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A Review on Microcontroller Based Automatic Power Factor Correction

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ABSTRACT: There are number of motors working in industries which are inductive nature so they draws inductive current due to that inductive current power factor goes decreases than specified limit (0.95-1 %).If the power factor reduce than this limit then industries get penalty charges and also increases losses or cost .So that this project is designed to minimize these penalty charges and reduce the losses and also cost and also save power by increasing power factor by using Automatic Power factor Correction Technique by using microcontroller. Power factor can be defined as ratio of real power to apparent power .Real power is useful power and also said active power .Reactive power is the non working power which is generated by magnetic and inductive load to generate magnetic flux. Apparent power is the addition of active and reactive power.

KEYWORDS: APFC, Apparent power, capacitive bank, Power factor, Inductive load.

I. INTRODUCTION

In the industrial sector various types of loads are inductive in nature. This type of loads draws inductive current. Due to this inductive current power factor decreases. If load with low power factor then more current required than load with high power factor for the same amount of useful power transferred. If more current is required by load then it affects on different factors such as increase losses, increases cost.[5]

In this project operational amplifier is used which act as comparator mode to generate dual pulses to detect voltage and Current passing through their respective zero position. The voltage source is given by potential transformer to the zero crossing detectors (V) and also current source is given by current transformer to the zero crossing detector (I) .These pulses are given to two interrupt pins of the microcontroller. Then microcontroller display power factor on LCD. If the power factor will be low then microcontroller actuates relays using relay driver and connect capacitor bank in circuit which draws leading current thus improve power factor .The ideal power factor is unity. If power factor will be improve then losses and cost will be reduced. Power factor improvement saves power. The 8 bit microcontroller is used in the project belongs to 8051 family of microcontroller.[4]

II. BLOCK DIAGRAM WITH DISCRIPTION

As Show in Fig 1.the supply signal Voltage and current is given by CT and PT to the rectifier unit which convert these ac signal to dc signal. Then this dc supply is given to regulator. There are two regulators are used 7805 and 7812. +ve 12V supply is given to ZCD(V) and ZCD(C) for their operation and also give to the LCD display unit.+ve 5V supply is given to microcontroller. Operational amplifier act as comparator and generate dual pulses. These pulses are given to two interrupt pin that is INT0 and INT1 of microcontroller. Microcontroller have internal timer circuit which calculate time in ms which then convert into phase angle and power factor will display on LCD.If Power factor will be low then microcontroller actuates relay and shut capacitor will come in contact with device which provide leading current .Thus Power factor will be improve and show on LCD .[3]

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BLOCK DIAGRAM

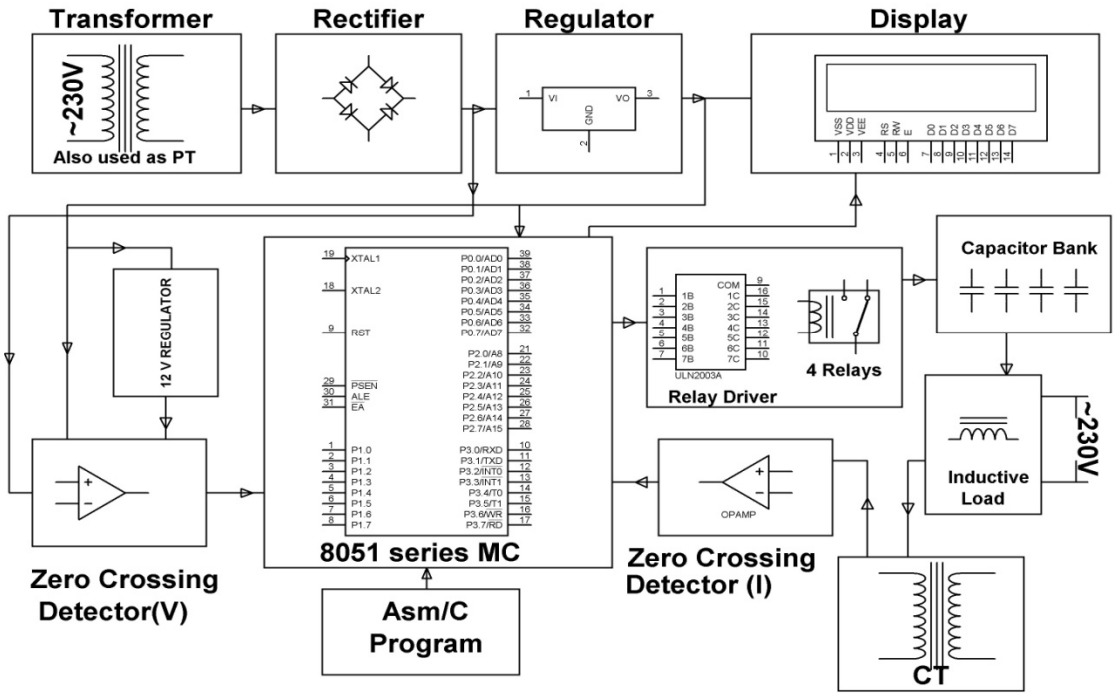

Fig. 1 Microcontroller based Automatic power factor correction

III. CONVENTIONAL METHOD

Following methods are used for power factor improvement
1.Static compensation - If the power factor will be low due to inductive lagging current then static capacitors are connected in parallel with the devices then these capacitors provide leading current which neutralize lagging current and improves power factor .For three phase load capacitors are connected in star or delta.
Static capacitor is invariably used in power factor improvement in industries.[4]

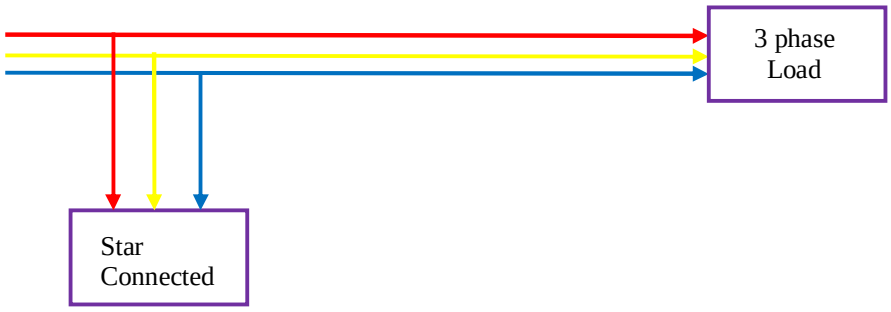

Fig. 2 Static compensation

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In fig. 2, shows the static compensation technique in which 3 phase load is connected with 3 phase line and static capacitors are connected in parallel which provide leading current which neutralize lagging current and improve power factor.
Limitation-They have short service life ranging from 8 to 10 years, easily damaged if the voltages exceed the rated value, and if once the capacitor is damaged, their repair is uneconomical.

2. Synchronous condenser-When synchronous motor operates at under excited and at over excited condition then it is called synchronous condenser. It can generate and absorb reactive power. When synchronous motor is over excited it draws leading current and works like capacitor. When synchronous condenser provides leading current it eliminate reactive component and improve power factor.[4]

Fig. 3 Synchronous condenser

In fig: 3, it shows the synchronous condenser technique for power factor correction. In this 3 phase load is connected through the line and synchronous motor is connected in parallel with line which act as compensator in overloading and under loading condition.

Limitation-There are considerable losses in the motor, Maintenance cost is high and it produces noise.

IV.MODERN TECHNIQUE

Due to the Drawback of above methods we are using the following modern method,
Automatic power factor correction-In this project we are going to use the technique which is called automatic power factor correction using microcontroller. In this project operational amplifier is used which act as comparator mode to generate dual pulses to detect voltage and Current passing through their respective zero position. The voltage source is given by potential transformer to the zero crossing detectors voltage and also current source is given by current transformer to the zero crossing detector current .These pulses are given to two interrupt pins of the microcontroller. Then microcontroller display power factor on LCD. If the power factor will be low then microcontroller actuates relays using relay driver and connect capacitor bank in circuit which draws leading current thus improve power factor.[6]

V.OBSERVATION TABLE

Before APFC circuit insertion,

Load	W(Watt)	V(Volt)	I(Amp)	Power Factor
No load	60	236	0.66	0.39
Half load	125	236	0.84	0.632
Full load	150	236	0.96	0.662

Above table shows power factor of induction motor before insertion of APFC circuit under various loading conditions.

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After APFC circuit insertion,

Load	W(Watt)	V(Volt)	I(Amp)	Power Factor
No load	60	236	0.30	0.86
Half load	115	236	0.52	0.92
Full load	138	236	0.60	0.96

Above table shows power factor correction of induction motor after insertion of APFC circuit under various loading conditions.

VI.RESULT

Comparative results between both conditions,

Load	Power Factor(Before APFC circuit)	Power Factor(After APFC circuit)
No load	0.39	0.86
Half load	0.63	0.92
Full load	0.66	0.96

At no load condition when APFC circuit is not connected then power factor is 0.39 and after connecting APFC circuit then power factor becomes 0.86.

VII.CONCLUSION

This method deals with modify method of automatic power factor correction. This method gives more accurate result than other methods. Thus we can conclude that from this system with increase in power factor we can save power and also efficiency can be increases and this system can be implemented in industries.

VIII.FUTURE SCOPE

In this technique there is no anyone moving part and also no extra motor is required for power factor correction thus it has low cost as compared to synchronous compensation technique. As compare to static compensation technique it has long life. So Automatic Power Factor Correction Technique can use in industries in future. Also PWM method can be employed in this scheme.

REFERENCES

[1] Ei-sadek M. .Z, "Static VAR compensator of reducing energy losses in industrial loads", Electric power system research, Vol.22, issue 2, 1991.
[2] Hubbi Walid, and Takashi Hiyama, "Placement of static compensator to minimize power system losses ", Electric power system research, Vol.47, issue 2, 1998.
[3] Prasad Phad, "Minimizing the penalty in industrial sector by engaging the automatic power factor correction panel of microcontroller" Mul disciplinary journal of research in engineering and Technology, Vol. 1, pg no.73-79, 2014.
[4] Aparna Sarkar and Umesh Hiwase, " A new topology for single phase induction motor drive with improve power factor", Priyadarshini college of Engineering.
[5] Tiwari Anant kumar., Sharma, Durga., and sharama, Vijay kumar., "Automatic power factor correction using capacitive bank", Dr. C.V.Raman Institute of science and technology,Vol.4, pp.394-395, 2014.