Power Factor Improvement using Arm 11 Microcontroller

[1]R.S.Solunke, [2]Prof. M.A. Mechkul

[1] M.E. Scholar, [2]Assistant Professor
E&TC Department

***Abstract*—This paper implement efficient system which removes unwanted effect of reactive load to improve power factor.This is simple and effective technology for used to measure power factor of inductive load using Arm 11microcontroller. The system is usable in various areas like domestic and industrial. The inductive type load gives low power factor also home appliances has low power factor so there is need of power factor improvement. The system has capability to sense voltage and current by potential and current transformer and using proper algorithm capacitor bank is switch on to remove unwanted effect of reactive power to manage power factor. The power factor of an inductive load shownon LCD display.**

***IndexTerms*—Power factor, ReactivePower,KVA,PT.**

I. INTRODUCTION

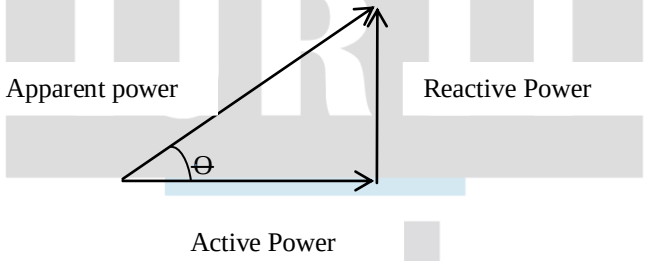
The appliance uses the electricity for various type of load. The inductive load having a lagging power factor, due to this low power factor the power losses were increases in the power system. The capacitor plays important role in compensating the reactive power. This improvement in power factor near unity helps to avoid the heavy penalties and also reduces electricity bill of consumer. The industrial and power system having inductive type of loads gives rise lagging current which decreases the power factor of the system.

A. Power factor

Power factor is important in every type loads. The power factor with value near to unity gives effective use of electricity. The ratio of real power and apparent power taken from electrical load where KW is actual load power and KVA is apparent power. Power factor gives result of efficient use of power supply in system [7]. The reactive power moves back and forward in between source and load.

$$PF = \frac{ActivePower}{ApprantPower}$$

The power triangle shows relation between active power, apparent power and reactive power. Apparent power gives a combination of both real and reactive power, so this can be calculated by using the addition of these two components.



II. Methods of power factor improvements

A.Capacitor:

Improvement means this method reduces difference between voltage and current phase angle. As inductive load require reactive power for their function. This power is given by capacitors connected in parallel with load. it operate as source and gives less reactive power. Result of this is lower phase angle between current and voltage. Advantages are

- It has low losses
- It has low maintenance.
- it is easily installed

B. Synchronous Condenser:

It is a synchronous motor with shaft having no load. This motor operates at any condition of power factor like leading, lagging depends upon his excitation. For lagging power factor loads synchronous condenser is on load side with overexcited. This just work like capacitor .it gives the lagging current from system [2]

C. Phase Advancer:

To improve power factor of an inductive motor AC Exciter is used. The exciter is mounted on to shaft of given motor which is connected to rotor circuit of motor. The improvement in power factor in this technique is due to exciting ampere turns which give rise flux for slip frequency [9].

III. COMPONENTS,FUNCTIONAL BLOCK DIAGRAM

A. Main component

1. Auxiliary power supply
   Transformer
2. Arm 11 LPC 1768 microcontroller.
3. LCD display
4. Zero cross detector
5. Potential transformer and current transformer
6. Capacitor bank

B. Functional block diagram

Zero crossing of voltage and current signal is detected by VZCD and IZCD from potential transformer and current transformer According to phase difference between voltage and current Arm 11 microcontroller gives the signal to switch on capacitor through relay and improves power factor.

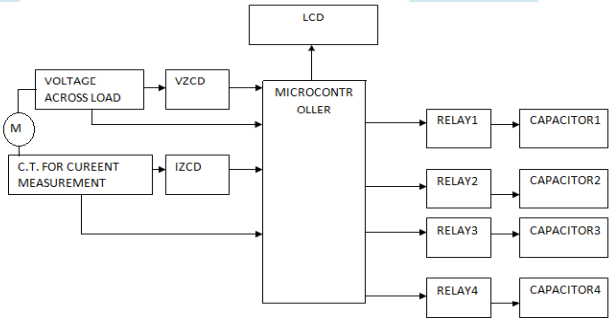


Fig.2 Block diagram of system.

The block diagram of automatic power factor improvement system consists of following.

A. Sensing section :

The input to the circuit is given from the regulated power supply. The AC input 230V from the mains supply is step down by the transformer into 12V voltage and also 12-0-12V transformer gives 12V to aboard which contain dual power supply of 12V which is given to zero crossing detector circuit Op-07 also given to Arm board and Auxiliary power supply. The potential transformer steps down the voltage to 6v.

B. Arm microcontroller Unit:

The Arm cortex-M3 LPC1768 is 32 bit microcontroller are most powerful microcontroller with low power consumption. It receive the signal from ZCD detect whether first voltage edge is falling or current edge depending upon this logic it detects power factor is lagging or leading and accordingly it switch on/ off capacitors. The features of arm microcontroller [8].

- ARM Cortex-M3 controller, running at frequencies of up to 100 MHz (LPC1768)
- A Memory Protection Unit supporting eight regions is included.
- ARM Cortex- built-in Nested Interrupt Controller.
- 512 KB on-chip flash programming memory. improved flash memory accelerator
- It gives high-speed 120 MHz operation with zero wait states.

ARM Microcontroller used is LPC 1768 which is heart of the entire power factor improvement system. It get input and zero crossings of current, voltage waveforms of load. It controls the capacitor bank which gives compensate for leading or lagging power factor.

C. Relay and capacitor bank:

Accurate switching of capacitor stages prevents unnecessary switching for responsive control. According to signals from Arm 11 LPC 1768 microcontroller electromagnetic relays on or off to on or off the capacitor bank to improve power factor. The bank consists of 2 and 4 microfarad capacitor. The power factor is display on LCD for motor load [2].

IV. Flow chart

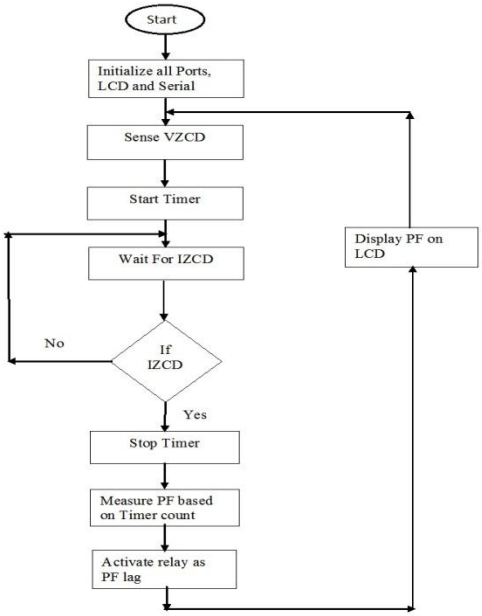


Fig. 3 Flow chart for system.

It first detects voltage signal of load then it start timer wait for current signal if current signal then stop timer. It measure power factor depending upon the count. Activates the relay circuit if power factor is lagging, then it displays improved power factor on LCD [4].

VI OBSERAVATION TABLE

I. Before power factor improvement circuit

Load	Power Factor
Exhaust fan	0.676
Table Fan	0.751

II. After power factor Improvement

Load	Power Factor
Exhaust Fan	0.921
Table Fan	0.990

VII RESULT

The Observation table shows difference of power factor before power factor improvement circuit insertion and after insertion.

Load	PF before improvement circuit	PF before improvement circuit
Exhaust Fan	0.676	0.921
Table Fan	0.751	0.990

VIII. CONCLUSION

The Project gives more efficient technique to improve the power factor of load like motor by efficient way. The static capacitors are used to give improved power factor in industries and in home appliances. The system calculate power factor based on algorithm then uses capacitors when power factor is low otherwise it cut off from line because switching is done automatically. It gives improved power factor as well as increases capacitor life [1].

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