UNIVERSITI TEKNOLOGI MARA
CAWANGAN PULAU PINANG

DESIGN AND DEVELOPMENT OF BI-DIRECTIONAL TWO STAGE BATTERY CHARGER FOR DUAL PV-GRID

MUHAMMAD IMRAN BIN YUSOFF SHAZILLY

Faculty of Electrical Engineering

July 2017

ABSTRACT

Throughout the evolutions of solar technology, various version of battery charger that are available commercially are built with various charging methods for harvesting solar power. However, there are various methods of battery charging that is implemented in the end-user products today that would give various side effects to the battery. This research presents the two stage bidirectional battery charger for dual PV-grid's design and development. The system implements two types of charging circuit which is the pulse charging sub-circuit and the float charging sub-circuit with the operation is controlled by an ATMega 2560 microcontroller loaded with Arduino. The implementation of Arduino software and libraries in AVR microcontroller significantly reduce the complexity of programming in order to create signals which provides charging algorithm and detects current and voltage for the charging circuit. In order to verify the expected outcome, the experimental hardware are developed and tested. The experimental data collection was performed to analyze the charging curve of the experimental hardware comparing with a commercial PWM charger where the system is proven to be able to charge efficiently without harming the battery life in the long run. With the C=7.2Ah, the results showed that the commercial PWM charger produces an output current as highest as 6.4A which equals to 0.9C charge rate while pulse charging sub-circuit only produces 1.8A of maximum output current which equals to 0.25C. Thus, the proposed system of this research is able to charge lead acid battery efficiently within 0.25C of the maximum safe charging rate recommended and contributes to preserve the battery life in the long run.

ACKNOWLEDGEMENT

First and foremost, I would like to express a big gratitude to Allah swt for His blessing and the strength given during the progress of completing this study. Without His blessings, none of this is possible. Special appreciation goes to my parent for their love, understanding and unconditional support throughout this long and tough journey.

I would like to express a big thanks and gratitude to the supervisor of this research, Dr. Intan Rahayu binti Ibrahim for the commitment in giving precious help, advice and guidance throughout this study.

I would also like to acknowledge the assistance from the technicians and staffs at the electronics lab of UiTM Pulau Pinang for their continuous help and support during the lab work.

TABLE OF CONTENTS

CHAPTER 1
INTRODUCTION

1.0 RESEARCH BACKGROUND

Among the various source energy that were used today, solar energy sought by our modern society is to be increasing due to the economical and sustainability of renewable energy that the only disadvantage is the absence of sun shine and weather condition [1,2]. Solar energy is one of the renewable power energy that is capable to significantly reduce the dependency of consumer towards the conventional power energy. The photovoltaic cell (PV) is categorized as a semiconductor that is able to generate an electric energy through chemical reaction where it is ionized by the radiation. To store the energy harvested from solar generation, lead acid battery is commonly used. The simplest way to store solar energy is by connecting photovoltaic panel directly to the lead acid battery, but the output of the photovoltaic cells would damage the battery due to overcharge or undercharge since electricity output generated from solar is always inconsistent due to dependency to intensity of sunlight. Therefore, throughout the evolutions of solar technology, various version of battery charger is built with various charging methods to solve the problem [3]. In this project, a bi-directional charger is designed, developed with two stage charging methods to suit application of dual PV-grid.

1.1 PROBLEM STATEMENT

There are various method of battery charging that are implemented today especially in solar energy harvesting that would give various side effects to the battery whether it is by the manipulation of current or voltage . The basic idea of charging is that when the battery voltage is lower than the charging voltage, the battery would receive current from the charging side until the potential difference between two points reached equilibrium. In solar power perspective, the simplest way to achieve