AUTOMATIC POWER FACTOR IMPROVEMENT USING PROTEUS SIMULATION

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Abstract: Power factor is the ratio of active power consumed by the load in to the apparent power flowing in the system. So the power factor improvement is a major challenge in industrial, municipal, local and household application so as provide economical electricity to consumer demands as result reduce electricity bill. In this paper microcontroller based automatic power factor improvement is implemented in order to minimize electricity bill, reducing losses, and saving power. By observing power factor continuously, the power flow of the system can be improved sufficiently. In this paper PIC microcontroller static capacitors instead of high cost capacitor, to achieve the unity or near unity power factor parallel capacitor method is implemented in such way that number of small rating capacitors are connected to microcontroller so as to maintain the power factor close to unity by automatically connecting capacitors when according to requirement.

Keywords: *PIC microcontroller, Proteus, capacitors, power factor correction, detectors* and relays.

INTRODUCTION

The demand and dependency to machineries by human being is increasing day by day which leads to increase the electricity demand. So most of these machineries are inductive load and causes lagging power factor as result leads to poor power factor which leads to system instability, failure, and higher cost of electricity, so as to supply this load economically and efficiently power factor correction comes in to picture.
Power factor correction is a technique by which the power factor can improve close to unity so as to reduce the system losses as result increase efficiency of system and provide efficient and reliable power flow along the power system, power factor correction is required whose power factor is less than 90%, by improving power factor, power quality can improve and finally power losses decreases sufficiently. There are different methods of power factor correction such as static capacitor, synchronous condenser and phase advancer but in this paper automatic power factor correction method is proposed which is implemented by Proteus 8 professional software simulation so as to interface PIC microcontroller (programmable interface controllers) with small rating parallel connected capacitors.
In this paper automatic power correction is implemented and the comparative result is observed, the result shows the effective improvement of power factor in the proposed model.

FLOWCHART

Fig 1. Represents the complete flowchart for automatic power factor correction, when the system implemented, the system will initialize and read the output, input voltage and input current. The amplifiers are used to convert the input sine wave in to output square wave which is required for power factor improvement angle translation, the PIC microcontroller is employed to detect and measure the power factor, if the power factor is one it will display on LCD and if it is not one then the micro controller add the capacitors automatically by relays which are connected in each capacitor. Addition of capacitors lead to eliminate magnetizing current as result increase power factor to unity or close to unity and finally the system stopped.

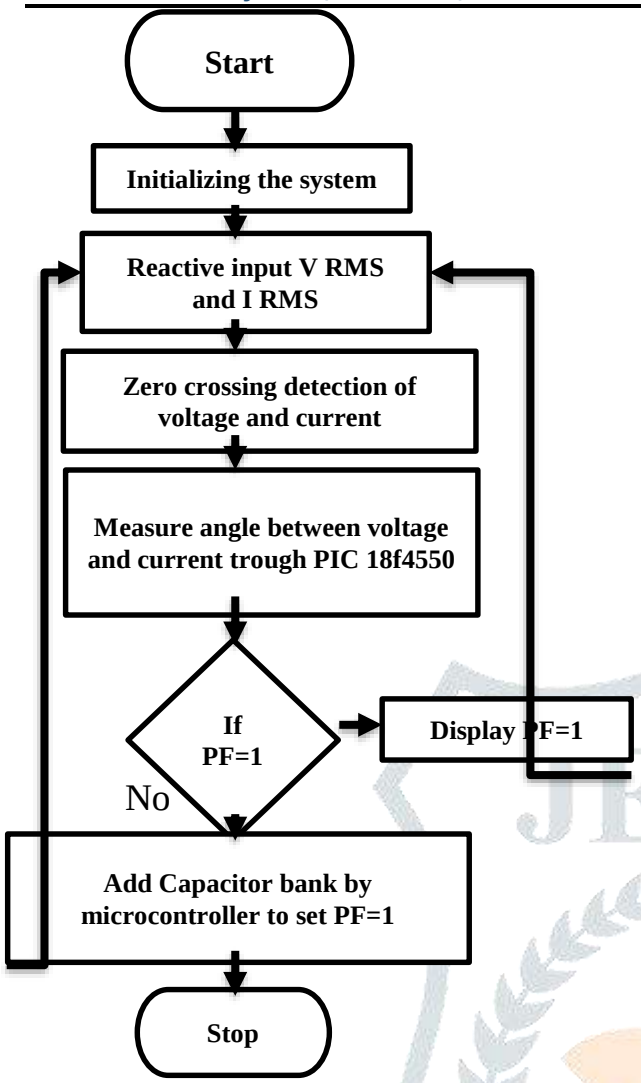

Fig 1. Show the flowchart of proposed model

Fig 2. Shows the circuit configuration of proposed model. The circuit is consists of PIC microcontroller which is programmed so that whenever the power factor is unity or close the unity display the power factor on the LCD and if power factor is not unity it will automatically add up the capacitor banks, the capacitor bank eliminate magnetizing current and provide smooth current flow as result to improves power factor effectively, the operational amplifiers are used to convert the sin wave to square wave which is required for power factor correction angle translation, the relay system paly vital role in the model which connect the capacitor bank automatically when the power factor is not unity, inductive load and resistive load are connected with respective switches so as to implement the system with different nature of load and finally observe the comparative result of inductive and resistive load as result come to know how much the power factor has been improved, the LCD is connected to microcontroller so as to display the power improvement and changes of power factor, the proposed system work significantly and it is suggested to any industrial application to provide the hardware of the proposed system so as to reduce power losses, improve power factor, increase efficiency of system and even it is advisable for transmission lines and distribution network so as to improve the power factor of system and consequently increase the efficiency, reliability and stability throught

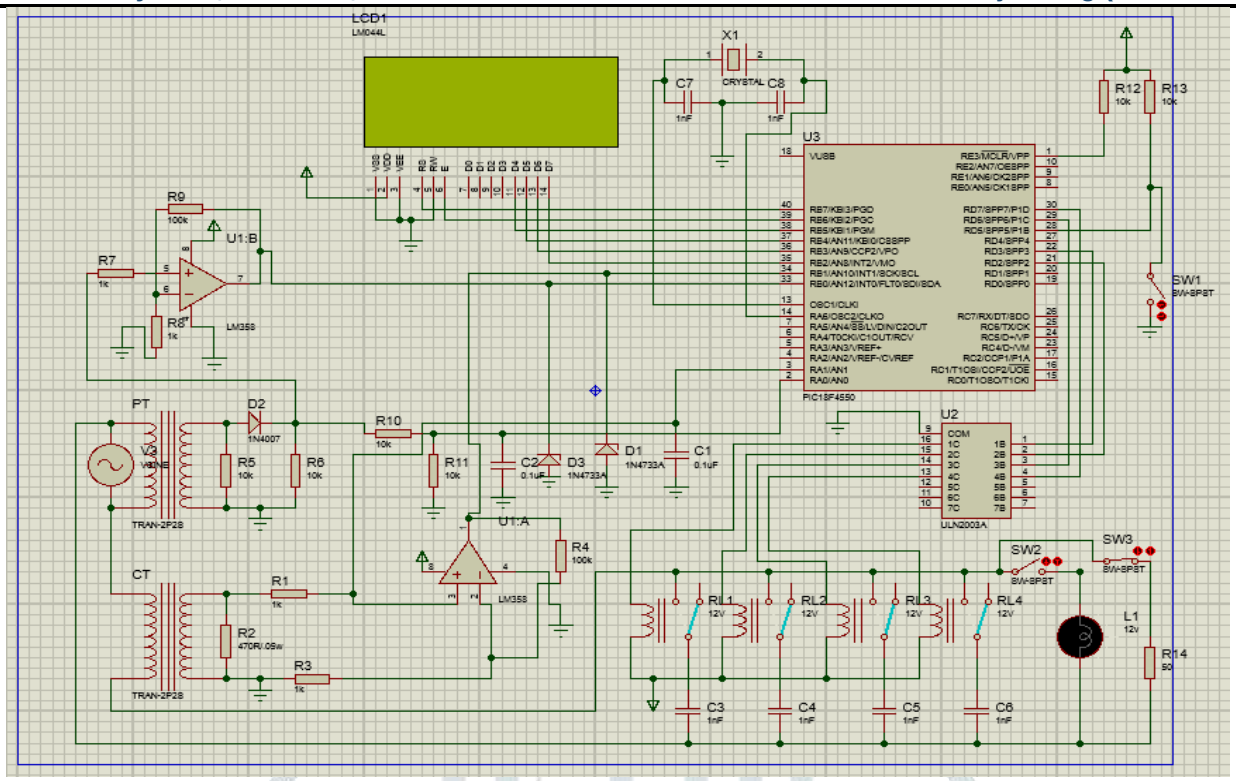

Fig 2. Circuit diagram of proposed model

RESULT

Power factor of proposed model with and without power factor correction

Fig 3. Show simulation model of system with and without power factor correction

The left figure shows without PFC — the right figure shows PFC

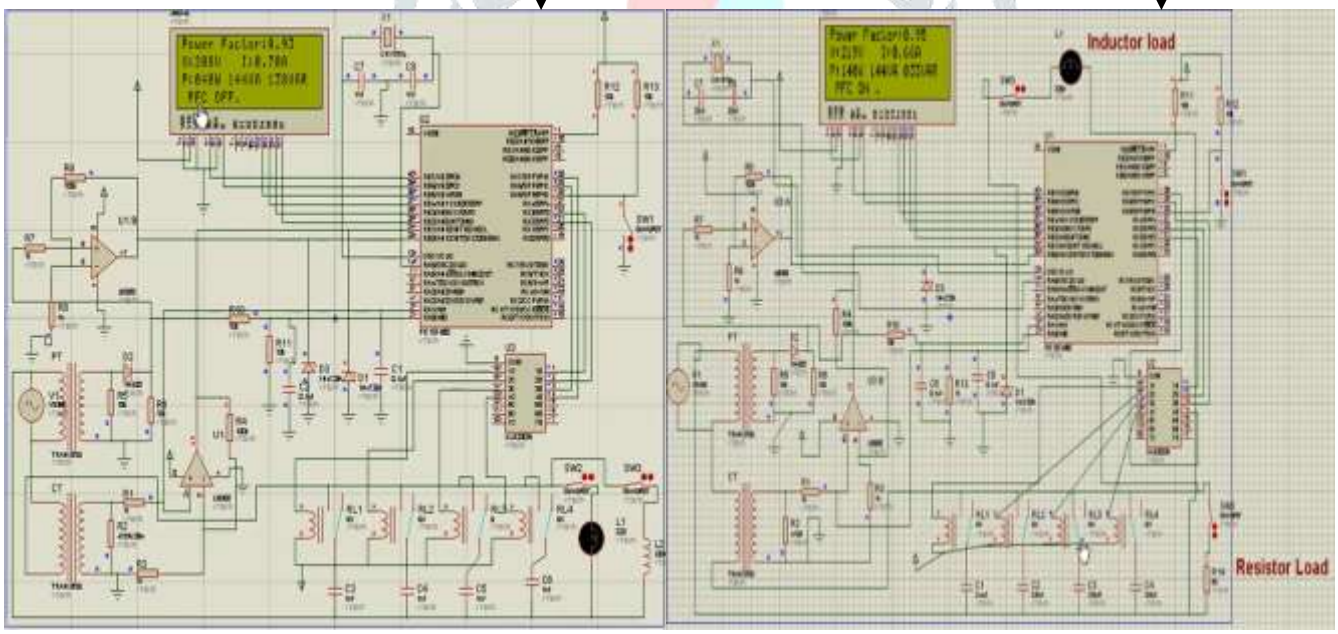

Fig 3. Show circuit configuration with and without PFC

The data of the system without PFC is given in to table below

Resistive load	Inductive load	Active power (W)	Reactive power (Var)	Apparent power (VA)	Power factor (%)
on	off	29	0	29	94
on	on	37	141	146	93.5
off	on	28.8	159	162	93

Table 1. Shows power factor of system without PFC

Figure below illustrate the graphical representation of system data without the operation of automatic power factor correction.

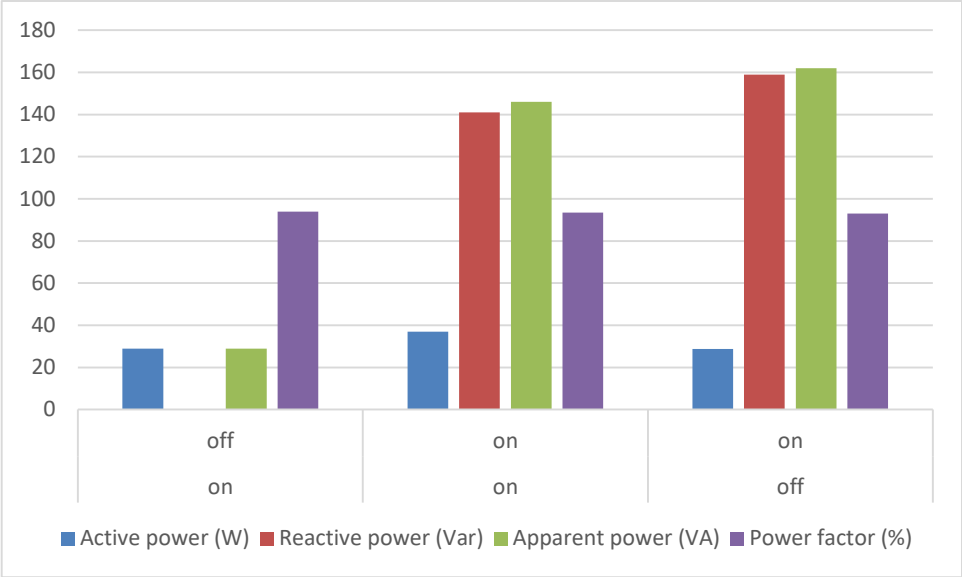

Fig 4. Shows graphical representation of system data without PFC

According to table 1 the power factor of the system is poor due to the presence of inductive loads and it must be corrected so as to improve the efficiency of system.

The data of the system with PFC is given in the table 2 and shows how much the power factor has been improved

Resistive load	Inductive load	Active power (W)	Reactive power (Var)	Apparent power (VA)	Power factor (%)
on	off	30	0	29	99
on	on	38	141	146	97
off	on	29	159	162	97

Table 1. Shows power factor of system with PFC

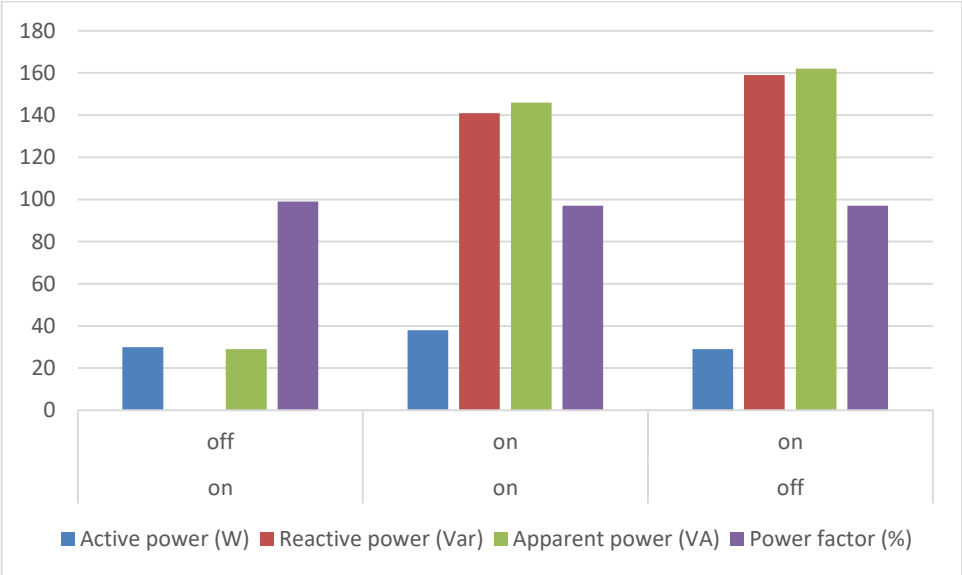

Fig 5. Show graphical representation of system data with PFC

According the mentioned tables it is clear that power factor improved sufficiently after implementing the model. So it is necessary for each and every industry to provide the hardware of this model so as to improve the power factor of the machineries which are used in any applications as result to increase system efficiency, reduce losses, decrease failure and reduce electricity bill.

CONCLUSION

Power factor improvement is the main objective in any industry, to improve the power factor of high power machineries it is advised for any industry to provide the hardware of automatic power factor correction which is implemented in this paper, so as to reduce power losses, increase efficiency and reduce electricity bill. In this paper automatic power factor improvement is implemented in Proteus software, the result which is taken from the implementation is enough satisfying to any consumers.

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