

raf

TK7868.P6 .D59 2009.



0000073303

Multi-purpose hybrid power supply / Diyana Zahirah
Jaafar.

MULTI-PURPOSE HYBRID POWER SUPPLY

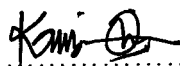
DIYANA ZAHIRAH BINTI JAAFAR

(B010710243)

10TH MAY 2010

“I hereby declare that I have read through this Project Progress Report entitle of “Multi-Purpose Hybrid Power Supply” and found that it has comply the partial fulfilment for awarding the degree of Bachelor of Electrical Engineering (Industrial Power).”

Supervisor's Name : MR. KYAIRUL AZMI BIN BAHARIN

Signature : 

Date : 10 MEI 2010

MULTI-PURPOSE HYBRID POWER SUPPLY

DIYANA ZAHIRAH BINTI JAAFAR

**This Project Final Report for Final Year Project 2 is Submitted to
Faculty of Electrical Engineering,
Universiti Teknikal Malaysia Melaka
in Partial Fulfillment of Requirements for the Degree of Bachelor in Electrical
Engineering (Industrial Power)**

Faculty of Electrical Engineering

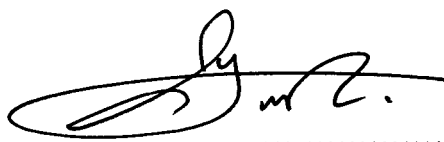
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

(2010)

I declare that this Project Progress Report entitle of “Multi-Purpose Hybrid Power Supply” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature

:


.....

Name

:

DIYANA ZAHIRAH BINTI JAAFAR

Date

:

10TH MAY 2010

DEDICATIONS

“For my beloved parent, Mrs. Hafsa binti Ahmad for being such a wonderful mother to her children; and Mr. Jaafar bin Ab Rahman for being such a great father and inspiring his children with his patience and love.”

ACKNOWLEDGEMENT

All praises to Almighty Allah S.W.T. as the sustainer of the world and may there be His blessing to all messengers and his last messenger, the Prophet Muhammad S.A.W. and his family, companions, followers and the entire believer till the end of time.

Special gratitude to Dean of Electrical Engineering, Prof. Madya Dr. Zulkiflie Ibrahim; Head Department of Industrial Power Engineering, Mr. Mohd Hendra Hairi; Project Supervisor, Mr. Kyairul Azmi Baharin; Panels Projects, Mr. Alias Khamis and Mr. Amrullah Isma and all UTeM's staff.

Very special thanks to my parent, Mr. Jaafar Ab Rahman and Mrs. Hafsah Ahmad for their warmth encouragement and for being very supportive in terms of giving their advises, financial support and time during completing this report; to all my friends for their help, sharing knowledge, guidance and support.

Also not to forget, to all people who get involved and give their support in completing this industrial training programme directly and indirectly. May Allah S.W.T reward you all with the best here in this world and thereafter. Amin.

ABSTRACT

Nowadays, having a reliable power supply has become a must for our daily use. To have a portable power supply might be handy for outdoor supply purposes. The purpose of this project is to design a hybrid power supply system that can cater small AC and DC loads in order to solve the problems of; the availability in getting electric power source during electricity breakdown; the availability to obtain electrical power source other than use of generators during outdoor activities; saving time and cost; and the availability to have a reliable power supply. Multi-Purpose Hybrid Power Supply is a project focusing on designing a hybrid power supply consisting of conventional electric power plug point and/or photovoltaic solar panels. It gives added features where we can choose either to use supply from the conventional plug point or from the PV solar panels. The types of source which cater the loads are in DC (9V) and single phase AC (240V). This feature gives the consumer options in choosing to use their desired loads which might be in AC or DC rating. The design of this project will involve in determining the required components and the electrical characteristics of each component. The design must be fabricated and analyzed thoroughly. A project planning must be arranged properly during completing this project in order to solve the problems and to get the expected results.

ABSTRAK

Kini, memiliki bekalan kuasa yang boleh harap sudah menjadi satu kemestian untuk digunakan dalam aktiviti kita sehari-hari. Dengan memiliki bekalan kuasa mudah alih juga turut membantu memberi bekalan kuasa untuk aktiviti luar rumah. Tujuan projek ini adalah untuk merekabentuk satu sistem bekalan kuasa hybrid yang boleh membekalkan kuasa pada beban AU dan AT yang kecil dalam usaha untuk menyelesaikan masalah seperti; mendapatkan ketersediaan sumber kuasa apabila gangguan elektrik berlaku; ketersediaan untuk mendapatkan sumber kuasa selain menggunakan generator untuk kegiatan di luar rumah; menjimatkan masa dan kos; dan ketersediaan mendapatkan bekalan kuasa yang boleh harap. Bekalan Kuasa Hibrid Pelbagai Guna adalah satu projek yang memfokuskan pada merekabentuk satu bekalan kuasa jenis hybrid yang terdiri daripada titik plag kuasa elektrik yang sedia ada dan/atau panel solar fotovolta. Ia memberi beberapa ciri tambahan di mana kita boleh memilih sama ada menggunakan sumber bekalan daripada titik plag elektrik sedia ada atau pun daripada panel solar PV. Jenis sumber yang membekalkan kuasa kepada beban adalah dalam AT (9V) dan juga fasa tunggal AU (240V). Ciri ini memberi pengguna pilihan untuk memilih menggunakan beban berkadar AU atau AT. Reka bentuk projek ini akan melibatkan proses menentukan penggunaan komponen-komponen elektronik dan sifat-sifat setiap komponen yang diperlukan. Reka bentuk projek hendaklah dibina dan dianalisis dengan teliti dan menyeluruh. Satu perancangan projek hendaklah disusun dengan betul semasa hendak menyiapkan projek ini yang bertujuan untuk menyelesaikan masalah dan untuk mendapatkan keputusan yang diharapkan.

TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	ACKNOWLEDGEMENT	v
	ABSTRACT	vi
	TABLE OF CONTENTS	viii
	LIST OF TABLES	xii
	LIST OF FIGURES	xiii
	LIST OF APPENDICES	xv
1	INTRODUCTION	1
	1.1 Introduction	1
	1.2 Project Overview	1
	1.3 Problem Statements	2
	1.4 Objectives	2
	1.5 Project Scopes	3
2	LITERATURE REVIEW	4
	2.1 Literature Review	4
	2.2 What is a Solar Cell	4
	2.3 Photovoltaics: Solar Electricity and Solar Cells in Theory and Practice	5
	2.4 Review on Solar Applications	6

2.5	First Review:	6
	Solar-Recharged UPS as a Low Cost AC Power Supply for Electronics and Environmental Education (By J. Diz-Bugarin, M. Rodriguez-Paz, 2008)	
2.6	Second Review:	7
	Study on Portable Power Supply Equipment Using The Flexible Solar Cell Sheet (By Sonoda Toshiaki, Iguchi Yoshio, Yonemochi Shigenobu, 1995-1997)	
2.7	Third Review:	8
	Solar Electricity in Rural Villages (By S.N. Singh, A.K. Singh, 2009)	
2.8	Fourth Review:	10
	Sizing and Techno-Economical Optimization for Hybrid Solar Photovoltaic/Wind Power Systems with Battery Storage (C. Protogeropoulos, B. J. Brinkworth, R. H. Marshall, 1996)	
2.9	Fifth Review:	11
	Soldier-Worn Portable Power Management System (By Anon, 2009, Source by Protonex Technology Corporation)	
2.10	Sixth Review:	12
	P3-Portable Solar Power Panel (By Anon, 2009, Source by Global Solar)	
2.11	Seventh Review:	13
	A Portable Solar Power Supply Device with High-Efficiency Inverter (By Lu Jianxiang, Zhang Qiangsheng, 2009)	

3	METHODOLOGY	15
3.1	Methodology	15
3.2	Project Methodology	15
3.3	Cell Types	18
3.4	Designing a Hybrid Power Supply	19
3.4.1	Study on Solar Power Supply's Operation	19
3.4.2	Study on Conventional Power Supply's Operation	20
3.4.3	Study on Combining Both of Power Supply Types	21
3.5	Solar System Sizing Calculation	21
3.5.1	Load Requirement	22
3.5.2	Sizing the Solar Panel	24
3.5.3	Selecting Solar Panel and Regulator	24
3.5.4	Sizing the Inverter	25
3.5.5	Sizing the Battery	26
3.6	Software for Simulation Purpose	27
3.7	Software for PCB Drawing	27
3.8	Procedure of PCB Making	28
3.9	Hybrid Integration Hardware	30
4	RESULT AND DISCUSSION	31
4.1	Result and Discussion	31
4.2	Expected Result	31
4.3	Circuit Design and Simulation	32
4.3.1	9 V Regulated Power Supply	32
4.3.2	Solar Battery Charger with Overcharge Protection	35

		xi
4.3.3	Mini AC Inverter Power 10W-30W by D313 Transistor	37
4.4	Discussion	44
5	CONCLUSION	45
5.1	Conclusion	45
5.2	Conclusion of Project	45
5.3	Recommendation	46
	REFERENCES	48
	APPENDICES	50

LIST OF TABLES

TABLE	TITLE	PAGE
3.1	Efficiency for three types of solar panel	18
3.2	Characteristics of monocrystalline silicon solar panel	18
3.3	Specification of load	23
4.1	The components required in voltage regulator circuit	33
4.2	Data Obtained for Solar Battery Charger for Various DC Voltages Applied	36
4.3	Actual Voltage Waveforms Obtained During Troubleshooting Testing	40
4.4	Actual Current Waveforms Obtained During Troubleshooting Testing	43

LIST OF FIGURES

FIGURE	TITLE	PAGE
2.1	Photovoltaic Cell Semiconductor Layers	5
2.2	Complete Solar Kit with Panel and AC Socket	6
2.3	UPS Modifications to Allow Solar Recharging (External Elements in Red)	7
2.4	Block Diagram of Solar Power Supply	9
2.5	Power Module of Solar Power Supply	10
2.6	The Device of Soldier-Worn-Portable Power Management System	11
2.7	The Portable Solar Power Panel	12
3.1	The Chart of Project Methodology	16
3.2	Front and Back View of Monocrystalline Silicon Solar Panel	19
3.3	Block Diagram of a Solar Power Supply's Operation	20
3.4	Block Diagram of a Conventional Power Supply's Operation	20
3.5	Block Diagram of a Multi-Purpose Hybrid Power Supply's Operation	21
3.6	Pensonic Radio with Digital Alarm	22
3.7	EAGLE Version 4.11	28
3.8	Circuits on PCB Layout	28
3.9	Drilling the PCB	29
3.10	After Completing the Soldering Process	29
3.11	The Multi-Purpose Hybrid Power Supply	30
4.1	9 V Regulated Power Supply	32

4.2	IC Regulator of LM 7809	33
4.3	9 V Regulated Power Supply on PCB Layout	34
4.4	9 V Regulated Power Supply on Simulation using Proteus 7.10	34
4.5	Solar Battery Charger with Overcharge Protection	35
4.6	Solar Battery Charger with Overcharge Protection on PCB Layout	35
4.7	Solar Battery Charger on Simulation using Proteus 7.10	36
4.8	Mini AC Inverter Power 10W-30W by D313 Transistor	37
4.9	Mini AC Inverter Power 10W-30W on PCB Layout	38
4.10	Mini AC Inverter Power 10W-30W on Simulation using Proteus 7.10	38
4.11	Simulation Result for Voltage Wave Forms	39
4.12	Testing Mini Inverter Circuit with Output of 224.6 VAC	40

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	FYP Project Planning	50
B	Description of 10W Monocrystalline Solar Panel (XHH10)	51
C	Datasheet of LM 7809	52
D	The Simulation Results of Solar Battery Charger with Overcharge Protection	54

CHAPTER 1

INTRODUCTION

1.1 Introduction

Hybrid power describes the combination of a power producer and the means to store that power in an energy storage medium. In power engineering, the term “hybrid” describes a combined power and energy storage system. It does not mean a “method”, such as the popular use of hybrid to mean a vehicle.

Examples of power producers used in hybrid power are photovoltaics, wind turbines and generators that use fuel. Examples of energy storage media are batteries or hydrogen (for later use in fuel cells).

Hybrid power supply systems, like the name implies, combine two or more modes of electricity generation together, usually using renewable technologies such as solar photovoltaic (PV) and other types of renewable energy.

Hybrid power supply systems provide a high level energy security through the mix of generation methods, and often will incorporate a storage system (battery, fuel cell) or small fossil fueled generator to ensure maximum supply reliability and security for application of big loads.

1.2 Project Overview

Multi-Purpose Hybrid Power Supply is a power supply project which is a combination of conventional electric power plug point and/or photovoltaic solar panels.

The types of source which cater the loads for this hybrid power supply are in DC and single phase AC.

1.3 Problem Statements

The ultimate goal of a problem statement is to transform a generalized problem into a targeted and well-defined problem which can be resolved through focused research and careful decision-making. For this project, the problem statements that have to be solved are:

- a) The availability in getting electric power source:
We have to create a suitable power supply which can be adapted as a backup source of supply.
- b) The availability to obtain electrical power source other than the use of generators during outdoor activities like camping, etc.:
For example, to switch on the lights, radios and other electronic goods that has small wattage during outdoor activities.
- c) Saving time and cost:
To save time and to reduce the costs spend.
- d) The availability to have a reliable power supply:
To create a reliable power supply device that is able to cater any types of desired loads that required AC (single phase) and/or DC source.

1.4 Objectives

We normally face the problems especially in having a good supply of power in its use especially when it involves questioning whether the supply given is reliable or not, the efficient use of the power supply and the usefulness of the power supply we use in helping us with our daily activities either for indoor or outdoor use.

There are some objectives that is planned to be achieved in this final year project.

The objectives are:

- a) To construct a power supply that can cater small scale AC and DC loads.
- b) To build a reliable power supply that consists of conventional electricity and solar photovoltaic.
- c) To design a hybrid power supply that can optimize time of power usage and energy.
- d) To build a portable hybrid power supply that is suitable for outdoor and indoor use.

1.5 Project Scopes

In order to go through with the final year project, the students must know the scopes of their project. This will help them to get the right information and in the same time keep them on the right track in completing the study involved in their project.

The scope of the project helps the students to clarify the limitation of the project in terms of methods applied, tools, theoretical aspects and practical aspects. The scope of a project includes the area or range of things that are related to the project. The scopes for this FYP are:

- a) Only conventional and solar photovoltaic panels are considered as supply for this hybrid power supply systems.
- b) It will cater for loads of up to 5 W only.
- c) Compare to UK standard of solar sizing is 20%, the current peak hour chosen for Malaysia is 38% (Lim, 2009). [1]

CHAPTER 2

LITERATURE REVIEW

2.1 Literature Review

Literature review is once a conceptual for analysis of a project. This is a step to find out how to design and to perform the operation of a project. There can be several of methods to brew a literature review such as analysis a paper work which is related to the project we have work on it.

It is very important in the process for the completion of the project. Literature review is the work to find out other research works that are related to the project so that it can be as a benchmark to the project we have work on it.

2.2 What is a Solar Cell

A solar cell converts solar energy to electrical energy. Photons in the sunlight will provide the energy that moves the electrons from one layer of a semi-conducting metallic wafer to another. A current is created by the movement of the electrons.

Solar cells are devices which convert solar energy directly into electricity. The most common solar cells function by the photovoltaic effect. “Photo” means light and “voltaic” means electrical current or electricity (light-electricity). A solar cell supplies in direct current (DC) electricity that can be used to power DC motors and light bulbs among other things. Solar cells can even be used to charge the rechargeable batteries so that electricity can be stored or transported for later use when the sun is not available. [2]

There are two types of cells primarily used today, silicon and gallium arsenide, which come in several of different grades and varying efficiencies. The satellites that orbit the earth typically use the gallium arsenide type, while the silicon type is more commonly used for earth based (terrestrial) applications. The cloud cover, intensity of the sun and temperature usually will affect the array's performance output.

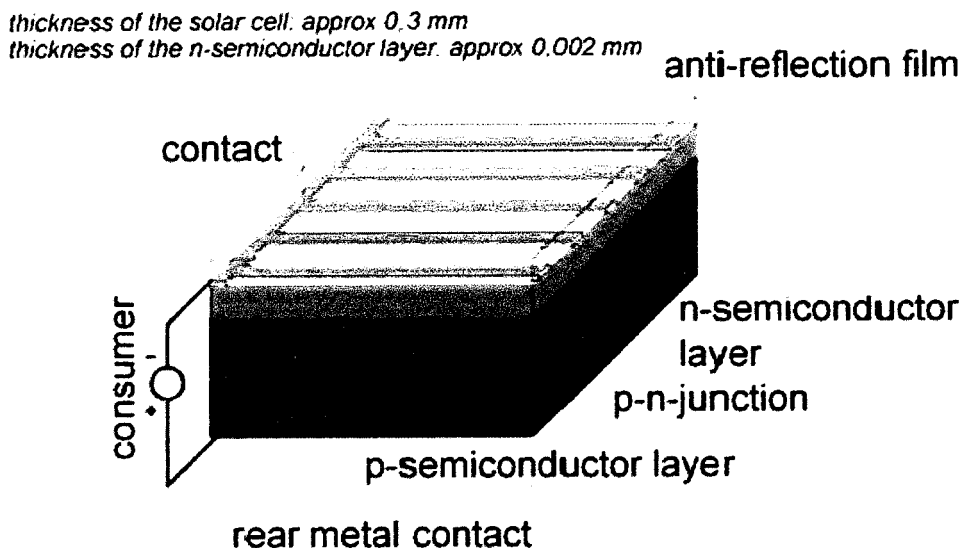


Figure 2.1: Photovoltaic Cell Semiconductor Layers [2]

2.3 Photovoltaics: Solar Electricity and Solar Cells in Theory and Practice

Photovoltaic cells are a relatively technology. Their development and use has come about as part of the technology developed for space travel and satellite communication systems. The word “Photovoltaic” is a combination of the Greek word for Light and the name of the physicist Allesandro Volta.

It identifies the direct conversion of sunlight into energy by means of solar cells. The conversion process is based on the photoelectric effect discovered by Alexander Bequerel in 1839. The photoelectric effect describes the release of positive and negative charge carriers in a solid state when light strikes its surface.

2.4 Review on Solar Applications

The literature review must include a detailed survey of the background to the project, including an overview of the subject, discussion of any essential theories and a review of any important publications such as the text books, research papers and etc.

The background of Multi-Purpose Hybrid Power Supply is mostly based on solar energy application and consisting of few power electronics application such as the power inverter.

2.5 First Review: Solar-Recharged UPS as a Low Cost AC Power Supply for Electronics and Environmental Education (By J. Diz-Bugarín, M. Rodríguez-Paz, 2008) [3]

The article describes about the transformation of an Uninterruptible Power Supply (UPS), which is commonly used as power backup for desktop computers into a solar rechargeable portable mains supply. Almost any commercially available UPS can be used and the conversion can be made without having detailed knowledge about electronic circuits inside. The project's article also states that a few external elements must be added such as the solar panel, charge regulator (commercial or self-made), a protection diode, cables and connectors. The system has many applications as a solar educational kit, as a small power source for car or camping, or for lighting and powering small isolated buildings.

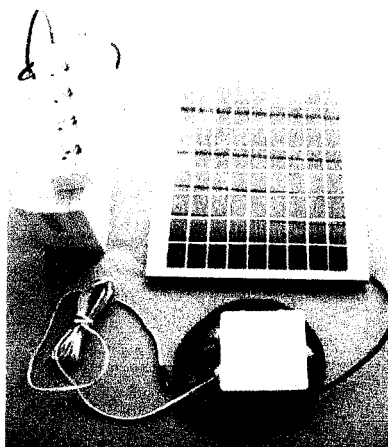


Figure 2.2: Complete Solar Kit with Panel and AC Socket [3]

as a power supply for the field and which is excellent in maintenance, supply, and secrecy, and does not have noise, and exhaust gas and exhaust heat.

The equipment consists of the amorphous silicon solar cell module covered by the surface protection film processed with the sand mat, the lithium ion secondary battery, and the charger. The result of this study is as follows:

- a) The solar cell module were the unfolding condition size 900mm*600mm*1.5mm, the folding condition size 180mm*300mm*20mm, the weight of 440g, the maximum output of 22W, the surface reflectance of maximum of 2%, and the conversion efficiency of 5.8%.
- b) The secondary battery and the charger were able to be charged even if the output of the solar cell module changed (14V-20V).

2.7 Third Review: Solar Electricity in Rural Villages (By S.N. Singh, A.K. Singh, 2009) [5]

This paper presents the development of a solar power converter for a rural house to meet the additional electrical energy demand which is increasing day by day due to rapid growth of population. A prototype sample has been constructed to explore the feasibility of developing such system to work as a supplementary source.

The PWM conversion technique is used in the development of proposed solar power converter produces a grid quality usable AC power supply from PV and /or battery source. The optimal design of system components like PV, battery and inverter etc has resulted in a cost effective system and offer a stabilized consistent power supply for household loads.

The total load(s) are divided into two category namely critical and heavy duty loads. The critical load(s) are prioritized to match with the availability of power sources whereas balance loads are connected together and powered through auxiliary sources. A