UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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DESIGN AND ASSEMBLE PHOTOVOLTAIC PANEL USING MONOCRYTALLINE CELLS

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelors of in Electrical Engineering Technology (Industrial Power) with Honours.

by

MUHAMMAD MUHAIMIN BIN AHMAD
B071210269
910803146605

FACULTY OF ENGINEERING TECHNOLOGY
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DECLARATION

I hereby, declared this report entitled "DESIGN AND ASSEMBLE PHOTOVOLTAIC PANEL USING MONOCRYTALLINE CELLS" is the results of my own research except as cited in references.

Signature : .....

Author's Name : Muhammad Muhaimin Bin Ahmad

Date : 10/12/2015

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Industrial power) (Hons.). The member of the supervisory is as follow:

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(Project Supervisor)

ABSTACT

Solar photovoltaic system is a natural energy from the sun. Solar photovoltaic system is an innovative technology that uses sunlight to produce power or electricity would be without contaminating or damaging the environment. Next, a solar photovoltaic system, also known as renewable energy as a source of solar energy is still in the early stages of use, especially in Malaysia. Therefore, the government is actively promoting and supporting research of solar energy and the government created the program "Green Technology" at the national level to encourage researchers and students involved in this program. Furthermore, Malaysia is a tropical climate which is located in the range of the equator and receives a lot of light. However, the use of solar energy or solar photovoltaic system is still at the primary level compared to developed countries like china and German due to less exposure to knowledge about the importance of solar energy among Malaysians. Therefore, my project is a platform for students and researchers to develop and share knowledge about solar energy. This project is the design and installation of solar panels. This project is the students an opportunity to learn the skills of design and installation of solar panels and the skills available to the public. In this project, technical aspects and much needed skills and financial costs for the design and installation of solar panels.

Key word : fotovoltaik, Teknologi Hijau, Malaysia

ABSTRAK

Sistem fotovoltaik suria adalah tenaga semulajadi daripada cahaya matahari. Sistem fotovoltaik suria merupakan inovasi teknologi yang menggunakan cahaya matahari untuk menghasilkan bakalan kuasa atau bekalan elektrik tanpa mencemarkan atau merosakkan alam semulajadi. Seterusnya, sistem fotovoltaik suria juga dikenali sebagai tenaga boleh diperbaharui kerana sumber tenaga suria masih dalam peringkat awal penggunaan terutamanya di Malaysia. Oleh itu, kerajaan Malaysia giat mempromosikan serta menyokong penyelidikan tenaga suria dan kerajaan telah mewujudkan program "Teknologi Hijau" di peringkat kebangsaan untuk menggalakkan penyelidik dan pelajar menceburi dalam program ini. Tambahan pula, Malaysia merupakan sebuah negara beriklim hujan tropika yang terletak di linkungan garisan khatulistiwa dan menerima jumlah cahaya yang banyak. Walaubagaimanapun, penggunaan tenaga suria atau system fotovoltaik suria masih di peringkat rendah berbanding negara maju seperti china dan german ekoran kurang pendedahan ilmu tentang kepentingan tenaga suria dikalangan rakyat Malaysia. Oleh demikian, projek saya ini merupakan satu landasan untuk pelajar dan penyelidik untuk mengembangkan dan berkongsi ilmu tentang tenaga suria. Projek ini adalah rekebentuk dan pemasangan panel solar. Projek ini merupakan pendedahan kepada pelajar untuk pelajari kemahiran rekabentuk dan pemasangan panel solar dan kemahiran itu boleh dikongsi kepada orang ramai. Dalam projek ini, aspek teknikal dan kemahiran amat diperlukan serta kos kewangan untuk rekabentuk dan pemasangan panel solar.

Kata kunci : fotovoltaik, Teknologi Hijau, Malaysia

DEDICATION

To my beloved parents

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I, Muhammad Muhaimin bin Ahmad, B071210269, want to thank the Universiti Teknikal Malaysia Melaka and Fakulti Teknologi Kejuruteraan and also JTKE that provide the opportunity to give the experience in the final year project. During 14 week, i learn more knowledge about solar system including assembly process. Hopefully the experience and knowledge can be using in the future especially during the industrial work.

Next, I want to thank my supervisor, Sir Mohd Firdaus bin Mohd AB Halim because help me to finish this project and give encouragement and enthusiasm to continue this project. Sir Mohd Firdaus bin Mohd AB Halim also, to give me opinion in solving problems. May God have mercy on my supervisor, thank you.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

Mono-si	-	Monocrystalline
η	-	Efficiency
V	Voltage	
A	-	Ampere
DC	-	Direct current
AC	-	Alternating current
PV	-	Photovoltaic
Tcell		Temperature cell
PSF		Peak sun factor
Voc		voltage open circuit
Isc		Current short circuit
W		watt

CHAPTER 1
INTRODUCTION

1.0 Introduction

This chapter explains about photovoltaic system that follows the objective and scope of the project that need to be achieved. Firstly, the, main purpose of this project is to design and assemble solar panel also including the cost of the project and the simulation design.

1.1 Project Background

Photovoltaic also being refer as solar panel. The photovoltaic is a method of converting light or solar energy to electrical energy. The power that is been generate from photovoltaic is a green technology and it can be a renewable energy source. This project is an assembling of solar cell to supply the solar power. The number of solar cell influence the output power and battery storage. Next, the efficiency of solar cell depends on the characteristics of the solar cell. For example, the Monocrystalline is good solar cells compare others. Main purpose of project is a design and assembly of the solar panel and collecting the analysis of the output data. The design of the solar panel must be following the required specification to get the best output from it.

1.2 Problem Statement

In Malaysia, solar technology still at a lower stage of use to compared with others countries. This project is a good platform for the students to gain knowledge, skills and experiences about solar system. This project also includes the overall cost and the final analysis for the solar panel. Finally, the final year project can be to solve many problems that related to the solar system. It wills also increasing the awareness and usage of the solar system among Malaysian people in industry or any field.

1.3 Objective

The main objective of this project is to provide the design of the solar panel that follow the right equipment and the right standard grid connecting solar photovoltaic system in Malaysia and analyze the performance of the solar panel.

1. To identify the standard equipment used in design of solar system.
2. To determine the specification in design and assembly of solar system.
3. To determine the performance of solar panel.

1.4 Scope

The scope of this project is to focus on the design and assemble of the solar panel. To get the work start in easy peace and to get the best product to be out , the first main importants things to be look into is the design of the product. In addition by designing we can determine the size and diameter for each of the solar panel. It will make the process of installing the solar panel into pieces become easier and systematic. After completing the process of designning and assembling the solar panel we can start to oberserve, analyze and collect the data according to our requirment. The power of solar depends on the sun and the temperature of an area. From changes of the temperature we can obtain differences reading for the voltage and current.

1.5 Advantage and disadvantage of solar system

Solar system advantage:

a) The solar system is a green technology
b) Its free from sound pollution because its generate electricity withleout any sounds compared to diesel fuel and hydro
c) Solar energy is continuous and infinite (forever)
d) Solar panel require little maintenance compared to other power generator
e) The solar is a natural resources and also a renewable source

Solar energy disadvantage:

a) The cost is expensive
b) The efficiency of the solar system to be working depends on the angle of the sun to recieved the amount of sunlight needed for it
c) Large area of land is required to absorb the amount of light that is needed
d) At night the solar system cant generate electricity. Possible to do so but large capacity of battery to store the power

CHAPTER 2
LITERITURE REVIEW

2.0 Introduction

Chapter 2, describe about the resources that has been referred from books, journals, and internet. This section also explains about the fundamental of solar, operation and others.

2.1 Fundamental of Solar System

Solar cell is refer to a Photovoltaic Cell (PV), are the device that convert the solar energy (Sunlight) into direct current (DC). The internal solar cells have two polarities one side is Positive Charge (Electron) and the other side is Negative Charge (Hole), refer to figure 2.1. When the solar energy absorbs irradiance it will generate the (hole) and (Electron). The total of the charge are difference for both sides, referred to electromotive force or voltage.

Its have two types of Solar System that is On-Grid System and Hybrid/Off- Grid System. Now we will see the comparison from this both system firstly we will go with On- Grid System. On-grid System is a one system that connected with power utility company. The advantage is it can export to grid or other mean sell solar power to utility if the power is excess and low maintenances because on-grid not used the battery for supply the energy. Next, hybrid system is standalone and the system not required the utility for supply the energy. It required more maintenance if cause damages the system and the system more complicated.

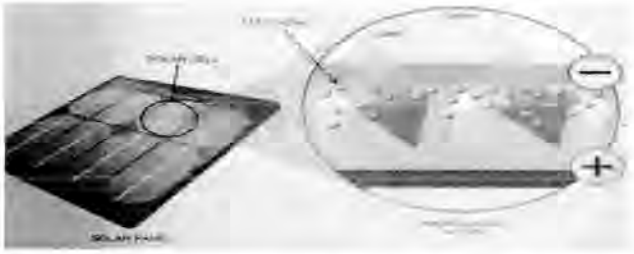

Figure 2.1 reaction electron and hole

Source from book: Generating clean electron green power technology

2.1.1 The Principle

Solar cells also known as electronic devices. Which it can convert sunlight into electricity. The process will produce the current and voltage to generate electrical power. How the process is being done? Firstly, the process depends on the material used, because certain material has effect on temperature. For example, temperature of thin film is less compare monocrystalline. Then, the process requires the material that can absorb light quickly to produce the electron to increase energy state. Next, the movement of electron to external circuit is much higher than solar cell. Then, the electron dissipates its energy and repeating back to the solar cell so the process of generating electricity will took place. A variety of material and process in marketing follow the requirement for photovoltaic energy conversion, but in world of photovoltaic energy conversion uses semiconductor material in the form p-n junction. What the p-n junction? It is formed by combination p-type and n-type. P-type has high concentration of hole or deficiency of electron while n-type is high concentration of electron. The process will cause excess electron form n-type try to diffuse with the hole of p-type while the excess hole from p-type try to diffuse with the electron of n-type. Movement the electron to the p-type side exposes positive ions in n-type and holes expose negative ions in p-type. The resulting the process cause create electron field at the junction and forming the depletion regions. Lastly, the process solar is a similar with operation of diode

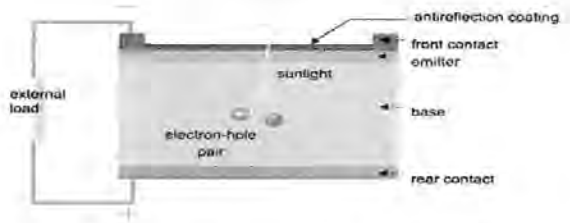

Figure 2.2: Cross section of the solar cell

Sources from internet: http://www.pveducation.org

2.2 Monocrystalline

There are many different types of solar cell such as monocrystralline, polycrystalline, thin film and etc. For this project, monocrystalline cells as the main component of the solar cell, as illustration in figure 2.3. In theory, crystalline solar cell is very efficient cause it can approaches 29% and the best record by world was recorded are 24.3%, while monocrystalline recorded on 17 – 16%. There are few factors that cause limiting the PV cell competency. Firstly, there is no limit on the basic properties of silicon semiconductor. The protons energy drops 1.12eV because the silicon semiconductor while photon can be loose it energy by exceeding to 1.12ev because of the dissipation via heat. Next, the common value for Voc is conventional monocrystalline and PV cell are 625mV and 610mV. Lastly, although PV cell shows high competency the Voc will not go higher than 722mV.

(Source from www.google.monocrystalline)

Figure 2.3 monocrystalline

Source from internet: www.google. monocrystalline

2.3 Advantage and Disadvantage of Monocrystalline

Advantages

1) Is a free toxic Silicon
2) Very Stable
3) Monocrystalline can live longer. Most monocrystalline can live up until 25 years.
4) Monocrystalline solar panel has highest efficiency compares to polycrystalline.

Disadvantages

1)Increase manufacturing cost caused have to buy silicon to cover the shortage of it
2) The voltage will drop when the temperature is rising

2.4 Sun Path

Sun path refer to the sun position (Azimuth and Altitude) that change throughout the year. As the engineer major in Solar System, to understand about the position of the sun is very crucial because we want to get the maximum PV power. Based on the theory in the northern hemisphere, the sun is seen much longer in the southern hemisphere compare to the sun seen in the north hemisphere. Besides that, earth magnetic declination through north also important because to determine the north at each of the country. Earth magnetic declination is the difference between the true north and magenetic north. If engineer does not know how to differentiate or to recognize it a research or experiment can be declared as wrong one. Next, In Malaysia, its magnetic declination is close to zero because its position closes to the equator line. However, the position of solar noon always near zenith both north and south but depending on location and month in the year. (Refer: Yong, Sheng Khoo, Andre,Raghav,Dazhi, Member IEEE, Ricardo Ruther, Thomas Abd Armin.Optimal Orientation and Tilt Angle for Maximizing in-Plane Solar Irradiance for PV Application in Singapore).

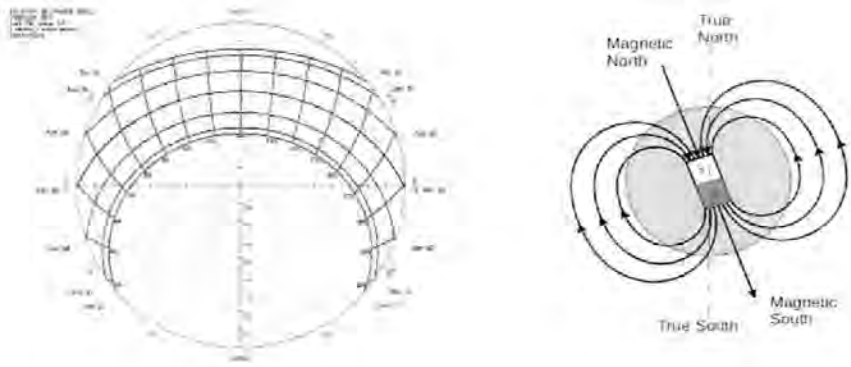

Figure 2.4: Sun path and Earth magnetic declination

Source from internet: Google image

2.4.1 Solar Path Coordinate

Solar path coordinate is to find the maximum position for the PV energy. Three conditions should be considered for this procedure:

1) True North
2) Altitude Angle
3) Azimuth Angle

In Malaysia, to find the true north the solar panel must be tilt to south because the sun is seen in south much longer. Next, altitude angle and azimuth angle the position of the sun seen more in the morning on the East side or evening on the West side. The figure 2.5 show a position of solar path coordinate. Why the solar panel should be tilt? It should be tilt because is to prevent the module from dust and other object that can block sunlight to be absorb by the solar panel. When it rains, the rain water can wash away dust particles from the solar panel. It can reduce the cost of maintenance to clean the solar panel. The method of tilt angle can be seen at figure 2.6.

Figure 2.5: Solar path coordinate

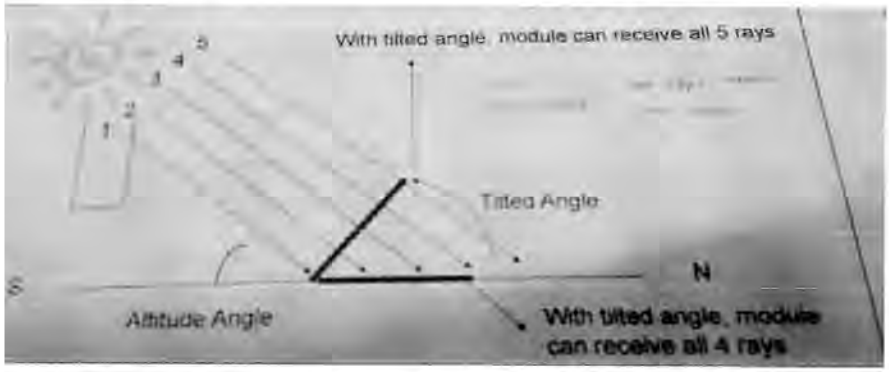

Figure 2.6: Tilt angle

2.5. Schottky diode

The schottky diode is semiconductors that have a low drop of voltage and a very fast switching action. The voltage of schottky diode is 0.15 to 0.45 Volts. The schottky diode has the common size for the maximum average current of 70mA, 100mA, 200mA and 1A. Next the ranges of forward voltage are from 280mV to 430mV and common forward voltage for schottky diode is 800mV to 1V. Below is the symbol of schottky diode.

2.6 Hotspot Phenomenon and Solar Panel

The hotspot phenomenon can be occurs when the cell at the solar panel shaded or something that blocks the light to go through into the solar panel. If shading of the solar panel occurs the solar cell cannot be operating and it will generate power dissipation. This will cause the solar panel efficiency to be decrease. The problem solving for this matter is to use schottky diode to block the current at the solar cell to bypasses the current with reverse condition, as illustration in figure 2.7. The bypass diode is connected parallel with the solar cell and assembles it in reverse bias, as illustration in figure 2.7. So, the recommendation is to fit the diode to prevent the current to flow back through a PV solar panel at night time. Besides that the phenomenon of the sun can cause less efficiency of solar panel. In the afternoon, the perpendicular of the sun will enable the solar panel to absorb more energy from it.