شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

شبكة المعلومـــات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

جامعة عين شمس

التوثيق الالكتروني والميكروفيلم

﴿ قَسَـــم ﴾

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد اعدت دون آية تغيرات

يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of
15 – 25c and relative humidity 20-40 %

بعض الوثائق الأصلية تالفة

بالرسالة صفحات

لم ترد بالأصـــل

El Mansoura University
Faculty of Engineering
Electrical Power & Machines Department

Design and Analysis of Solar Photovoltaic System Powering Electrical Vehicle

BY

Eng. Azza Samir Attia Ali Dwah

B.Sc. Electrical Engineer, El Mansoura University, 1997

Assistant Researcher in Electrical Engineering Department

A Thesis Submitted In Partial Fulfillment for the Requirements of the Degree of Master Science M.Sc.

In

Electrical Engineering

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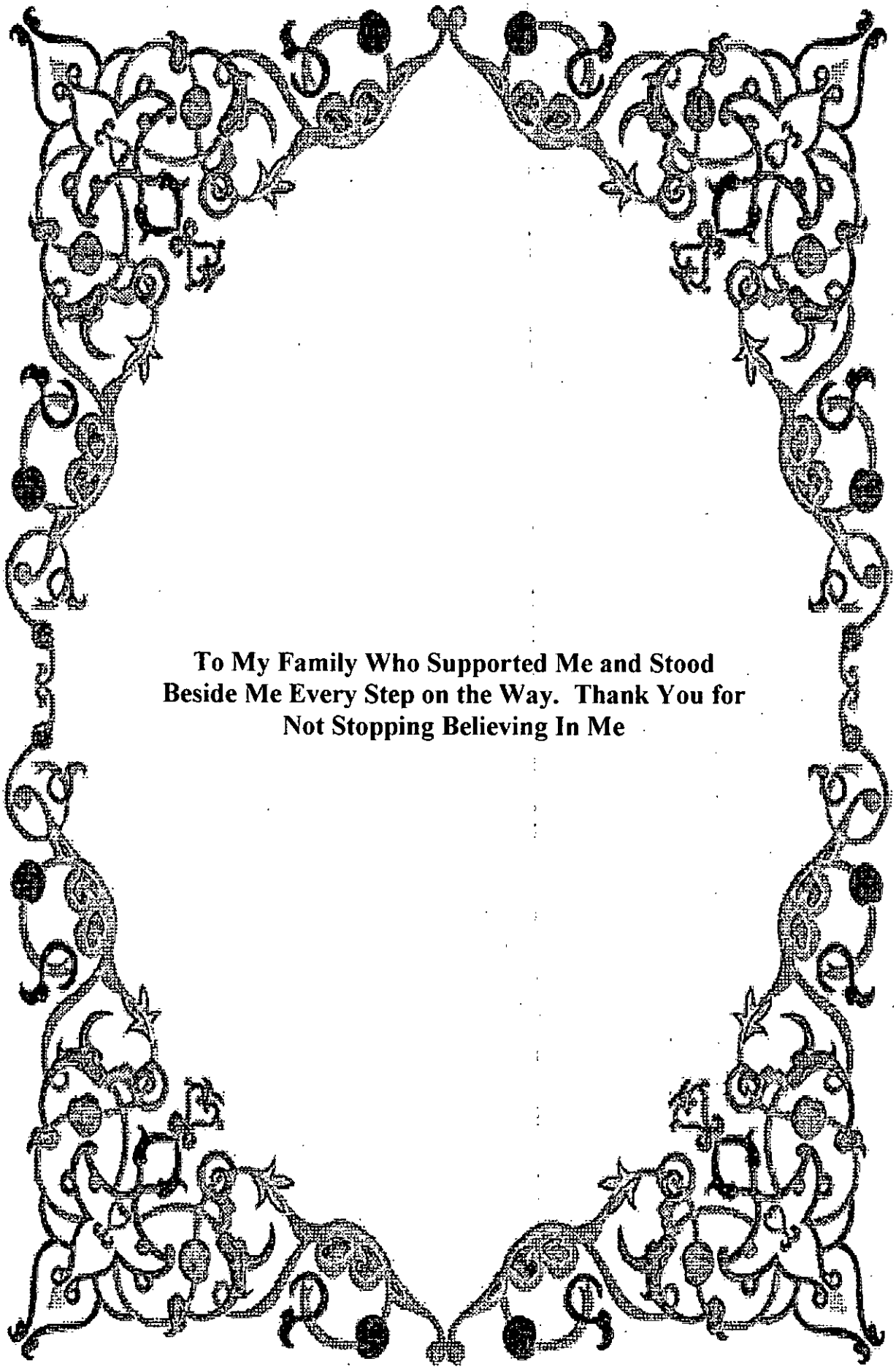

To My Family Who Supported Me and Stood Beside Me Every Step on the Way. Thank You for Not Stopping Believing In Me

SUPERVISORS

Thesis Title

Design and Analysis of Solar Photovoltaic System Powering Electrical Vehicle

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Date 7 / 2 / 2001

introduction

The photovoltaic power system used to drive a solar car consists of:

(1) Solar cells array (SCA) modules to feed the solar car motor.

(2) Battery energy storage system to ensure that the car will be continually operating during sunshine or night hours.

(3) DC/AC converter (inverter) in order to match the input power to the motor with the output power of the SCA or BES.

(4) Maximum power point tracker to operate the SCA at its maximum power point at any insolation level and thus fully utilizes it.

We thought we should review all these parts in this thesis. It will be clear from its contents that we designed some parts and accurately analyzed the operation of another parts and theoretically reviewed the remaining parts. Then, the upcoming six chapters give a complete study for these parts in addition to experimental conclusions and recommendations. Because they correspond to the solar car.

CHAPTER (1)

It is an introduction to the world of solar energy. It contains information about solar radiation, different types of renewable energy, and specifically solar energy. It also covers different types of solar cells. The importance of a storage element to the photovoltaic systems is presented. An introduction to the main thesis topic, which is solar car, is illustrated briefly covering the impact of solar car racing on the solar car developments and the vehicle important parameters.

CHAPTER (2)

In this chapter we reviewed a number of topics related to solar cars and photovoltaic solar cells array. These topics covered some important areas concerning high efficiency solar cells used in solar cars, solar car architecture and aerodynamics. About PV array we discussed solar cell efficiency, cooling, matching between solar cells used in a module, and maximum power trackers. The discussion includes also different travelling strategies of a solar car. In addition to a method used in PV system design. Also some important definitions was discussed such as photovoltaic effect.

CHAPTER (3)

This chapter is about the battery energy storage system. It includes a complete survey about batteries used in solar cars and their technical data. Also, a table covering their advantages and disadvantages is presented. The electrochemical processes inside batteries are explained such as polarization, and resistive losses. In addition to charging and discharging electrochemical reactions. Then accurately analysis was performed on a test battery that was chosen to be a lead-acid one. We came out from these analyses with a complete description of what happens exactly inside the battery at three states. These states are charging, discharging, and open circuit state. Then a method was obtained and recommended to calculate the parameters of the lead-acid battery equivalent circuit. This method is applicable on charging and discharging. The recommendation was based on the estimated error of the mathematical model built up to verify the proposed method. The error was no more than 4%.

CHAPTER (4)

In this chapter the thyristor basics are reviewed, as it is the controlled semiconductor used in building the DC/AC converter (inverter). Then the drive circuits chosen to trigger this thyristor is explained theoretically and graphically

by drawing it's representing circuits. Also, the method for designing its elements was pointed out clearly. The designing process of the inverter itself and its elements is then fully explained. The designed inverter was then tested by using one module of SCA. Mathematical models for SCA output current and inverter output voltage were built up. The mathematical models for SCA include mathematical models for SCA short circuit current, voltage at maximum power point and the voltage drop on the SCA series resistance. All these models had a maximum error of 4%. The AC mathematical model for inverter output voltage had a maximum error of 6%. A study of the effect of changing both insolation level and load value was performed on the designed inverter.

CHAPTER (5)

The chapter studied the inverter operation when connected with three paralleled SCA modules. The aim was to prove that it could be operated at high power rating. Then strange behavior from both the filtered capacitor and the transformer was observed. These behaviors were analyzed carefully and explained scientifically, which took a lot of experimental work. At last the performance of the designed inverter is obtained when supplying it from a constant voltage source (as the SCA was a constant current source). This proved that the designed inverter has good regulation. Thus, the poor regulation it has when supplied from SCA was because the SCA is known to have poor voltage regulation. This is due to its non-linear insolation-dependent I-V characteristics.

CHAPTER (6)

The last Chapter contains all the conclusions we had throughout the five chapters. Also it contains a number of recommendations based upon our experimental work and theoretical review carried out in this thesis.

Acknowledgement

All my respects and gratitude goes to my supervisors. Thank you for being so kind and helpful.

Prof. Dr. Galal, you taught me how to keep up with the progress around us and try to be part of it instead of watching it.

Prof. Dr. Adel, I learned a lot from you. On the personal level, how to be kind and generous to whom is working under your supervision and in the same time being very respectable personality. On the scientific level, the aim of any researcher is to make almost good and perfect work.

Assistant Prof. Dr. saad, working with you was a great pleasure to me. Patience, persistence, and a lot of reading are the key for getting accurate and good experimental results that's what you taught me. Thank you for helping me all the way. Your presence was very important to make the thesis in this form.

I owe a great deal to my father and mother. I wouldn't be able to finish this without your continuous encouragement, support, and kindness. A very big thank you goes to my brother. I'm grateful for all the time and attention you gave me and for keeping up with me all the time.

Eng. Azza Samir Attia

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