Analysis And Optimization of Power Factor Correction Techniques For Single Phase Power Supply

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Abstract- *A low power factor leads to an increase in losses and draws penalty by the utility. Modern industry implementing the mechanized methods can suffers from lower power factor due to the use of different electric equipment which requires more reactive power. Significant savings in utility power costs can be understood by keeping up an average monthly power factor close to unity. The above drawback is overcome by the PFC. Power factor correction (PFC) is a technique of reducing the undesirable effects of electric loads that create a power factor which are less than one. In this paper an Automatic Power Factor Correction (APFC) Unit is build which monitors the power factor and automatically it corrects the power factor. Power factor correction is a method of reducing undesirable adverse effects of electric loads that causes a power factor to be less than one. In this t an Automatic Power Factor Correction Unit is build which monitors the power factor and automatically it corrects the power factor. The phase differences between voltage and current are determined using zero crossing detectors with some basic functions of microcontroller. The project is designed to minimize penalty for industrial units using automatic power factor correction unit. The microcontroller used in this project belongs to 8051 family. The time lag between the zero-voltage pulse and zero-current pulse is duly generated by suitable operational amplifier circuits in comparator mode is fed to two interrupt pins of a microcontroller. The program takes over to actuate appropriate number of relays from its output to bring shunt capacitors into load*

Keywords- Power Factor, Capacitor Bank, Relay, Micro Controller, Rectifier, Current Transformer, Potential Transformer etc.

I. INTRODUCTION

Power factor is the ratio between real power and the apparent power of the equipment. In the present trend, Automatic Power Factor Controller design can be achieved by using programmable device. As we think about programmable device embedded system comes forefront. Embedded system nowadays is very popular and microcontroller proves to be advantageous with the reduction of cost, extra hardware use such as timer, RAM, ADC are avoided. Only the relays used are disadvantageous as they are too bulky and need regular maintenance. Now the embedded technology has become cheaper with the help of technical revolution so as to apply it in all the fields

Automatic Power Factor Correction device is very useful to improve the transmission of active power efficiently. Power factor must be maintained within a limit. As inductive load is connected, Power factor lags and when Power factor goes below the lagging Power factor, then a penalty is charged by the supplying company. Therefore, it is necessary to maintain Power factor within limit. APFC techniques can be applicable to industries, power systems and also to households to make them stable and also help in improving the efficiency of the system. Poor Power factor can be improved by addition of Power factor correction, but a poor Power factor which is caused due to distortion in current waveform needs to have a change in the design of the equipment

APFC is to be developed based on microcontroller(AT89S52\C51) Poor Power factor can be improved by addition of Power factor correction, but a poor Power factor which is caused due to distortion in current waveform needs to have a change in the design of the equipment APFC is to be developed based on microcontroller(AT89S52\C51) . Lesser reactive power flows from the line. They decrease the phase difference in the voltage and current. When capacitors are used Losses are low and also requires very less maintenance. Installation of capacitors is easy because of lighter weight and do not require foundation.

II. PROBLEM FORMULATION

The problem formulation for optimizing power factor correction techniques in a single-phase power supply involves assessing factors like reactive power, harmonics, and efficiency. Key aspects include identifying existing power factor issues, exploring various correction methods, and proposing a solution that minimizes reactive power, reduces harmonics, and improves overall power factor. The

optimization goal is to enhance power quality while ensuring efficient energy utilization in single-phase systems.

The project aims to address power factor inefficiencies in single-phase power supplies by analyzing and optimizing correction techniques. The focus is on minimizing reactive power, reducing harmonics, and improving overall power factor to enhance energy efficiency and power quality.

The project focuses on improving power factor in single-phase power supplies. It aims to minimize reactive power, reduce harmonics, and enhance overall efficiency for better energy utilization and improved power quality. The problem formulation for optimizing power factor correction techniques in a single-phase power supply involves assessing factors like reactive power, harmonics, and efficiency. Key aspects include identifying existing power factor issues, exploring various correction methods, and proposing a solution that minimizes reactive power, reduces harmonics, and improves overall power factor. The optimization goal is to enhance power quality while ensuring efficient energy utilization in single-phase systems. The project aims to address power factor inefficiencies in single-phase power supplies by analyzing and optimizing correction techniques. The focus is on minimizing reactive power, reducing harmonics, and improving overall power factor to enhance energy efficiency and power quality. Define the Objective: Determine the specific goal of the analysis. Is it to enhance power efficiency, reduce reactive power, improve voltage stability, or comply with regulatory standards? Identify Parameters: List the key factors that affect power factor correction, such as load variations, types of loads, input voltage fluctuations, etc. Formulate Constraints: Consider limitations or boundaries that affect the optimization process, such as cost, available space for additional components, technology limitations, or existing system constraints.

Select Evaluation Metrics: Determine the criteria to evaluate the effectiveness of power factor correction techniques. This might include measures like power factor improvement, THD (Total Harmonic Distortion) reduction, efficiency gains, etc. Research Methodology: Choose suitable methodologies for analysis and optimization, such as simulation software, mathematical modeling, empirical studies, or a combination of these approaches. Develop Solutions: Based on the analysis, propose various power factor correction techniques like passive or active methods

III. PROPOSE SYSTEM METHODOLOGY

In this proposed system, two zero crossing detectors are used for detecting zero crossing of voltage and current. The project is designed to minimize penalty for industrial units using automatic power factor correction unit. The microcontroller used in this project belongs to 8051 family. The time lag between the zero-voltage pulse and zerocurrent pulse is duly generated by suitable operational amplifier circuits in comparator mode is fed to two interrupt pins of a microcontroller. The program takes over to actuate appropriate number of relays from its output to bring shunt capacitors into load circuit to get the power factor till it reaches near unity. The capacitor bank and relays are Research Article Volume 10 Issue No.7 IJESC, July 2020 26778 http:// ijesc.org/ interfaced to the microcontroller using a relay driver. It displays time lag between the current and voltage on an LCD. Furthermore, the project can be enhanced by using thyristor control switches instead of relay control to avoid contact pitting often encountered by switching of capacitors due to high in rush current. Problem Identification: Conduct a comprehensive assessment of the existing power factor inefficiencies in single-phase power supplies. Measure and analyze reactive power levels and harmonics to identify specific areas of improvement. Literature Review: Review existing literature on power factor correction techniques, emphasizing their applicability to single-phase systems. Identify successful case studies and methodologies used by other researchers or industries to address similar power quality issues. Correction Method Exploration: Explore various power factor correction methods, including capacitor banks, active power filters, and other advanced technologies. Evaluate each method's effectiveness in minimizing reactive power, reducing harmonics, and improving overall power factor.

Simulation or Experimental Setup: Develop a simulation model or set up an experimental environment to validate the chosen power factor correction method. Simulate different operating conditions to assess the method's performance in real-world scenarios. Performance Metrics Definition:

Define metrics for evaluating the performance of the power factor correction solution, considering parameters such as power factor improvement, reduction in reactive power, and harmonic distortion levels.

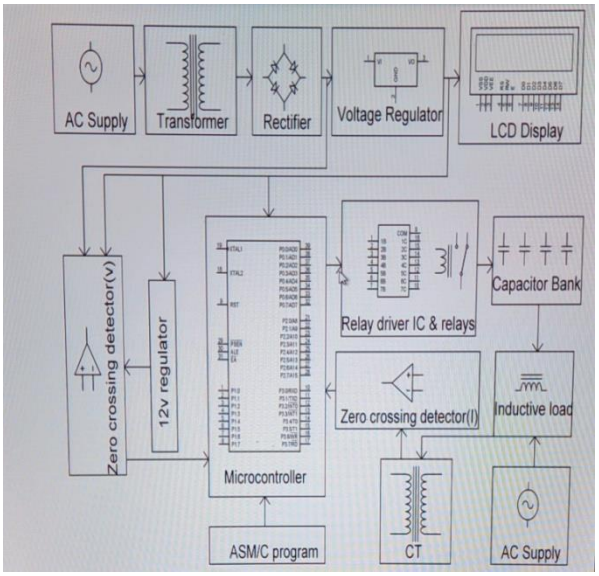

Figure:- Block Diagram

IV. CONCLUSION

It can be concluded that power factor correction techniques can be applied to the industries, power systems and It can be concluded that power factor correction techniques can be applied to the industries, power systems and also households 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 microcontroller reduces the costs. Due to use of microcontroller multiple parameters can be controlled and the use of extra hard wares such as timer, RAM, ROM and input output ports reduces. 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 Automatic Power Factor Correction device is very useful to improve the transmission of active power efficiently. Power factor must be maintained within a limit. As inductive load is connected, Power factor lags and when Power factor goes below the lagging Power factor, then a penalty is charged by the supplying company. Therefore, it is necessary to maintain Power factor within limit. APFC techniques can be applicable to industries, power systems and also to households to make them stable and also help in improving the efficiency of the system. Poor Power factor can be improved by addition of Power factor correction, but a poor Power factor which is caused due to distortion in current waveform needs to have a change in the design of the equipment APFC is to be developed based on microcontroller. Lesser reactive power flows from the line. They decrease the phase difference in the voltage and current. When capacitors are used Losses are low and also requires very less maintenance. Installation of capacitors is easy because of lighter weight and do not require foundation.

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