

ABSTRACT

This paper is used for the purpose of power saving for industrial and commercial establishment. Power factor is defined increase as the ratio of real power to apparent power. Where real power is the time integral of the instantaneous power measured over a full period and the apparent power is simply the product of the RMS voltage and RMS current measured over the entire period.

The time lag between the zero voltage pulse and zero current pulse duly generated by suitable operational dual amplifier circuits are fed to two interrupted a pins of the microcontroller where the program takes over to actuate appropriate number of relays at its output for bringing shunt capacitors into the load circuit to get the power factor till it reaches 0.97. Shunt capacitor ratio will be change a current and voltage due to the power efficiency define and power its changed a circuit power due to high and current.

Measure a unit pulse count and current transformer due to show the rating and increasing power factor value will be change show the display which device perform like "LED BULB, BULB,MOTOR,AC,TV,REF," all using this technique power factor increasing due to easily saving energy of a Power.

Keywords: Current transformer, Current Sensor technology, Micro controller atmega328,LCD Display, Capacitor bank, Relay.

I. INTRODUCTION

This thesis presents the design and implementation of designed to reduce the power loss in industries by power factor compensation through a number of shunt capacitors. This results in reduction in amount of electrical load for industries and commercial establishments. Power factor increase is a defined as the ratio of Real power to apparent power. This principal at a 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 non-working 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 low power factor, the industry needs more energy to meet its demand, so the efficiency decreases.

This implemented design will help at utility to improve fault restoration time and we can utilize transformers for long period of time. Transformers electric device are step-down power system components which are used at various voltage levels with the capacity varying from 1KVA to 600MVA. Any damage to this component results is completely loss in power system. Having low power factor, the industry needs more energy to meet its demand, so the efficiency decreases.

In this technique for system the time lag between the zero voltage pulse and zero current pulse duly generated by suitable dual operational amplifier circuits in comparator mode are fed to two interrupt pins of the microcontroller. Microcontroller atmega 328 and capacitor charge due to start system and relay protection is on displays the power loss due to the inductive load on the LCD 16x2. The program takes over to actuate appropriate number of relays at its output to bring shunt capacitors into the load circuit to get zero power loss

In Electronics power unit system, a monitor to fault condition is any work to flow condition of electric current. As like a short condition circuit break is a transformer fault in which current flow by passes through the

normally load. if a circuit is interrupted by some failure. In R,Y,B line phase at the systems, a faulty may involving 1nd or other phase and that a ground, only 1 between phases. In a “ground fault” or “earth fault”, current pass into the ground. The proper short circuit fault at to current of a fault can be calculated for electronics power systems. In transformer power electronics unit systems, protection devices monitor to detected a fault conditions and operate circuit trip a phase and other devices to limit the of service to a unit power system off.

Further the project can be enhanced by using thyristor control switches instead of relay control to avoid contact pitting often encountered by The project is designed to reduce the power loss in industries by power factor compensation through a number of shuntcapacitors

The reactive power and by which the power factor value is increased and the system efficiency is alsoincreased. useful for the industry and the commercial purpose because they are use heavy or high electricity consumption machine by which they also requirement of more power comparison than of others by which not enough power supply in the rural areas at all time so they feel difficulties but by the use of this project we reduced the power by mean of increase the value of power factor by use of capacitor in series.

II. METHODOLOGY

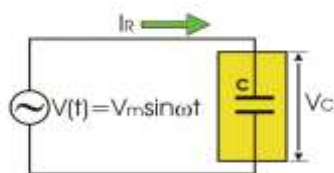
The power saver to the system design and apply the method and power consumption condition to Power saver is a convenience and necessary tool for consumers whose are used high load in industries and commercial purpose electricity is used the power d is monitor.

The instantaneous power of the circuit is given by

$$\begin{aligned}
 p &= v i = V_m \sin \omega t I_m \sin(\omega t - \phi) \\
 &= \frac{1}{2} V_m I_m 2 \sin \omega t \sin(\omega t - \phi) \\
 &= \frac{1}{2} V_m I_m [\cos \omega t \cos(\omega t - \phi) + \sin \omega t \sin(\omega t - \phi)] - [\cos \omega t \cos(\omega t - \phi) - \sin \omega t \sin(\omega t - \phi)] \\
 &= \frac{1}{2} V_m I_m [\cos \omega t - \cos(\omega t - \phi)] - \cos(\omega t + \omega t - \phi) \\
 &= \frac{1}{2} V_m I_m [\cos \phi - \cos 2\omega t - \phi]
 \end{aligned}$$

When AC passes through capacitor, it charges first to its maximum value and then it discharges. The voltage across capacitor is given as,

$$\begin{aligned}
 V_C &= \frac{1}{C} \int I(t) dt \\
 \text{or } I(t) &= \frac{dq}{dt} = \frac{d(CV)}{dt} \\
 \text{or } I(t) &= C \frac{d(V)}{dt} = C \omega V_m \cos \omega t = C \sin(\omega t + \frac{\pi}{2}) \\
 &= \frac{V_m}{\omega C} \sin(\omega t + \frac{\pi}{2}) = I_m \sin(\omega t + \frac{\pi}{2})
 \end{aligned}$$



Figure(g)

Thus it is clear from above **single phase power calculation** of $I(t)$ and $V(t)$ that in case of capacitor current leads voltage by angle of $\pi/2$.

$$\begin{aligned} \text{Instantaneous power, } P &= V(t)I(t) = I_m \sin\left(\omega t + \frac{\pi}{2}\right) V_m \cos \omega t \\ &= I_m V_m \cos \omega t \sin \omega t = \frac{1}{2} I_m V_m \sin 2\omega t \end{aligned}$$

Power through capacitor consists of only fluctuating term and the value of power for full cycle is zero.

Resistive Power

Let's take the condition first where the single phase power circuit is fully resistive in nature, that means the phase angle between voltage and current. i.e. $\phi = 0$ and hence

The single phase power equation is

$$P = V_m I_m \sin \omega t \sin(\omega t - \phi)$$

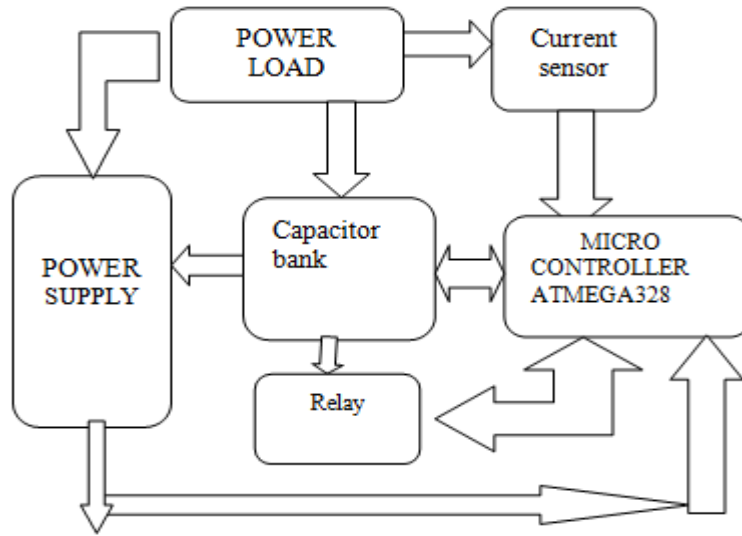
Which is time dependent function. Whereas **three phase power equation** is

$$P = 3 \times \frac{V_m}{\sqrt{2}} \times \frac{I_m}{\sqrt{2}} \cos \phi$$

III. WORKING AND PRINCIPAL

In project of power saver we use the Microcontroller Atmega328. A microcontroller (sometimes abbreviated μC , uC or MUC) is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications. Firstly we give 230v AC power supply to the transformer. Here we are using 12V,1Amp step down transformer that convert 230v AC into 12v AC. From the output of the x-mer ,3 lines i.e. R,Y and B goes on rectifier circuit (Signal conditioning circuit). Each line having 2 wires ,one is phase and another is neutral. Diodes are connected in H pattern. Here we are using 1N4007 diode. It work as a rectifier that convert 12v AC into 12v DC. Capacitors are used in power supplies for smooth the output of a rectifier circuit. Here we are using three 7805 voltage regulator IC'S that fixed the voltage at 5volt. Register having 1k value and LED'S are also connected together in series for fault indication. Now 3 phase wires from this board goes to LCD board . Where these 3 wires are connected from three pin connector. This LCD board need an external power supply to operate this board ,so we connect 9v battery from it. Here we used 16x2 LCD DISPLAY and ATMEGA 328 microcontroller which is 28 pin . LCD and Microcontroller are interfaced together. Microcontroller's first pin is reset. It's second pin connect to GPS i.e. global positioning system and third pin is connected to GSM i.e. global system for mobile communication. Here we are using SIM28ML GPS Modem and SIM300 GSM Modem. Microcontroller's 4th pin connect to LCD's 4th pin i.e. register select. It's 5th pin connect to LCD's 6th pin i.e. enable. It's 7th pin connect to 5v supply. 8th pin of microcontroller connect to ground. 9th and 10th pin of microcontroller connect to crystal oscillator and ceramic capacitor. where crystal oscillator provides clock frequency and ceramic capacitor used for noise elimination. 11th ,12th and 13th pin of microcontroller connect to three phases i.e. R,Y & B. 14th,15th,16th& 17th pin of microcontroller connect to LCD's 14th,13,12th& 11th pin simultaneously these are data lines. 18th and 19th pin of microcontroller are open. 20th& 21st pin connect to VCC i.e.5v. 22nd pin goes to ground & 23rd-28th pin are open. When system works properly LCD get initialized and display welcome message on it. If fault occurs in any one of the line , it indicates on LCD DISPLAY in the form of x-mer line1 fault, "X-mer" line2 fault or X-mer line3 fault with longitude and latitude. This current sensor LM 1172 connect inside of the x-mer. It is also connect to LCD board with 2 pin connector. Microcontroller sends high signal to relay driver IC whenever power factors falls less than 0.9. BC-547 turn on relays which in return connects capacitor banks with the load. First of all the phase difference between voltage and current waveforms are measured and then power factor is calculated. In case of low power factor capacitors are added to improve it.

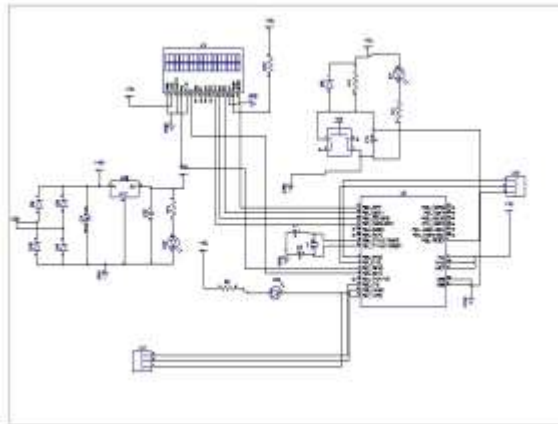
Hardware Design



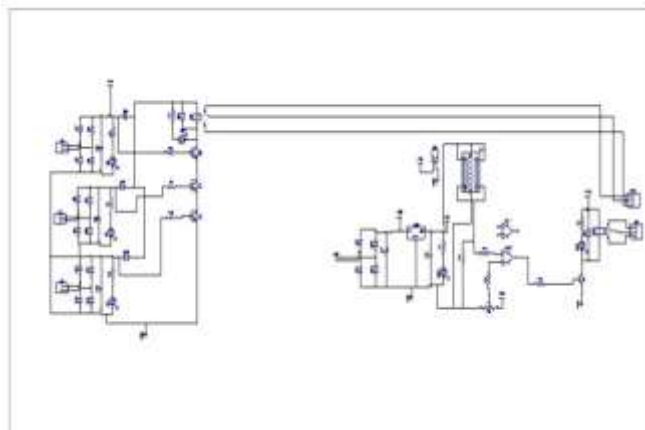
IV. CIRCUIT DESIGN

4.1 Circuit monitor for power saver

The estimates break down energy consumption by "end use". End uses reported by Home Energy Saver include heating, cooling, water heating, major appliances, small appliances, and lighting.



5.2 Circuit for capacitor bank and relay



V. EXPERIMENTAL RESULTS

Micro controller, current transformer is used to get current wave form from of load current and current transformer also step down ac current. LM358 is used as a comparator in this circuit. similarly voltage transformer is used to get current wave form and fed this wave to LM358 comparator. LM358 is used as zero crossing detector in this project. After LM358 both current and voltage waveforms are fed to Atmega328 microcontroller. microcontroller measures zero crossing detection and power factor by measuring time difference between current and voltage wave form. Time difference between current and voltage waveform is used to measure power factor using picmicrocontroller.

For more details on how pic microcontroller measures power factor and done power factor measurement calculation, check following article. I have explained working on power factor measurement project in this article. microcontroller calculate power factor and take necessary actions based on power factor. Relay driver ic lm A1172 is connected with microcontroller and which is used to drive relays. Microcontroller sends high signal to relay driver IC whenever power factors falls less than 0.9. BC-547 turn on relays which in return connects capacitor banks with the load. First of all the phase difference between voltage and current waveforms are measured and then power factor is calculated. In case of low power factor capacitors are added to improve it.

An "active power factor corrector" (active PFC) is a power electronic system that controls the amount of power drawn by a load in order to obtain a power factor as close as possible to unity. In most applications, the active PFC controls the input current of the load so that the current waveform is proportional to the mains voltage waveform (a sine wave). The purpose of making the power factor as close to unity (1) as possible is to make the load circuitry that is power factor corrected appear purely resistive (apparent power equal to real power). In this case, the voltage and current are in phase and the reactive power consumption is zero. This enables the most efficient delivery of electrical power from the power company to the consumer. Some types of active PFC are: Boost, Buck and Buck-boost. Active power factor correctors can be single-stage or multi-stage. Active PFC is the most effective and can produce a PFC of 0.99 (99%).upon our power factor ratio.

In most commercial and industrial facilities, a majority of the electrical equipment acts as a resistor or an inductor. Resistive loads include incandescent lights, baseboard heaters and cooking ovens. Inductive loads include fluorescent lights, AC induction motors, arc welders and transformers.

Typical power factor values for some inductive loads

Table different loads and their power factors

LOAD	POWER FACTOR(PF)%
INDUCTION MOTOR	70-90
SMALL ADJUSTABLE SPEED DRIVE	90-98
MAGNETIC BALLAST	70-80
ELECTRONIC BALLAST	90-95
ARC WELDERS	35-80
FLUORESCENT LIGHT	100

A table below shows effect of different capacitor ratings on the current and power factor of system.

POWER FACTOR		CURRENT (AMPS)		CAPACITOR (MICRO FARAD)
Before	After	Before	After	
0.86	0.88	1.93	1.8995	1.2878
0.86	0.92	1.93	1.8169	4.0193
0.86	0.95	1.93	1.759	6.356
0.86	0.98	1.93	1.705	9.375

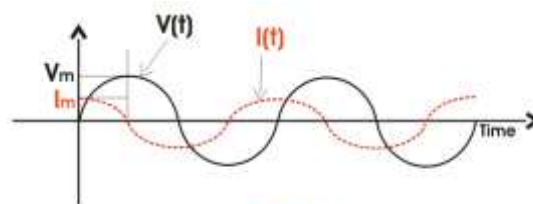


Practical implement prototype Project

The all system design first PCB design by software, and transformer design AutoCAD connected to a wire and coil turns 1000 and component soldering by PCB check the hardware of the system testing LCD display show the location and Fault and fault circuit Also design by PCB and connect to Line phase and current module also connect to this system



Operation PCB



Figure(h)

Output voltage and current waveform

Advantages of the system

1. This system design is very useful for electric power unit maintenance.
2. This System protection for very have loss for transformer
3. In system can b control over load problem.
4. Power distribution unit to easy way.
5. The system design very low cost.

VI. CONCLUSION

By observing all aspects of the power factor it is clear that power factor is the most significant part for the utility company as well as for the consumer. Utility companies get rid from the power losses while the consumers are free from low power factor penalty charges. By installing suitably sized power capacitors into the circuit the Power Factor is improved and the value becomes nearer to 0.9 to 0.95 thus minimizing line losses and improving the efficiency of a plant. By using this PFC system the efficiency of the system is highly increased.

Use capacitor banks at motor control center or service entrances to facilitate switching for varying load.

VII. SCOPE FOR FEATURE WORK

A power saver monitor at a module can be connect to this system for receiving and storing capacitance parameters information periodically about all the distribution power of transformers utility in a database application. This database will be a useful source of information on the utility transformers. The utility in monitoring the operational work of their distribution transformers and identify faults before at characteristics failures thus resulting in significant very cost saving fast working system reliability.

The automatic power factor correction using capacitive load banks is very efficient as it reduces the cost by decreasing the power drawn from the supply. Install conditions as harmonic filters to avoid harmonic resonance problems and excessive voltage distortion levels.

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