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AUTOMATIC POWER FACTOR RELAY USING PIC-CONTROLLER

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ABSTRACT:In the present technological revolution power is very precious. So we need to find out the causes of power loss and improve the powersystem. 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 programmable devices then the embedded technology comes into fore front. The embedded is now a day very muchpopular and most the product are developed with Microcontroller based embedded technology. Automatic power factor correction device reads power factor from line voltage and line current by determining the delay in the arrival of the current signal with respect to voltage signal from the function generator with high accuracy by using an internal timer. This time values are then calibrated as phase angle and corresponding power factor. Then the values are displayed in the 2X16 LCD modules. Then the motherboard calculates the compensation requirement and accordingly switches on different capacitor banks. This is developed by using 8051 microcontroller. Automatic power factor correction techniques can be applied to the industries, power systems and also house holds to make them stable and due to that the system becomes stable and efficiency of the system as well as the apparatus increases. The use of PIC microcontroller reduces the costs..

***Keywords:-*Power Factor Correction (PFC), Total Harmonic Distortion (THD), Power factor(PF)**

1. INTRODUCTION:

In the present scenario of technological revolution has been observed that the power is very precious. The industrialization is primarily increasing the inductive loading, theInductive loads affect the power factor so the power system losses its efficiency. There are certainorganizations developing products and caring R&D work on this field to improve or compensate the power factor. In the present trend the designs are also moving forwards the miniature architecture; this can be achieved in a product by using programmable device. Whenever we are thinking about any programmable devices then the embedded technology comes into fore front. The embedded is now a day very much popular and most the product are developed with Microcontroller based embeddedtechnology. The advantages of using the microcontroller is the reduction of the cost andalso the use of extra hardware such as the use of timer, RAM and ROM can be avoided. This technology is very fast so controlling of multiple parameters is possible; also the parameters are field programmable by the user.

The Automatic Power factor Correction device is a very useful device for improving efficient transmission of active power. If the consumer connect inductive load, then the power factor lags, when the power factor goes below 0.97(lag)then the Electric supply company charge penalty to the consumer. So it is essential to maintain the Power factor below with in a limit. Automatic Power factor correction device reads the power factor from line voltage and line current, calculating thecompensation requirement switch on different capacitor banks.

2. LITERATURE SURVEY:

The paper entitled “A high performance single phase rectifier with input power factor

correction ," the authors P. N. Enjeti and R Martinez have proposed the approach has many advantages, including fewer semiconductor components, simplified control, and high-performance features, and satisfies IEC 555 harmonic current standards. Simulation and experimental results obtained on a laboratory prototype are discussed.

The paper entitled "An Overview of Power Factor Improvement Techniques in Domestic and Industrial Loads", the author's Silpa Thomas, Anjali Shalimar, Unnikrishnan L. have proposed thata suitable circuit for Automatic power factor correction can be developed and the same technique can be applied to the industries, power systems and households such that stability of the system can be increased. . It is economical to use microcontroller for the development of the circuit.

The paper entitled," An Efficient AC/DC Converter with Power Factor Correction" the author's Suja C Rajappan , K. Sarabose , Neetha John have proposed , several techniques for power factor correction and harmonic reduction have been reported and a few of them have gained greater acceptance over the others. In this paper a bridgeless power factor correction boost converter is proposed which results in improved power factor and reduced harmonics content in input line currents as compared to conventional boost converter topology.Bridgeless power factor correction boost converter eliminates the line-voltage bridge rectifier in conventional boost power factor correction converter, so that the conduction loss is reduced.

The paper entitled "Reduced conduction loss zero-voltage-transition power factor correction converter with low cost ,"the author's J.G. Cho,J.W. Won,H.S. Lee have proposed A new low conduction loss, low cost zero-voltage-transition (ZVT) power factor correction converter (PFC) is presented. The conventional PFC which consists of a bridge diode rectifier and a boost converter (one active switch) always has three semiconductor conduction drops.

The paper entitled" Developing Islanding Arrangement Automatically For Grid on Sensing Voltage or Frequency Beyond Range",the author's Mr.NitinDhama and Abhishek Gupta, Ajay Mundra, EktaRai ,Shreya Singh have proposed a way to determine any synchronization failure. Here a frequency and a voltage variation detection system are used. The frequency variation is achieved using an external timer and detection is achieved using the internal timer of the microcontroller. The voltage variation is achieved using a voltage regulator and detection is achieved using a comparator arrangement and any variation in voltage is detected by the microcontroller.

3. PROPOSED WORK :

The solution to overcome the limitations of commonly used power factor improvement scheme is to develop an automatic power factor controller using capacitors. The objective of the system is to maintain a constant power factor at all times irrespective of load conditions by switching the required capacitances into the system. In this method, the problem of over capacitance and over voltages at light loads is eliminated. Figure below shows the block diagram of an automatic power factor controller using PIC microcontroller.

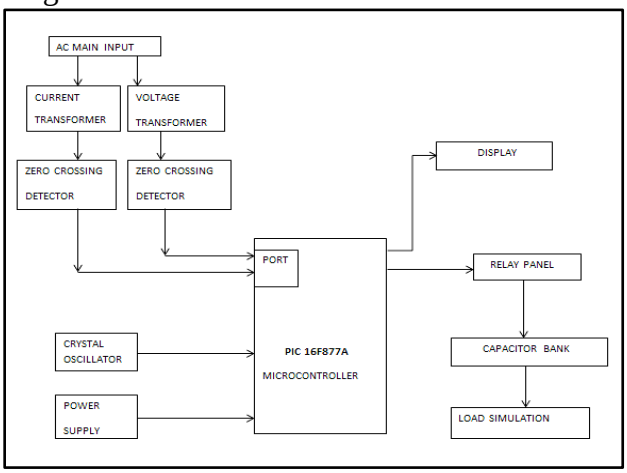

Fig. Block diagram of APFC relay

This is the block diagram of Automatic power factor relay controller. PIC microcontroller is the

major part of the system. Other peripherals are interface with the PIC microcontroller .We are using relay driver for switching the different capacitor banks. LCD 16*2 display is used for displaying power factor of system. Power supply is used for transformers and PIC. In the load simulation board different type of load is present.

3.1. METHODOLOGY:

The proposed algorithm has mainly three sections: a comparator section, a microcontroller section and finally a correction section. The input AC voltage is given to a current transformer and a voltage transformer. This part of the system is referred as comparator section. Voltage transformer step down the input voltage and current transformer is used to extract the waveforms of current. The output of the voltage transformer is proportional to the voltage across the load and output of current transformer is proportional to the current through the load. The output of both voltage transformer and current transformer is given to a comparator which acts like a zero crossing detector. Comparators are constructed using LM358 op-amp. The output of the comparator changes during the zero crossing of voltage and current waveform. These outputs are given to the PIC which does the further power factor calculations.

PIC 16F877A microcontroller is the heart of the automatic power factor controller which finds the displays and finally controls the Power Factor. The current power factor is found out first. This is found by taking tangent of ratio of time between zero crossing of current and voltage waveforms and also between any two successive zero crossing of the voltage waveform.

The PIC microcontroller calculates the power factor of the system when the load is connected. If the calculated power factor is less than 0.9 then the capacitor is switched on using relay circuits. Current lag in non-liner loads is compensated by current lead in capacitors. In this method the phase difference between the voltage and current will be reduced.

This method eliminates the need to install smaller capacitor units and the corresponding switching devices on the distribution system. Thus the installation costs are gravely reduced. The active and reactive power is measured and the microcontroller calculates the power factor of the load .the capacitors are then automatically switched to get the desired power factor. Thus this algorithm is more suitable and efficient than commonly used methods.

4. IMPLEMENTATION:

4.1ALGORITHM FOR CONTROL SCHEME

Step 1- Set the user define lower and upper power factor(LPF & UPF).
Step 2- Set the user define threshold value of current(TUC).
Step 3- Determine power factor.
Step 4- determine value of current.
Step 5- if value of current is less than TUC, take noaction and go to step 3.
Step 6- if the value of power factor is between LPF andUPF take no action and go to step 3.
Step 7- if the value of power factor is less than LPFswitch on the next off capacitor and wait for 1.0 seconds. Go to step 3.
Step 8- If the value of power factor is more than UPF oras leading, switch off the first on capacitor andwait for 1.0 second. Go to step 3.

4.2ALGORITHM FOR DETERMING POWER FACTOR

Step 1- Check for voltage cross zero from negative topositive.
Step 2- Timer T starts (T).
Step 3- Timer T1 starts (T1).
Step 4- Check for current cross zero from negative topositive.
Step 5- Timer T1 stops.
Step 6- Check again for voltage cross zero from negativeto positive.

Step 7- Timer T stops.
Step 8- Phase φ = (T1 / T) * 360.
Step 9- Get cos φ from look up table.
Step 10- If T1> T/4 report power factor is leading.Current and voltage waveform with time period (T) areshown in figure 2 and 3 and combined waveform with time gap (T1) is shown in figures below.

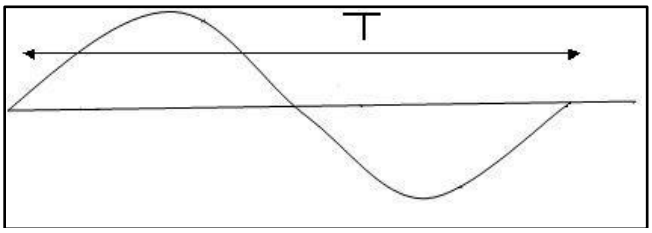

Fig. 1: Voltage with time period

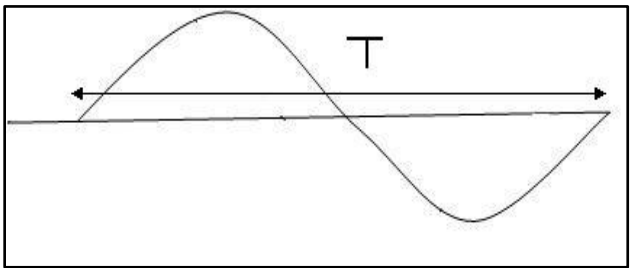

Fig. 2: Current with time period

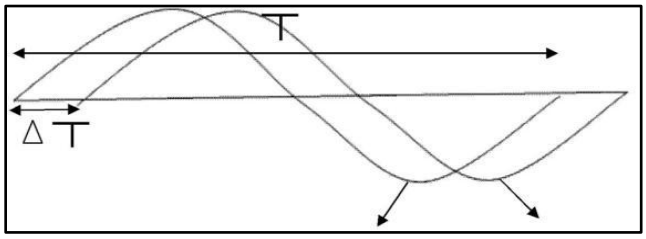

Fig. 3: Current and voltage with time gap

Here we take the value of count and value of count1 then take the ratio of count1 to count. This will give the ratio between time gap and time period. Now the angle is calculated as-

$\theta=(\text{counT1/count})*360^0$ …eq.1
where ,θ=angle
And then,
Power factor = cos(θ) …eq.2

The preferred scale is 1:4.

5. CONCLUSION & FUTURE SCOPE

Thus we conclude that power factor correction techniques can be applied to the industries, power systems and also house holds to make them stable and due to that the system becomes stable and efficiency of the system as well as the apparatus increases. The use of pic microcontroller reduces the costs. Care should be taken for overcorrection otherwise the voltage and current becomes more due to which the power system or machine becomes unstable and the life of capacitor banks reduces

6. REFERENCES

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