Novel reactive power compensation technique for an inductive load connected with micro grid

S. Arockiaraj¹, B. Sakthisudursun², M. Jawahar³ and A. Suban⁴

¹Assistant Professor (Sr.G), Electrical and Electronics Engineering, MepcoSchlenk Engineering College, Sivakasi, India
²Assistant Professor (Sr.G), Electrical and Electronics Engineering, MepcoSchlenk Engineering College, Sivakasi, India
³Assistant Professor, Electrical and Electronics Engineering, Mepco Schlenk Engineering College, Sivakasi, India
⁴Assistant Professor, Electronics and Communication Engineering, Velammal College of Engineering and Technology, Madurai, India

Email: arockiaraj.s@mepcoeng.ac.in

Abstract. The modern power factor repair process using Arduinio Mega2560 provides fast, easy and efficient power adjustment among other methods. Adjusting the active factor of the incoming load will reduce the amount of active energy. The speed of adjustment for proper identification of the power factor was performed using the Arduinio Mega2560. The incoming load causes a lower power factor so by using the appropriate system such as Arduinio Mega2560, the appropriate capacitor bank and other components the problem is solved and the results are obtained with MATLAB verification. Whenever the power factor deviates from the required value or it is automatically closed and saves it at all times. The Arduinio Mega2560 is connected to the MATLAB and the power level is available.

Keywords: Arduinio, PFC, power factor, A Tmega

1. Introduction

The correction of Power factor is a response for the adverse effects to electrical load that create a less energy factor. Power factor plays an important role in machine performance and overall energy quality [1]. At today's level of global energy is greatly reduced in the widespread use of imported machinery. It will therefore be more efficient and economical if the power factor is held on the customer side [2]. Visual power is the product of charges that flow to the operator in relation to the time and energy of the circuit. Because of the energy stored in the load and returned to the input feed, or because of the non-linear load corresponding to the current wavelength obtained from the source, the apparent potential will be much greater than the actual force [4]. When a device (usually a load) generates power in the absence of a power factor, which returns to the supply, which is often considered by another person. The customer will be penalized if they do not keep the power feature. This project aims to reduce this customer disruption [3]. The main purpose is to obtain electrical energy, to inject energy into active energy. Power management close to unity, in residential areas, power fluctuations often in the evenings are reflected by the flashing of the light bulbs, the dimming of incandescent
bulbs, and the fan-free rotation of the fans. Therefore to alleviate these daily problems, we need to install PFC units [5].

![Block Diagram](image)

**Figure 1.** Block diagram

2. **Power factor correction tools**

2.1 **Software requirements**

2.1.1 *Arduino ide.* The Arduino project creates an IDE platform and open source software transcribed in the programme of java. From IDE to language processing, embedded system can be salvaged. Inscriptions embedded in the Arduino board mega with the download system on the firmware of the board.

2.1.2 *MATLAB.* MATLAB (matrix laboratory) is a mathematical software or multi-paradigm computing digital, analytics environment and fourth-generation encoding language. Language-based programming language has been modified by MathWorks .inc.USA, MATLAB allows matrix manipulation, analytical calculations, task and data editing, algorithms creation, user interface creation, and integration of coded coding codes, including ic, c + +, photon, python, java, et.

2.2 **Hardware requirements**

2.2.1 *Arduino mega.* It contains 54 digital input/output portals

2.2.2 *Powering up of arduino*
The power pins are as follows:

Give us a voltage through this pin, or, if you supply power with a power socket, reach it with a Vin.5V pin. This pin removes the corresponding 5V from the controller on board. power applied with 5V or 3.3V anchors exceeds the potential controller, and may damage the board.

b) Statement

The ATmega-2560 offers 4 UART TTL (5V) serial connections. On board ATmega16U2 is one of the above USB and is provided with com software on the computer (Windows devices require a .inf file, but OSX and Linux devices will automatically authorize the board as a COM port. Allows easy text data to be sent and moved on board

2.2.3 Zero crossing detector. Active amplifiers in direct circuits are also used in all incompatible circuits, which means that their output circuits show a negative change in relation to dynamic inputs [6]. These circles are known as circuit switches, the output of which rotates between the power levels of the positive and negative filters. Apparently this is used for more than zero circuit breakers, Schmitt triggers, good and flexible multivibrators.2.2.2.1 Zero Crossing Detector. Zero transition detector is a basic circuit adjustment for op-amp switching circuits [1], [2]. The only input signal source is connected to a fixed input output amp and the input terminal input switch is set, and the circuit is known as Non-inverting zero cross-detector. The circuit diagram is shown in the image below.

2.2.3.1 Flexible Zero Crossing Checker.

Most of the time when the input signal falls above or below zero voltage level, the output switches between one filling levels to another. It converts the Zero Crossing Detector

Figure 3. Non-inverting mode
2.2.4 Operating mode for capacitor bank. Capacitor bank is a collection of many identical capacitors connected similarly or sequentially due to requirement. These basic energy-intensive loads are the electrical circuit of electric motors, variance power up or down, input of transmission and distribution networks, input centre, etc. This active force must be properly restored, except that the ratio between the actual force applied by the load, to the total force applied by the load. People often refer to a factor as a lead or a setback. The inductive power factor was upgraded to 0.9229 by adding 43 microfarad power equivalent to the input load [7]. The power factor lies in the impedance of the load. "Unity of state power" refers to any state-owned company because if the power factor is low, the next generation should provide more now to the user with the required amount of energy used. In doing so, they find an additional line spread. Consider the situation of using a 10 KW electric car and paying for 15 KW of energy. Lost in industrial centre. It should therefore be avoided.

2.2.5 Voltage controller. Controlled power supply is mandatory for electrical devices. So there should be a certain amount of current and power. Circuit power is not constant due to flexible loads. Therefore, the Voltage regulator IC maintains the output power at a fixed rate.

![Pin Diagram 7805](image)

**Figure 4.** Pin Diagram 7805

Controlled power control is a mechanical device that operates at DC voltages and can also support its output precisely at a constant constant voltage even if there is a significant difference in DC input power. A circuit diagram with an IC controller and all the structural elements discussed above is shown in the figure below

![Internal Circuitry of 7805](image)

**Figure 5.** Internal circuitry of 7805

The C1 capacitor is known as a bypass capacitor and is used for high jumps on small ground spikes among other things. C2 is a capacitor filter used to stabilize the slow voltage changes used in circuit installation. An increase in capacitor value increases stability and a decrease in capacitor value reduces stability [3]. A capacitor is not the only one that can ensure that the most frequently generated spikes exceed the input. C3 is a capacitor filter used in circuits to control the conversion of electrical energy. The C4 is a capacitor that outperforms the smallest spikes in the world. The U1 7905 is an IC-controlled voltage.
2.2.6 **Installation load.** Inductors are widely used to replace current electronic equipment, motors and communication devices. As they have AC blocking properties while allowing DC to pass through the file, rectifiers and for a specific purpose are called compression [4]. They are also used in rectifiers and filters to distinguish desirable signals from unwanted and noisy waves, and in combination with capacitors to form a dynamic circuit used to adjust radio and TV receivers.

2.2.7 **Transfer driver.** In the application of the high current strength, the standing force is selected by the constant output and driving the differential circuit transfer than the separate structures in it. There are various ways to drive a transmission [5].

2.2.8 **Transfer driver IC circuit.** An important function of an electrical circuit is separated on or after the path control.

2.2.9 **IC circuit transfer driver ULN 2003.** If the base has received enough power to be pleasing, then the transfer of the transistor from Emitter to Collector also enables the transfer of operation.

![Figure 6. Internal circuitry of relay](image-url)
2.3 Operation for power factor correction

2.3.1 Working of hardware. In AC systems, electrical and current power are exchanged naturally. Phase angle is the cosine of the phase angle lag / lead between power and current. The low-level switch undermines the strength of the OPAMP IC741 material. OPAMP’s job is to convert that waveform (analogy) into Square wave (digital), for Arduino board. The current safe limit for Arduino mega is 40mA. It should therefore be lowered now to safe limits. The current is reduced by lowering the resistor Currently being installed as an OPAMP 741 with the same
frequency. The square results from OPAMP appear to have the same frequency. There is therefore no difference in the angle section on the analogy and digital signal where the inductive load is connected. The Arduino processor calculates the time left between two waves to skip an egg. The corresponding formula is Phase angle = (T * 0.36) / 0.02. The corresponding cosine of this phase component is a matter of energy [7]. Arduino switches capacitors per load to maintain a minimum phase angle. Switching is done with a transfer function. Transmission is powered by an external 9V battery. This adds power similar to a performance circuit. Eventually the PF goes up.

![Lagging waveform](image1.png)

**Figure 8.** Lagging waveform

![Circuit diagram](image2.png)

**Figure 9.** Circuit diagram
2.4 MATLAB SIMULATION

2.4.1 Without capacitance

![Figure 10. Without capacitance](image)

2.4.2 With capacitance

![Figure 11. With capacitance](image)
### Table 1. Simulation results

| Load Type      | Before Voltage correction | After Voltage correction |
|----------------|----------------------------|--------------------------|
|                | Real Power (Watts) | Power factor | Voltage | Real Power (Watts) | Power factor | Voltage |
| Full Load (9A) | 4873 | 0.75 | 404 | 5024 | 0.9229 | 423 |
| Half Load (6.5A) | 2815 | 0.532 | 409 | 2953 | 0.8364 | 432 |
| ¼ th Load      | 1774 | 0.3539 | 414 | 1813 | 0.923 | 443 |

### Output waveforms

![Voltage waveform](image)

**Figure 12.** Voltage waveform
Figure 13. Serial monitor output without capacitor

Figure 14. Current waveform
Figure 15. Serial monitor with capacitor

PROTOTYPE

WITHOUT CAPACITANCE

WITH CAPACITOR
3. Conclusion

This is an attempt to design and implement an energy controller using the ARDUINO board. Arduino guards continuously and then by force or by force of power take control action. This enables a powerful and easy-to-use controller, enables us to keep real-time action taken by Arduino, helping to monitor changes in electrical output on LCD in real time. It is achieved by improving the energy sector to become more economical than building more energy centres. The offer will be able to fund an additional load that could be useful in the energy crisis. This could solve the power crisis in countries like India, Pakistan thus reducing their annual costs in electricity bills. This project is being tested in a transfer-based management. In the future power conversion controls can be implemented. Finance and complexity are critical issues for continued improvement. In the future PWM strategies can be employed in this program.

References

[1] Cho J.G et al 1997 One zero-voltage phase replaced PWM fullbridge converter for power adjustment IEEE Applied Power Electronics Conference 4 457-463
[2] Jain P, Espinoza J and Ismail N 1997 One phase zero-voltage zero-current replaced a full bridge dcextended power range load range Conference Proceedings of Intelec72 120-124
[3] Umesh S, Venkatesha L, Usha A 2014 An effective single-phase power repair process for repairing a full Power Conversations Technol ICAECT challenges11 130-135
[4] Garg R.K, Ray S, Gupta N 2016 Reactive power compensation and power factor improvement using fast active switching technique IEEE 1st International Conference on Power Electronics Intelligent Control and Energy Systems12 1-5
[5] Shiojina D, Cheng M.M, Isobe T, Shimada R 2012 SVC-MERS Controller and Design Rule A new fast power compensation with line frequency change and a small capacitor IEEE Energy Conversion Congress and Exposition22 2045-2052.
[6] Mohan N, Undeland T.M 2009 Power Electronics Converters Applications and Design USA Wiley Publications 23 314-321
[7] Gopalarathnam T, Toliyat H.A 2003 The new topology of unipolar brushless DC motor drive with high power IEEE Trans. Power Electron18 1397-1404