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TK301 M72 2006



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Digital apparent power meter / Mohd Safuan Shamsuri.

**DIGITAL APPARENT POWER METER**

**MOHD SAFUAN B SHAMSHURI**

**MAY 2006**

“I hereby declare that I have read through this report and found that is sufficient in terms of scope and quality to be awarded of the degree of Bachelor in Electrical Engineering (Industrial Power).”

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**DIGITAL APPARENT POWER METER**


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**This Report Is Submitted In Partial Fulfillment Of Requirements For  
The Degree of Bachelor In Electrical Engineering (Industry Power)**

**Fakulti Kejuruteraan Elektrik  
Kolej Universiti Teknikal Kebangsaan Malaysia**

**MAY 2006**

“I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references”

Signature : .....  .....

Student : MOHD SAFUAN BIN SHAMSHURI

Date : 4 MAY 2006

**Special dedicated to Mastia and my family,**

## ACKNOWLEDGEMENTS

First of all, I would like to express my thankfulness to Allah S.W.T who has given me all this strength that I need, in completing this final project and also prepare this report.

On this opportunity, I would like to express my gratitude to the Faculty of Electrical Engineering, Kolej Universiti Teknikal Kebangsaan Malaysia generally, and especially to supervisor Prof. Madya Md. Noah Bin Jamal for his helped, advices and guidance that I gain from doing this project.

To my parents, a million of thanks to them because they've supported me for all this while with their pray and their love. Last but not least, I would like to thank to all my friends in 4BEKP2 who being such a wonderful friends to me and also to everyone who involve in this project.

Thank you!

## ABSTRACT

This project is about digital apparent power meter. This meter is used to measure the value of apparent power. Compares to analog system, digital is more accurate and easy to read the measurements as display on the screen. PIC microcontrollers from Microchip were use in this digital apparent power meter project. The main part of this project is encoding and decoding the digital signals. This problem makes it desirable to use a microprocessor, since the data registers can be use to store and parse the digital values at appropriate times. PIC16F877A has been chosen as a central processing unit in this project. This digital apparent power meter uses multiple circuits to sense and multiple the values of apparent power and then the signal will be sent to the PIC. Next, the value will be display by 7 segments LED display. Using serial port connection as an optional, this meter can be connected to the computer and the value then can be display on the computer. At the end of this project, after implemented the hardware, the troubleshooting is the most important action that must be taken in order to achieve the objective of this project.

## ABSTRAK

Projek ini adalah mengenai meter kuasa untuk mengukur nilai kuasa nyata daripada motor atau beban. Seperti yang kita tahu, meter kuasa ini digunakan untuk mengukur nilai kuasa nyata. Jika dibandingkan dengan sistem analog, system digital adalah lebih tepat dan mudah untuk dibaca nilai pengukurannya pada skrin. *Microcontroller* keluaran Microchip akan digunakan dalam projek ini. Bahagian utama projek ini adalah bagaimana untuk mendarabkan nilai voltan dan arus untuk mendapatkan nilai kuasa nyata. Dengan itu litar pendarab yang sesuai diperlukan dalam menghasilkan nilai tersebut. Masalah ini juga memerlukan projek ini menggunakan *microprocessor* untuk menukar nilai analog ke nilai digital memandangkan *data register* boleh digunakan untuk menyimpan dan menghuraikan nilai digital pada masa yang sesuai. PIC16F877A telah dipilih sebagai unit pemproses utama dalam projek ini. Meter kuasa ini menggunakan litar pendarab untuk mencari nilai kuasa nyata dan seterusnya dihantar ke PIC untuk diproses. Setelah itu nilai bacaan bagi kuasa nyata akan dapat dipaparkan menggunakan paparan *LED 7 segment*. Dengan menggunakan sambungan *serial port* sebagai pilihan, meter kuasa ini akan dapat disambungkan ke komputer dan bacaannya juga akan dapat dipaparkan di komputer. Di akhir projek, setelah perkakasan disiapkan, *troubleshooting* adalah langkah penting yang perlu diambil bagi mencapai objektif projek.



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## CHAPTER I

### INTRODUCTION

#### 1.1 DIGITAL APPARENT POWER METER.

As we know, digital apparent power meter is an instrument to measure the value of apparent power at the line phase of the generator. This instrument usually used at the power station that generated electricity. There are two types of apparent power meter that can be build which is using electrodynamic's type where consists pair of fixed coils or electronic type which using op-amp application. This project will use electronic component such as current sensor, step-down transformer, microcontroller PIC, and 7 segment display as a main part of the circuit.

There are two types of apparent power meter which is used analog and digital meter. But nowadays, the digital apparent power meter is frequently used because the value can easily be read from output compare with the analog type. Digital apparent power meter is a measurement meter that determined the value of apparent power. This meter has its own advantages compare with the other meter in the market.



## 1.2 OBJECTIVE AND PROJECT SCOPE.

The main objective of this project is to design hardware which is a power meter that can measure the value of apparent power from generator output and then convert the value of apparent power from analog input to digital output where the measurement value of the apparent meter in digital output can be show in LED 7 segment display. The value of apparent power can be determined by multiplying the value of voltage and current.

The project scope for this project is

- Design a multiple circuit using current sensor that can measure the value of apparent power.
- Then using PIC to convert the value of apparent power from analog input to digital output.
- Using LED 7 segment display to display the reading from digital output of PIC.
- Using serial port connection to transfer the value of apparent power to the computer as optional.

### 1.3 REPORT OUTLINE.

There have 5 chapters overall in this project. Chapter 1 gives some brief introduction about this project and also the objectives and scope of this project. This chapter also includes the report outline for this project, project background and also some problems statement of this project.

The literature review in order to get an idea about the project will be discussed in chapter 2. In this chapter, it reviews the related works that have been done by other people all over the world.

Chapter 3 consists five main parts where this chapter is the main part of this report. The five main sections are:

- a. Project Design
- b. Circuit Design
- c. Programming PIC
- d. Hardware implementation
- e. Testing and troubleshooting

Chapter 4 brings further discussion about the project, the results and also analysis based on the results.

In chapter 5, it gives the conclusion and recommendation about the project that has been done.

#### 1.4 PROJECT BACKGROUND.

Chapter 1 provides necessary background of this project such as the multiple circuits' specifications and the basic principal of PIC microcontroller. A brief introduction to the concept of application is given to give basic understanding of the project.

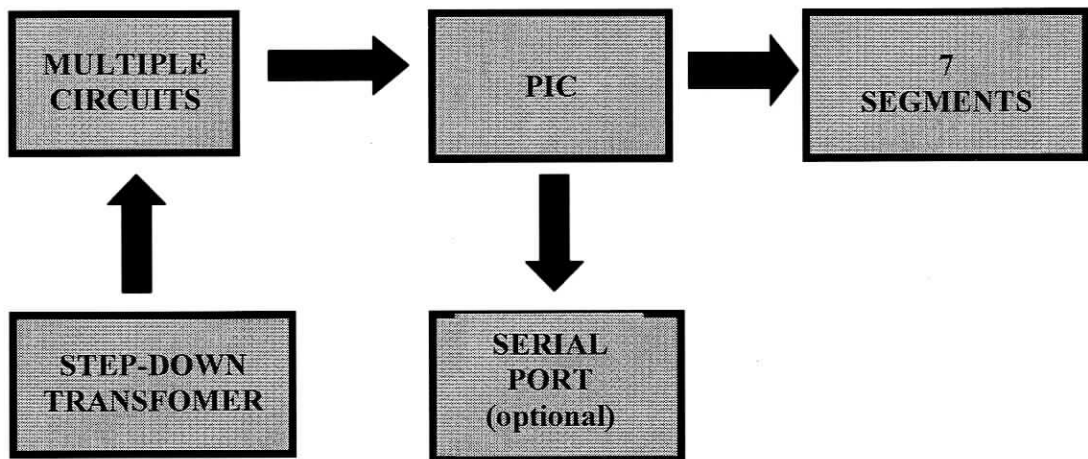


Figure 1.1: Apparent Power Meter Block Diagram.

The main part of this project is to multiplying the value of current and voltage and gets the value of apparent power. It can be done using current sensor the value of current. The second part of this project is encoding and decoding the analog input to the digital input. This problem makes it desirable to use a microprocessor, since the analog input of apparent power can be process in the microprocessor and then can be converting to the digital values at appropriate times. For example, to transmit a series of digital ones and zeros, several registers can be loaded with the entire code and shifted out of the registers as the code is transmitted. In addition, the speed of modern microprocessors eases timing issues, and the flexibility of software.

Multiple circuits are a circuit that consist a current sensor capacitor, diode, and variable resistor. The main purpose of the multiple circuits is to multiple the value of current and voltage to get the value of apparent power. Then the value of apparent power in analog input will be send to PIC and change in digital value. Using current sensor, the value of current can be determined and be multiply with the value of voltage.

The controller part or we call this as microcontroller functions as the brain of the system. In this system, the controller part or the central processing unit that has been used is PIC16F877A. It processes all the input from the multiple circuits which is apparent power. As we know the value of apparent power is an analog input and when the value is attached to the PIC16F877A, it will provides an appropriate output based on the sequence and logic of the program made by the user in digital output so the value can be shown in LED 7 segment display. It controls everything in the whole system including its own visual display if included.

For this project, the value of apparent power will be present using LED 7 segment display and also on the computer using serial port connection as an optional. When the digital apparent power meter has successfully connected to the generator, the reading for the apparent power can be shown.

## **1.5 PROBLEM STATEMENT.**

In a power station the generated voltage and power quantities are measured and displayed for the station operator. This project is to design a power meter as part of a bigger project to set up a mini power system in the laboratory.

The proposed meter will have a digital read out and interface output for computer application.

## CHAPTER II

### LITERATURE REVIEW

This chapter reviews available project created to get an idea about the project design, conception and any information that related to improve the project. There are many apparent power projects that have been done by other people with differences technique and design.

The early design of apparent power meter is based on the principle of the electrostatics which has pair of fixed coil of current coil and potential coil. The current coils are connected in series with the circuit, while the potential coil is connected across the line. Also, on analog apparent power meter, the potential coil carries a needle that moves over a scale to indicate the measurement.

A current flowing through the current coil generates an electromagnetic field around the coil. The strength of this field is proportional to the line current and in phase with it. The potential coil has, as a general rule; a high-value resistor connected in series with it to reduce the current that flows through it. This is an old version of power meter. But now they are used electronic component as a part of measuring circuit. It is because electronic component is a low cost component, easy to use and more accurate.



There are many ideas that have been create to build the power meter and all the power meter have been done using electronic components and follow the electric theory to get the value of apparent power.

### APPARENT POWER THEORY.

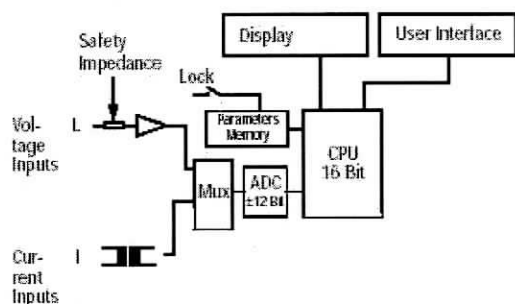


Figure 2.1: Apparent Power Meter Theory

Power in an AC circuit is the vector sum of true power and reactive power. This is called apparent power. True power is equal to apparent power in a purely resistive circuit because voltage and current are in phase. Voltage and current are also in phase in a circuit containing equal values of inductive reactance and capacitive reactance. If voltage and current are 90 degrees out of phase, as would be in a purely capacitive or the

purely inductive circuit, the average value of true power is equal to zero. There are high positive and negative peak values of power, but when added together the result is zero.

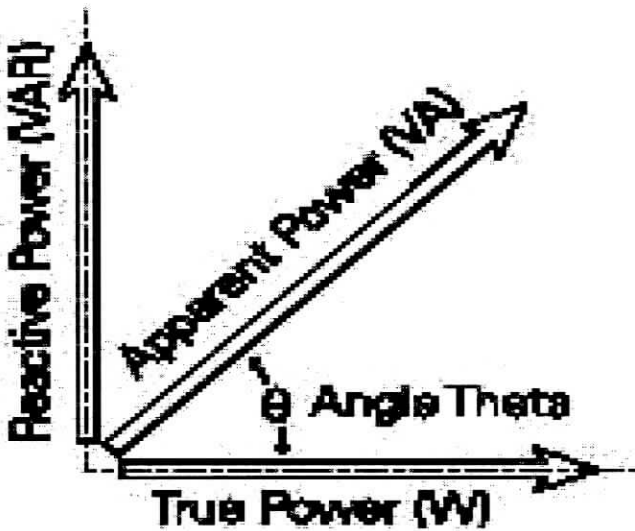


Figure2.2: Power triangle

The formula for apparent power is:

$$S = VI$$

Where S= apparent power

V = voltage

I = current

Apparent power is measured in volt-amps (VA).