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The design of power suply switch for 415V / Mohamad Sharazmi Sharudin.

THE DESIGN OF POWER SUPLY SWITCH FOR 415V

MOHAMAD SHARAZMI BIN SHARUDIN

MAY 2006

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"I hereby certify that I have read and understood the following project thesis. To my opinion this thesis is sufficient in term of scope and quality to achieve partial fulfillment of requirement for the Degree of Bachelor in Electrical Engineering (Industrial Power)."

Signature : 

Name of Supervisor : DR. MUSSE BIN MOHAMUD AHMED

Date : 4 MAY 2006

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DESIGN OF POWER SUPPLY SWITCH FOR 415V

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

Faculty of Electrical Engineering (FKE)
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MAY 2006

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"Hereby, I declare that this report is a result of my own research idea except for works that have been cited clearly in the references."

SIGNATURE: 

NAME : MOHAMAD SHARAZMI BIN SHARUDIN

DATE : 4th May 2005

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To My beloved

Father, Mother, Brothers And Sister

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Praise to Allah S.W.T for his mercy that at last the Final Year Undergraduate Project is now completed. Without His mercy, I would have not come this far, for which I am just a humble servant of Him.

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Lastly, to the people who might use this report, I hope that you all can forgive me if there is any mistake in this report. I hope that you are happy for what I have done for this project.

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ABSTRACT

The title of this project is the Design of Power Supply Switch For 415V. The aim of this project is to design a product that will function as a switch for 3 phase 415 voltage system. When completed, this hardware will have the ability to remotely control the circuit when power supply is in either 'on' or 'off' depending on where there is a need for it. The design process of this hardware will be based on the application of Power Electronic study. It will replace the way power supply switch in the old time being built which is largely based on the application of electromechanical. Based on the application of Power Electronic study, this hardware consists of triac, triac's control circuit, automatic function and external cooling system. The power supply switch that will be designed will work as a path for the current to go through and will be able to supply power to other equipment such as voltage sensor, current sensor, loads and others.

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ABSTRAK

Tajuk kepada projek ini adalah Design of 415V Power Supply Switch. Tujuan utama projek ini diusahakan adalah untuk mereka suatu produk berupa suis yang boleh bekerja dengan lancar di bawah voltan bekalan sistem 3 fasa 415. Apabila projek ini siap, ia akan mempunyai kebolehan untuk beroperasi secara automatik samada bekalan kuasa dihidupkan atau dimatikan bergantung kepada keperluan. Rekaan projek ini adalah berdasarkan aplikasi yang telah dipelajari dalam elektronik kuasa. Ia akan mengantikan teknik rekaan terdahulu yang menggunakan teknologi gabungan elektromekanikal dalam pembinaan sesuatu suis. Berdasarkan aplikasi tersebut, suis ini pada akhirnya akan akan mengandungi triac sebagai binaan utama suis, litar kawalan kepada triac, litar fungsi automatic dan binaan luaran tambahan yang mengandungi system penyejukan litar. Litar suis ini akan berfungsi dengan membenarkan pengaliran arus ke beban dan dalam masa yang sama ia juga berfungsi untuk mengalirkan arus ke peralatan lain seperti pengesan voltan, pengesan arus dan sebagainya.

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TABLE OF CONTENT

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LIST OF TABLES

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LIST OF FIGURES

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LIST OF PROGRAMS

NO	TITLE
1	Multisim Program
2	AutoCAD Program

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LIST OF ABBREVIATIONS

ABBREVIATION	DEFINITION
SCR/ SCR's	Silicon Control Rectifier
PSU	Power Supply Unit
ABT	Automatic Bus Transfer
ALT	Automatic Load Transfer
UPS	Uninterruptible Power
RMS/ rms	Root Mean Square
IEEE	Institute of Electrical and Electronics Engineers
TRIAC/ Triacs	Triode for Alternating Current
AC	Alternating Current
IC	Integrated Circuit
DC	Direct Current

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LIST OF APPENDICES

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CHAPTER 1

INTRODUCTION

1.1 Overview For Power Supply

In this era, the continuation of electrical generation has become a major agenda for each nation to keep its industries running smooth. To make this happen, electrical engineers from around the globe have come with their own ideas on how to maintain the power generation or simply call electricity. This is where the power supply components such as power supply switch has become the main component to make the generation to continue as planed.

Basically, a power supply unit (sometimes abbreviated power supply or PSU) is a device or system that supplies electrical or other types of energy to an output load or group of loads. The term is most commonly applied to electrical energy supplies. The power supply can be described as a part inside a system. It is an important part of that system because it provides power in a form that is suitable for every other component inside or attached to the computer in order for it to work.

The word power supply is very broad, and could be considered to include all forms of energy conversion from one form into another. Conventionally though, the term is usually confined to electrical or mechanical energy supply. Constraints which commonly affect power supply are the amount of power that can be supplied, how long that can be supplied it for without needing some kind of refueling or recharging, how

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stable their output voltage or current is under varying load conditions, and whether they provide continuous power or pulses [1].

Since the past decade, there has also been an increasing in the usage of Power Electronic application in the design of a power supply switch in a Power Distribution System. It is also become a necessary to use an automatic power supply switch that works perfectly where there is a need for it. Furthermore, it will replace the mechanical power supply switch that has been used for the past decades.

Again, with the usage of power electronic application in the design of this project will help the power system itself to stay stable and more efficient in comparison with the 'old' method. When saying 'old' method, it means that a system that consists of mechanical part such as contactor, relay, to say a few.

1.2 Chronology Of Power Supply Switch

Since the past century, there has been a rapid change in the construction of Power Supply Switch. This include the material being used, choices of automatic and non-automatic, from mechanical power supply which barely consists of circuit breaker, contactor and transformer to an electronic power supply which are currently being used such as thyristors, diodes and relays.

They are changing in chronological way from the introduction of electromechanical relay to a static relay. Then the development of digital static relay goes back around 1970. Since that major studies have been made into designing material, which let to the introduction of microprocessor control. The present technology these days have brought the usage of SCADA system, just to name one of them. The explanation for this is shown in Table 1.1.

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Table 1.1: Historical trends in technology of control system [2]

Year	Product Description	Remarks
1880 – 1940	Electromechanical relays of various types for: - protective purpose - control functions	Used even today for simpler protection functions and simpler control function
1940 – 1960	Static relays with vacuum tubes for carrier differential protection and microwave protection of transmission line.	Later on replaced by static relay with semiconductor.
1965 – 1970	Digital static relay	Used A/D conversion and digital electronics techniques IC, LSIC'S used.
1970 – 1975	Digital computer based static protection system used for transmission system for main and backup.	On-line digital computer.
1975 – 1995	Microprocessor introduced for power system control proved cost effective and advantages for control function.	- Lately become popular. - Smaller in size.
1995 - Present	Introduction of SCADA system.	Supervisory control and data acquisition system. For load control.

With the usage of power electronic application to the design of power supply switch, engineers have found that this new technology has more benefit than its previous method application. Some of the benefits are as stated below:

(1) Power electronics switching system do not have mechanical contacts (moving

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part) which arise when using mechanical power supply.

(2) It reduces the time taken for the system in fault condition to return to normal. Hence, it increases system stability.

(3) The size of the system can be designed in smaller size.

(4) The components of the system are cheaper than its predecessor.

(5) Easier to handle.

(6) Reduce mistakes in wiring.

(7) More efficient than the mechanical power supply.

There are many systems nowadays which are using power electronic application as it based. Systems that have been designed using the power electronic methods for the purpose of switching the supply are:

(1) Simultaneously Power Supply Switch (SMPS)

(2) Automatic Bus Transfer (ABT)

(3) Automatic Load Transfer (ALT)

(4) Uninterruptible Power Supply (UPS)

All examples that have been mentioned above are just a tip of what exactly this technology can bring. Seeing the potentials this technology can brought for humanity, a project regarding the design of power supply switch has been done. The project which named 415V Power Supply Switch will be the main intention to be discussed in this report. The introduction of this project will be divided into 3 topics which are; 1.3) objectives of the project, 1.4) scope of the project, and 1.5) problem statement of the project.

1.3 Objectives Of The Project

The objective of this project is mainly to design automatic power supply as hardware. This switch will have the ability or will be able to:

a) Supply the power to 3-phase, 415V load systems.

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b) Remotely control the source supply which is connected to load; whether it is from the main supply or from the backup supply.

1.4 Scope of the Project

There are several things that must be considered in the design of this switch. The scope of this project will depend on; cost for the whole project, where the design is suitable to be used, time for the project to be completed, quality of the project, and the overall results of the project or outcome of the project.

a) *Cost for the whole project;* the estimation cost for the whole project will be in about RM 196.68.
b) *Where the design is suitable to be used;* the switch that will be designed is suitable to be used to the power supply source connected to the load. The second source will function automatically as backup supply using the automatic switch.
c) *Time to complete*; the time needed for the project to be completed is in about 8 months. This project was started from the early of July 2005 and will be finished in early of April, 2006.
d) *Quality of the project*; this project will be greatly benefited from the power distribution system. It has no mechanical part which will increase the time of operating of the switch. It will automatically take action to switch from the main supply line to the backup supply. Furthermore, this circuit will greatly reduce the cost in comparison to the 'old' version but at the same time it has the same function.
e) *Result for this project;* at the end of this project, a complete 415V power supply automatic switch will be presented.

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1.5 Problem Statements

There is a need for any power supply to be controlled from one source or from multiple sources. This power supply switch will be designed for controlling two sources of power supply systems by disconnecting one source and connecting to the other sources automatically.

But that is just only 'a tip of an iceberg' of this project. The automatic switch that will be designed is for the use of 415V application. That means that this circuit must be designed based on a three-phase power system. When saying this, the current of each line and phase, thyristors ratings, load that will to be used and other matters that might be arise must also be considered in to the design.

(1) Current and voltage

The current mainly depends on the load that will be used. Meanwhile the voltage itself will be 415V ac. When saying 415V ac, the voltage is in an RMS (Root Mean Square) value. So the exact value of the system that will be designed is 586.9V ac. This is the actual voltage or the peak voltage in a sine wave. To make this statement understandable, let's look at the figure below:

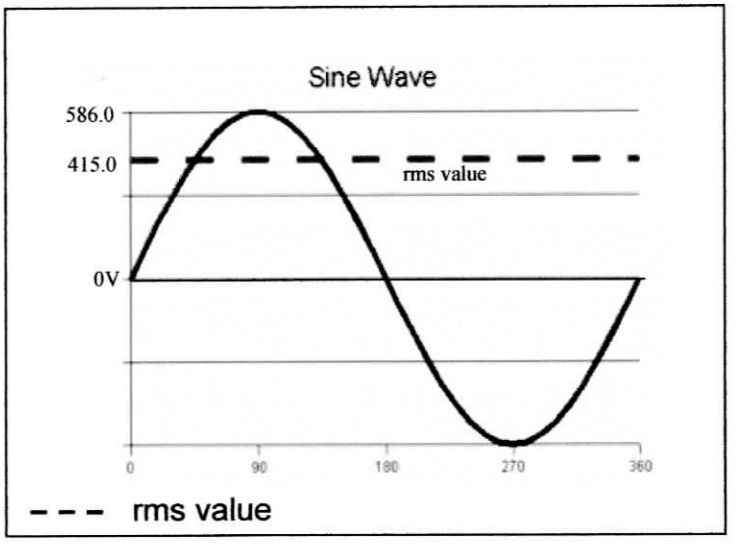

Figure 1.1: The Difference in rms value Between Voltages Applied in the Design [1]

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(2) Load for the system

Load is defined as a device connected to the output of a circuit. In the designed circuit, there has been a problem on which load is suitable to be chosen for the system. This has to be taken seriously because load will affect the performance of the circuits and the output voltages or currents, such as sensors, voltage sources, and amplifiers. Load can be resistive, capacitive and inductive.

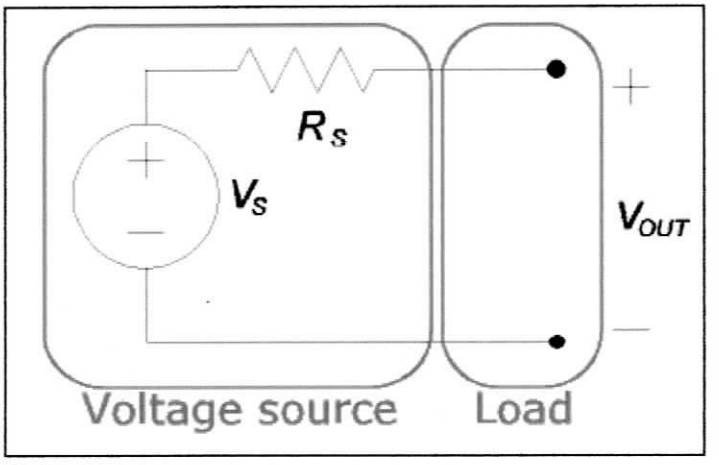

Figure 1.2: The Output Voltage, Vout [1].

(3) Control components

The components which will be used to control the circuit in order to archive the objectives are mainly power electronic components. From this source, a thyristor have been used as a control component.

The thyristor is a four-layer semiconductor device, with each layer consisting of an alternately N-type or P-type material, for example P-N-P-N. The main terminals, labeled anode and cathode, are across the full four layers, and the control terminal, called the gate, is attached to one of the middle layers. The operation of a thyristor can be

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