MULTIPLE OUTPUT CHARGERS FOR

PORTABLE APPLIANCE

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Power Electronic and Drives

May 2009

"I hereby declared that that I have read through this report entitle "Multiple-Output Charger for Portable Electronics Appliance" and found it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Power Electronics & Drive)"

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MULTIPLE-OUTPUT CHARGER FOR PORTABLE ELECTRONICS APPLIANCE

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A report is submitted in partial fulfillment of requirements for the degree Of Bachelor in Electrical Engineering (Power Electronics & Drive)

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May 2009

I declare that this report entitle "Multiple-Output Charger for Portable Electronics Appliance" 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 : …………………………………………

Date : …………………………………………

Specially dedicated to my beloved family especially my father and my mother whose is very concern, understanding, supporting and patient. Thanks for everything. Also, thanks for everything to all my friends. This work and success will never be achieved without all of you.

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ABSTRACT

This project is to develop a charging device that the output is multiple which have more than one output. Beside that, the charging device is portable which means that this device can be charge in a different place. The charging device is important nowadays because of the usage of portable electronics appliance and the type of portable electronics appliance. The charging device important part is the converter. So, the understanding of converter and the control circuit are important to this project. The converter that will be used is dc-dc converter and the control circuit is used to control the voltage output. Beside that, this project must be analyze and study about the operation and simulation which can be done either in Orcad Pspice, or Proteus. The hardware output must have the same result with the simulation result. This project can benefit the people that have many portable electronic devices and the people that usually use this device.

ABSTRAK

Projek ini adalah membangunkan sebuah peralatan pengecasan yang mempunyai keluaran yang melebihi daripada satu keluaran. Selain itu, peralatan pengecasan tersebut adalah peralatan mudah alih yang membolehkan ia dibawa kemana sahaja. Pada masa kini peralatan pengecasan adalah penting kerana pengunaan dan pelbagai jenis peralatan elektronik. Bahagian penting dalam peralatan pengecasan adalah penukar. Oleh itu, pemahaman bagi penukar dan litar kawalan adalah penting. Penukar yang akan digunakan adalah penukar arus terus dan kegunaan litar kawalan untuk mengawal keluaran voltan. Selain itu, projek ini perlu dianalisa dan pemahaman mengenai operasi litar serta simulasi dilakukan menggunakan aturcara simulasi Orcad Pspice, atau Proteus. Keluaran bagi keluaran perkakasan mestilah sama dengan keputusan bagi simulasi. Projek ini dapat memanfaatkan orang yang menggunakan pelbagai peralatan elektronik mudah alih dan bagi orang yang selalu menggunakannya.

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PIC   -   Peripheral Interface Controller

PWM   -   Pulse Width Modulation

MOSFET -   Metal Oxide Semiconductor Field Effect Transistor

IGBT   -   Insulated-gate bipolar transistor

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CHAPTER 1

INTRODUCTION / LITERATURE REVIEW

1.1   Introduction

With the development in technology, it is becoming essential to find many people using portable appliance such mobile phones, laptops, mp3, and ipod. Furthermore, the use of battery becoming important and to keep using it the battery must be charged. So, this project develops a multiple outputs charger for portable electronic appliance. This is because the chargers that available in the market right now only have single output only.

The aim of this project is to design a multiple outputs charger. The designed charger will have 2 different outputs, which are 5V and 20V.

The multiple outputs charger is developed from dc-dc converter. The dc-dc converter has been used is flyback converter because flyback converter is an isolated dc-dc converter. Isolated dc-dc converter has a transformer that provides number of advantages. The advantages are providing isolation, allow turns ratio adjustment to achieve required output voltage, allow polarity inversion and allow multiple outputs with different voltage levels. Other than that, the development of this circuit is depending on the control circuit. The type of control circuit has been used is pulse width modulation (PWM).

From this project, the project can introduce new charger for the user and can charge different type of portable electronic appliance.

1.2   Problem Statements

Nowadays many people use electronic device. So, they need to charge up their device to future usage. Currently, the charger that available in the market is only able to charge one type of device in one time. With the new era of power electronics technology, it is easier if there are chargers that able to charge up two or more electronic devices in one time. The designed circuit for multiple outputs charger must perform:

a) Provide the required constant output voltage.

b) Supplied from constant dc voltage.

1.3   Project Objectives

The project objective determines the goal intended to be attained from this project, which are;

a) To design and develop a charger that can charge different type of portable electronic appliance

b) To charge up more than one type of portable electronic appliance in the same time

c) To have 12V voltage source to charge portable electronic appliance and provide two outputs, 20V and 5V

1.4   Project scopes

The scope determines what should be included in the proposed project. The scopes are;

a) To design and develop the circuit based on dc-dc converter topology

b) To analyze the design circuit by using simulation software such as Orcad Pspice or Proteus

c) To construct the hardware with the following requirements

    i.   To control circuit based on pulse width modulation (PWM) technique

    ii.   To trigger power switches using microcontroller

The circuit based on dc-dc converter topology that has been used for this project is flyback converter. Flyback converter is used for the output power between 10W until 150W. The output is for the medium power output. Beside that, the flyback converter can be used to provide multiple outputs and it isolates the input and the output. Also the circuit of this converter is simple and the budget to produce this circuit is low compare to another dc-dc converter topology.

By analyzing the circuit using simulation, the suitable component for the circuit can be determined. So, the work to build the hardware is much easier. From the simulation, the performance of the charger can be analyzed and identify any problems.

The construction of the hardware is based on control circuit and power switches. The control circuit is important to trigger the power switches. Programmable Interface Controller known as PIC is used by generate the pulse width modulation (PWM) signal to the gate drive.

Pulse width modulation (PWM) is the method of choice to control modern power electronics circuits and is a useful method in controlling a lot of device. The basic idea is to control the duty cycle of a switch such that a load sees a controllable average voltage. To achieve this, the switching frequency (repetition frequency for the PWM signal) is chosen high enough so that the load cannot follow the individual switching events. Also a conventional linear output applies a continuous voltage to a load. PWM applies a pulse train of fixed amplitude and frequency, only the width is varied in proportion to an input voltage. PWM is employed in a wide variety of applications, ranging from measurement and communications to power control and conversion.

Power switches is used to trigger the circuit because it has many advantages such as increase efficiency and reduce EMI in power supply designs and also the right integrated switch can reduce heat and EMI and also improve power efficiencies 90% or more. Beside that, the power switches is triggered by microcontroller. The microcontroller that will be used is from PIC family. The PIC used is PIC16F877a.

1.5   Thesis outline

This project is to design multiple outputs charger for portable electronic appliance using dc-dc converter. This report will discuss it in detail in five sections. There are introduction and literature review, material and method, results, discussions of results, and suggestion and conclusion.

Chapter one (introduction / literature review) discussed about background of the topic, aims and technical background. The problem statement, project objectives, scope and thesis outline are also included in this chapter. Meanwhile in literature review, it divided into four parts. There is introduction, system set up, system modelling and control method. The system set up discussed about converter and control circuit, system modelling discussed about the parameter to design the circuit and control method discussed about conduction mode, type of control circuit and control circuit.

Overview in chapter two (material and method) will be divided into two parts. The first part describes about the techniques and consideration that applied during PSM 1 and PSM 2 which is the descriptions about block diagram. The block diagram is divided into six main criteria which are project definition, modelling circuit, experiment, construct circuit, result and discussion, and project completion. Beside that this chapter also discussed about simulation program for the project and Hardware Development and Implementation.

Chapter three (results) describe about the results from PSM 1 and PSM 2 which include the project simulation and the results from hardware testing. Also include the explanations of the project simulation and hardware testing.

Chapter four (discussion of results) describe about discussion about the general and overall project. Also, describe about project problem and limitation.

Chapter five (suggestion and conclusion) consist of conclusion, a brief summary, and suggestion to improve the project.

1.6   Literature Review

1.6.1   Overview

This sub-topic reviews an existing project created to get an idea about the project design, conception and any information that related to improve the project. There are many creations and innovations related to this projects that have been done by other people with difference concept and design. This sub-topic also covers the researches related to the subject. This will provide a clearer understanding of the system and its design. These part reviews, summarize and analyze the system set up, system modelling, and control method. This project involved with the multiple output charger for portable electronic appliances.

1.6.2   System set up

In order to realize the projects outputs that need, the system set up must be decide first. From the previous research [1]-[8] note that charger consists of converter and control circuit. The converter consists of dc-dc converter that generates output voltage and the control circuit consists of feedback circuit that control the switching.

Many topologies that have been used in developed the project outputs. Previous research in [1], [3], and [4] are used the flyback converter topology. Research in [2] used forward and flyback converter topology but derived from buck topology. The research in [4] used different type of converter which is active-clamp bidirectional flyback converter topology. It is choose because of good part-load efficiency in a continuous conduction mode. Also in research [6] used different type of converter which is zero current switching PWM flyback converter with simple auxiliary switch. Cuk converter and sepic converter are used in research [7]. In [8] used Buck zero-current switching PWM converter.

In [4] state the basic operation flyback converter. The basic function is a transfer of energy from supply source into transformer mutual inductance in the first time period. In a second time period this energy is transform into a load. It also describe as coupled inductor.

For better performance is switching, there are different solution to it. In research [4], [5], and [6] state the solution. In [4], switching losses have been minimized by turn-on each MOSFET with specific dead timer later than the PWM signal. In [5], by use soft switching which is soft rise and fall current edge in order to minimize the electromagnetic interference during switch on and avoid voltage spike. Also soft switching is used in [6] and offers the possibility of high-switching frequency and snubberless operation. Beside that, in the study [6] states that of use a passive resistor discharge clamp.

The converter can produce more than one output like the studies in [2] and [7].

1.6.3   System Modelling

Another important part in developing the output of charger is mathematical modelling or design based on the specification. The specification of the converter is needed to determine the value of component. The specification that in need in the design process is shown below:-

a) Voltage output, VO
b) Power output, PO (MAX)
c) Minimum input current, IO (MAX)
d) Maximum input current IO (MIN)
e) Maximum voltage input, VDC (MAX)
f) Minimum voltage input, VDC (MIN)
g) Switching Frequency, f

Beside that the mathematical is use to analysis the circuit. The analysis is done to compare to the theoretical. As in [1], the analysis and design are to proven that the result completely match with the theoretical concept. Beside that, to show the problem that is faced like in research [2].