

Minimizing Penalty By Engaging APFC Unit using Raspberry Pi

Prof. Prajakta S. Wankhade¹

¹Vaishnavi Bandgar ²Amruta Bansode ³Jeevan Gurav ⁴Akshata Patil

Department of Electrical Engineering, TSSM's BSCOER, Narhe, Pune

Abstract - The project is designed to minimize penalties by using an automatic power factor correction unit with the help of Raspberry Pi. The power factor is defined as the ratio of real power to apparent power. This definition is often mathematically represented as KW/KVA, where the numerator is the active (real) power and the denominator is the (active + reactive) or apparent power. Reactive power is the nonworking power but power generated by the magnetic and inductive loads, to generate magnetic flux. The increase in reactive power increases the apparent power, so the power factor also decreases. Having a low power factor, the industry needs more energy to meet its demand, so the efficiency decreases. Therefore, it can be seen that reducing the total current to the actual current required would result in greater efficiency. Power Factor values are in the range of 0-1, hence an electrical system with a power factor of 1 (unity) is using 100% useful current with no inefficiency. However, an electrical system with a power factor of 0.5 (50%) is using twice as much current as it needs. This technique can be applied to industries, power systems, and also households to make them stable, and due to that the system becomes stable and the efficiency of the system as well as the apparatus increases.

Key Words: power factor, industry, unity, efficiency,

1. INTRODUCTION

In the present technological revolution power is very precious. So we need to find out the causes of power loss and improve the power system. Due to industrialization the use of inductive load increases and hence power system losses its efficiency. So we need to improve the power factor with a suitable method. Whenever we are thinking about any automatic and programmable devices, we would like Raspberry Pi-based technology because Raspberry Pi-based technology is more suitable and has many advantages over other technology. Raspberry Pi is an open-source technology, it has a system on chip that uses Broadcom (BCM2837), inbuilt serial communication, I2C protocol, and Input/output interfacing.

1.1. Fundamentals of Power Factor

Power factor is a measure of how effectively electrical power is being used by a system. To understand the power factor, we first have to know that power has three components: working, reactive and apparent power. Working power is the current and voltage actually consumed. It performs the actual work, such as creating heat, light, and motion. Working power is expressed in kilowatts (kW), which register as kilowatt-hours on an electric meter. Reactive is not useful work, but it is needed. The power factor is the ratio of working power to apparent power or kW/kVAR. Power factor values can carry from 0 to 1.00. Typically, values range from 0.80 to 0.98. A power factor below 0.80 is considered low.



Fig -1.1: Power Triangle

1.2 Power Factor Correction

If the power factor of the plant is low, it uses more power than it needs to do the work. Poor power factor should be corrected as it substantially increases costs. Capacitors generally are the most economical means to improve the power factor. Power factor correction is the term given to a technology that has been used since the turn of the 20th century to restore the power factor to as close to unity as it is economically stable. This is normally achieved by the addition of capacitors to the electrical network which compensate for the reactive power demand of the inductive load and thus reduce the burden on the supply. There should be no effect on the operation of the equipment. A sample analogy for power factor is to relate it to a garden hose circumstances, if you need 10 liters of water per minute to come out at the end of the hose, the tap should be turned on to deliver that amount of water. But if your hose leaks, squashes between rocks, or is kinked because it is cheap, you will experience a drop in pressure. To achieve your target of 10 liters per minute, therefore, you need to turn up the tap and force more water through the hose. That is Power Factor Correction.



International Journal of Scientific Research in Engineering and Management (IJSREM)

Volume: 07 Issue: 06 | June - 2023

SJIF Rating: 8.176

ISSN: 2582-3930

1.3 Benefits of Power Factor Correction

1. Environmental benefit-reduction of power consumption due to improved energy efficiency. Reduced power consumption means less greenhouse gas emissions and fossil fuel depletion by power stations.

- 2. Reduction of electricity bills.
- 3. Extra kVA available from the existing supply.

4. Reduction of I2R losses in transformers and distribution equipment

5. Reduction of voltage drop in long cables

6. Extended equipment life- reduced electrical burden on cables and electrical components.

2. Block Diagram



Fig -2: Block Diagram

3. Working Principle



Fig -3: Circuit Diagram

3.1 Basic Scheme Hardware required

- Raspberry Pi board,
- LCD,



- Switch,
- Resistor.
- Lamp



Fig -3.1: Receiving section

3.2 Raspberry Pi

Raspberry Pi 4 Model B is one of the recent Raspberry Pi single-board computers. In this blog, you will see Raspberry Pi 4 specifications Pin Diagram, and Description. You can do all kinds of basic tasks using this computer when you need one monitor, keyboard, and mouse. you can play low graphics games, stream 4k video connecting on two displays, do all your office work, and many more. This small computer is designed for learning purposes. It was made for those who can't afford expensive computer hardware but still want to learn. The performance of this small computer is similar to entry-level x86-based pc systems.



Fig -3.2: Raspberry pi

Software Requirement:

• Raspberry Pi-based Python program

3.3 LCD 16x2

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.



ISSN: 2582-3930

3.4 ZMPT

ZMP101B is an AC Voltage Sensor used in DIY projects for measuring accurate AC voltage. It can be used with a whole host of microcontrollers with analog inputs such as Arduino and ESP boards. It senses voltage and sends it further to a raspberry pi.

3.5 Relay

A relay is an electrical switch that opens and closes under the control of another electrical circuit. In the original form, the switch is operated by an electromagnet to open or close one or many sets of contacts. It was invented by Joseph Henry in 1835. Because a relay is able to control an output circuit of higher power than the input circuit, it can be considered to be a form of an electrical amplifier.

3.6 Arduino UNO

The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc and initially released in 2010. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. In this project, it is used as ADC.

3.7 Capacitor

A capacitor is a device that stores electrical energy in an electric field by virtue of accumulating electric_charges on two close surfaces insulated from each other. It is a passive electronic component with two terminals. The effect of a capacitor is known as capacitance. While some capacitance exists between any two electrical conductors in proximity in a circuit, a capacitor is a component designed to add capacitance to a circuit.In this project it is used as capacitive load which opposes inductive load and corrects power factor.

3.8 Working Hardware



Fig -3.8: Working Hardware

4. CONCLUSION

It can be concluded that the power factor correction technique can be applied to industries and the household to make them stable and the system becomes stable. The efficiency of the system as well as the apparatus increases. Care should be taken for power factor correction otherwise the voltage and current increase due to which the power system or machine becomes unstable and the life of the capacitor bank reduces.

REFERENCES

- [1] https://www.hackatronic.com/raspberry-pi-4specifications-pin-diagram-and-description/
- https://www.elprocus.com/lcd-16x2-pin-configuration-[2] and-its-working/
- https://en.wikipedia.org/wiki/Arduino_Uno [3]
- https://www.iraj.in/journal/journal_file/journal_pdf/1-[4] 463-153001420342-44.pdf
- [5] https://en.wikipedia.org/wiki/Capacitor