AUTOMATIC POWER FACTOR FOR RESIDENTIAL

MOHD GHAFFAR BIN GHAZI

BEKE

MAY 2009

"I hereby declare that I have read this report and in my opinion this report in term of content and quality requirement fulfils the purpose for the conferring of the Degree of Bachelor in Electrical Engineering."

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AUTOMATIC POWER FACTOR FOR RESIDENTIAL

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This Report Is Submitted In Partial Fulfillment Of Requirements For The Degree

Of Bachelor In Electrical Engineering

(Power Electronic and Drives)

Faculty of Electrical Engineering

Universiti Teknikal Malaysia Melaka (UTeM)

MAY 2009

"I hereby declare that this report is a result of my own work except for the excerpts that have been clearly in the references"

Signature : …….

Student : MOHD GHAFFAR BIN GHAZI

Date : MAY 2009

Specially dedicated to

My beloved father and mother…
Ghazi bin Che Soh & Salmah Binti Talib

My beloved brother n sisters …
Ghadzali, Noridah, Irwan Faizal, Ilias and Shahidi,

My inspirational motivator…

All my friends,

Thank you for everything…

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ABSTRACT

This report addresses the design of Automatic Power Factor for Residential. The use of an Automatic Power Factor for Residential is very effective way to improve power consumption efficiency and used methods power factor corrections to composite power factor to 0.98. It is small and is flexible in its possible application. The design of the Automatic Power Factor for Residential has been broken down into its subsections and the theory and design considerations needed to implement the Automatic Power Factor for Residential have been discussed in length. The design and implementation of an input and output circuit suitable for integration into the Automatic Power Factor for Residential has been attempted. Input circuit consist AC to DC conversion and angle detection circuit to operate consistent give input voltage to PIC16F877A. Output circuit consist relay circuit to turn on or off capacitor when PIC16F877A give the signal to composite PF near to unity. MicroC programming is used to program PIC16F877A with can operate the whole Automatic Power Factor for Residential circuit. Data collection and analyze every detail have been discussed in a length and it influence the design, modification of programming and hardware of Automatic Power Factor for Residential circuit.

ABSTRAK

Laporan ini dibuat sempena rekacipta projek bertajuk Automatic Power Factor for Residential. Kegunaan projek ini adalah untuk memperbaiki penggunaan kuasa oleh pengguna dan cara yang di aplikasi adalah membetulkan faktor kuasa menghampiri kepada satu. Pembinaan projek ini dipecahkan kepada dua bahagian iaitu bahagian teori dan pembangunan litar yang di gunakan didalam projek Automatic Power Factor for Residential dibincangkan secara terperinci di dalam laporan ini. Pembangunan projek ini merangkumi litar masukan dan keluaran untuk kesesuaian untuk projek ini dapat berfungsi dengan cekap. Litar masukan terdiri daripada litar AC kepada DC conveter dan pengesan perbezaan sudut bagi memastikan voltan masukan konsistan kepada masukan PIC16F877A. Litar keluaran pula mengandungi litar geganti bagi memastikan ia berfungsi menghidupkan atau mematikan kapasitor untuk memampaskan faktor kuasa kepada 0.98. Penggunaan perisian MicroC pula untuk memprogramkan PIC16F877A dan bagi ia berfungsi dengan mengikut apa yang telah ditetapkan. Pengambilan data dan analisis data akan diterangkan secara terperinci di dalam laporan ini. Analisa ini mempergaruhi pembangunan, modifikasi program dan perkakasan projek ini.

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LIST OF ABBREVIATION

A	Ampere xiii
ADC	Analog To Digital
AC	Alternating Current
DC	Direct Current
C	Capacitor
R	Resistance
I	Current
V	Voltage
Hz	Hertz
PFC	Power Factor Correction
PF	Power Factor
USB	Universal Serial Cable
PIC	Microcontroller

LIST OF APPENDICES

CHAPTER1

INTRODUCTION

1.1 Introduction

This project is to improve power factor using capacitor and it switching controller control by microcontroller. Power factor is a ratio of the real power flowing to the load to the apparent power. By using this definition, power factor can be composite by using capacitor that gives reactive power to the load. In this project it consists four parts to archive before it successfully operate, that part are simulation circuit, programming, hardware development and testing.

1.2 Problem statement

Nowadays the application of devices to improve power efficiency method is widely use for consumer. The invention of the Power Factor Correction (PFC) for improves power consumption, but very rare inventions PFC for residential is develop especially for single phase 240V 50Hz. There only available static or time switching capacitor to improve Power Factor (PF) in the market. By using an automatic developed power factor correction, the difficulties that were through by using previous methods will be overcome.

1.3 Objective of project.

These project automatic power factor corrections develop focuses on the following four objectives:

- To improve power efficiency by using PFC method.
- To develop automatic trigger switching PFC.
- To develop real time improvement power efficiency device.
- To reduce utility bill.

1.4 Scope of project.

This following four scope projects is guided to complete this project. There are:

- Residential using single phase 240V/50Hz.
- Use below current 20A.
- Using power capacitor to improve power factor.
- Using PIC as main controller

1.5 Project Report Outline

Generally this project report is divided into six chapters, where it consists:

Chapter 1: Introduction

Chapter 2: Literature Review

Chapter 3: Methodology

Chapter 4: Hardware Development

Chapter 5: Results and Discussions

Chapter 6: Conclusion and Recommendation

Chapter 1 is an introduction for this final report that provided brief what is all about Automatic power factor correction for residential. In this chapter problem statement and objective for this project are included to give the direction of this report are.

Chapter 2 introduce to literature review for this project, what theory and component that use for develop this project. Literature reviews are previous study in this project that can be used to guide and give improvement to the project. It gives the batter chance to success will to develop and innovation in this project. Theory and component are give a general knowledge about this project and it will use to develop on this project.

Chapter 3 introduce to methodology that used on this project and it give a surface guided how this project are build. All these steps are complete shows how all steps; start with research on literature review to get result worked from experiment in the lab.

Chapter 4 introduce to project development for this project. Start from simulation circuit that used in this project, goes to programming develop and goes to hardware development. In this chapter also introduce to what simulation software that used in to develop in this project. Also C programming software to build program and itching procedure process to develop PCB soldering board circuit.

Chapter 5 introduce to result and discussion for this project. Result that get form experiment and testing are compiled and it discuss in detail in this chapter. From result and discussion in this chapter it will give if this project successfully or not bases on data that get from experiment.

Chapters 6 introduce to conclusion and recommendation for this project. It give conclude all the works and had been presented in previous chapter and all the results of the project. This is followed by recommendations for the future study work.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter reviews existing project created to get an idea about the project design, conception and any information that related to improve the project. There are many creations and innovations of projects that have been done by other people with differences concept and design. This chapter also covers the studies related to the subject. This will provide a clearer understanding of the system and its design. This project is all about the power factor correction. All this previous studies contribute to build this project and give roughly idea for example using build in zero crossing detectors on PIC microcontroller; using proper algorithm to calculate power factor value.

2.2 Programming of PIC-Micro Controller for Power Factor Correction.

This part discussed about the intelligent Power Factor Correction (PFC) which focused on design and development of a three-phase power factor corrector using PIC (Programmable Interface Circuit) micro-controlling chip. This involves sensing and measuring the power factor value from the load using PIC and sensors. Then using proper algorithm to determine and trigger sufficient switching capacitors in order to compensate excessive reactive components, thus withdraw PF near to unity and as a result acquires higher efficiency and better quality AC output [1]. Figure 2.1 shows the typical arrangement power factor correction design using PIC.

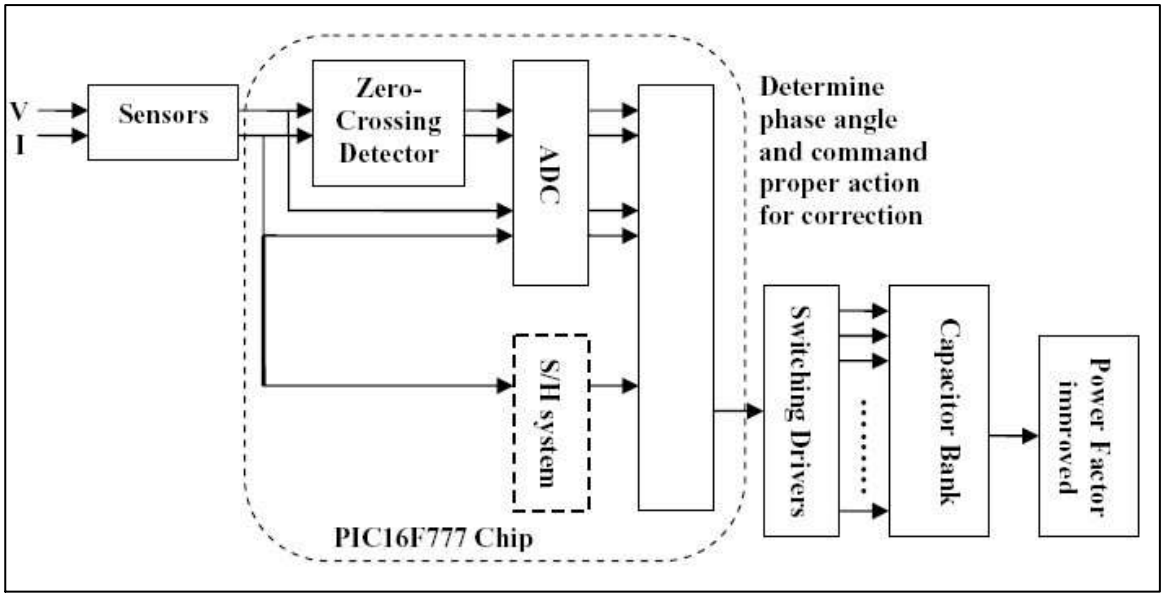

Figure 2.1: Overview of design system.

2.3 Power Factor Theory.

Power factor is the ratio between the KW and the KVA drawn by an electrical load where the KW is the actual load power and the KVA is the apparent load power. It is a measure of how effectively the current is being converted into useful work output and more particularly is a good indicator of the effect of the load current on the efficiency of the supply system.

All current will cause losses in the supply and distribution system. A load with a power factor of 1.0 result in the most efficient loading of the supply and a load with a PF of 0.5 will result in much higher losses in the supply system. A poor power factor can be the result of either a significant phase difference between the voltage and current at the load terminals, or it can be due to a high harmonic content or distorted/discontinuous current waveform. Poor load current phase angle is generally the result of an inductive load such as an induction motor, power transformer, lighting ballasts, welder or induction furnace. A poor PF due to an inductive load can be improved by the addition of power factor correction. Figure 2.2 shows clarified power triangle in electrical AC system.

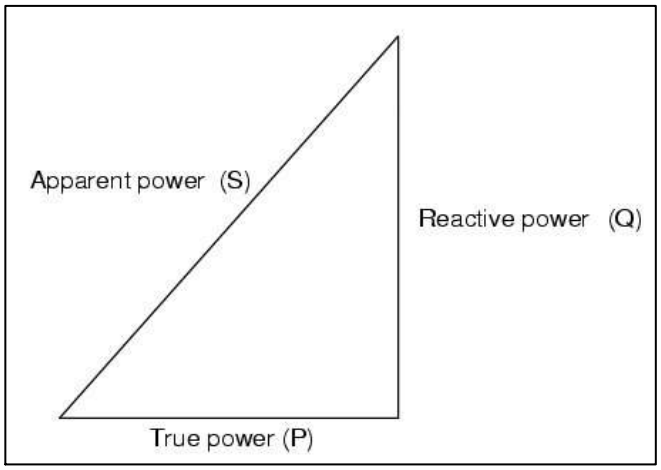

Figure 2.2: Power Triangle.

From the power triangle, power can be calculate by this formula.

Real Power (P) = VI COS θ (2.00)

Reactive Power (Q) = VI SIN θ (2.01)

Apparent Power (S) = VI (2.02)

Power Factor (PF) = COS θ (2.03)

2.4 Power Factor Correction Theory.

Power factor correction (PFC) is the process of adjusting the characteristics of electric loads in order to improve power factor so that it is closer to unity (1). Power factor correction may be applied either by an electrical power transmission utility to improve the stability and efficiency of the transmission network; or correction may be installed by individual electrical customers to reduce the costs charged to them by their electricity supplier. A high power factor is generally desirable in a transmission system to reduce transmission losses and improve voltage regulation at the load.

Device that use in residential normally are resistive and inductive load, because that power factor cannot reach 0.9 and reason power efficiency drop. It shows in figure 2.3 and 2.4 shown power triangle uncorrected circuit.

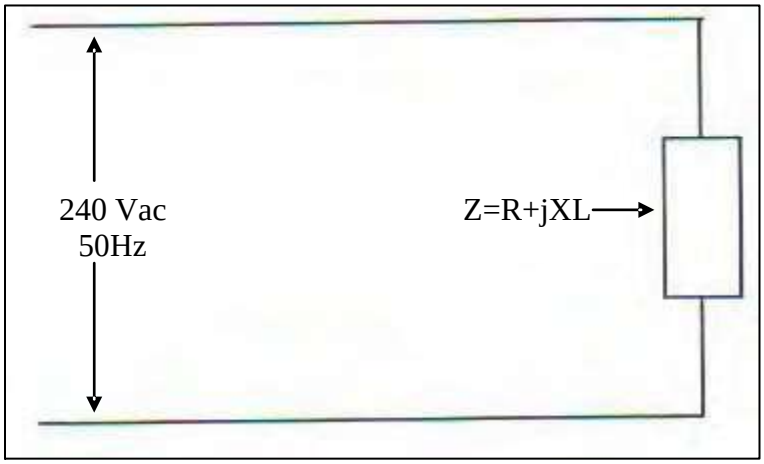

Figure 2.3Uncorrected circuits