller designed by Atmel in a mega AVR family. It has modified Harvard architecture 8 bit RISC processor. The microprocessor name Atmega328 has a very important meaning. AT means Atmel Semiconductor Company, Mega means a group and 32 means a memory of 32 kilobytes and 8 means a processing speed of 8 bit. This microcontroller is very admired and it is used in Arduino bords. It has ability to consume low power factor that's why it is mostly used for controlled power factor.



6.Block Diagram



7.Circuit Diagram



8.WORKING

In this project step down transformer is used. The input power supply of 230v is given to the transformer step down the voltage at 5 v. This output of transformer will be input of diode rectifier which convert the ac signal into pulsating dc for the input of microcontroller. Relay is connected to sense the abnormality in the system and capacitor is connected in parallel to the load. When the power factor will decrease below the standard value set in the microcontroller, the relay circuit switch the capacitor parallely to the load which compensate the reactive power occur due to the inductive load.

Here at first the no load is connected i.e. output is kept open circuited. In this case the input voltage is 230v and current is 0 A and display circuit shows the 0 pf.

In the second case resistive load is connected at the output of the system, which is taking the power of 107.72w, current of 0.47A and 230v of voltage. In this case the power factor 0.9 which is near to unity and no correction is required.

In third case the inductive load taking the power of 76.17w is connected the output of the system. Due to reactive power because of inductive load the current lags the voltage and the LCD, display the power factor of 0.65. this low power factor is sense by the relay circuit which switch the capacitor parallel to the load and the reactive power will be compensated. Due to which power factor increases upto 0.85 which is desired value.

9.Conclusion

The automatic power factor correction provides an efficient method to improve the power factor of a power system by economical method. Static capacitor are always used for improvements of power factor in distribution line and plants. However this system only produce the capacitor only when power factor is low or else they are cut off from the line. So it also increase the lifetime of capacitor not only improve the power factor. The power factor of distribution line can be easily improved by low cost with rating capacitors. This system can be improve the power the power factor of distribution line from load side with static capacitor. This static capacitor will appeal in the high voltage transmission line and

the its rating can be unaware and inexpedient. Hence, the variable speed synchronous condenser can improves the power factor which used in hogh voltage transmission line. The speed of synchronous condenser can controlled by and restrained device. the power factor correction method can be applicable for the construction and households to make strong due to the system becomes more stable and efficient of the process.

Reference

[1] Global journal of researches in engineering, electrical and electronics engineering, volume 13, issue 6, year13.

[2] P. N. Enjeti and R Martinez, "A high Performance single phase rectifier with input power factor correction" IEEE Trans. Power Electron. Vol. 11, No. 2, Mar. 2003.pp 311-317.

[3] V.K Mehta and Rohit Mehta, "Principles of power system", S. Chand & Company Ltd, Ramnagar, Newdelhi-110055, 4th Edition, Chapter 6.

[4] International Journal of Engineering an Innovative Technology (IJEIT) Volume 3, Issue 4, October 2013 272 Power Factor Correction using PIC Microcontroller.

[5] International journal of creative research thoughts (IJCRT), volume 6, issue 2 April 2018.

[6] International journal of engineering and information system, volume 4, issue 11, November.

[7] International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Volume 6, Issue 4, April 2017.

[8] Electrical Power Distribution Engineering, Turan Gonen, third edition, chapter 8.

[9] Electrical Machines by Nagrath and Kothari, Third Edition.