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DEVELOPMENT OF AC-DC CONVERTER

Submitted By:
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This Technical Report for Final Year Project is submitted to Faculty of Electrical

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In partial to fulfilment of Bachelor of Power Electronics & Drives Engineering.

Faculty of Electrical Engineering (FKE)

UNIVERSITI TEKNIKAL MALAYSIA MELAKA (UTeM)

STUDENT'S DECLARATION

I hereby declare that this thesis entitled ***"Development of AC-DC Converter"*** is the result of my own research except as cited in the references. This is project is adequate in terms of scope and quality for the award of the degree of Bachelor of Power Electronics & Drives Engineering.

Signature   :

Name   :   NURUL AIN BINTI SUHAIMI

ID Number   :   B011010117

Date   :   18/JUNE/2013

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the awards of the Degree of Bachelor of Power Electronics & Drives Engineering.

Signature   :

Name   :   NORHAZILINA BINTI BAHARI

Position   :   LECTURER

Date   :   18/JUNE/2013

ACKNOWLEDGEMENT

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Finally, I would also like to thank my parents. Even though both of them far away, but they always give me support to complete my degree and want me to shows good performance in representing my final year project. Their support gives me the strength to endure this final year project and successfully complete it.

ABSTRACT

Power electronics engineering nowadays gaining attention such example advantage of small components that can produce large benefits in quality of power production. If the circuit is designed to take into account all possible advantages and disadvantages of a parameter, it can have an impact on the resulting product. Structured circuit LED power previously divided into two stages, single stage and two stage structures has been in formation by previous researchers for the development of power electronics areas. Converter is a device that converting the unregulated DC input to a controlled DC output with a desired voltage. The applications that use the converter is switched-mode power supply (SMPS), DC motor control and battery charges. Two major sections that will analyse are non-isolated DC-DC converter and isolated DC-DC converter. Whereas in this project there is a combination between the use of isolated and non-isolated. The main purpose of this project is produced to meet the objectives of producing AC-DC converter that is capable of producing large scale power and is suitable for all current applications. Experiment was conducted to test whether the three circuits can meet the conditions of producing large power output and efficiency of the best circuits. Tested power output circuit by selecting 36W power LEDs connected in series based on LED configuration. Calculations have been performed to identify products capable of meeting the specified requirements. Analysis done by using Matlab Simulink software versions R2010a. The output voltage should produce 24V. Among all the circuits, the best circuit performance is interleaved single-stage flyback converter. The results of the analysis carried out, total harmonics distortion value is 15.94% and the efficiency of the circuit is 15.07%.

ABSTRAK

Bidang kejuruteraan elektronik kuasa pada masa kini semakin mendapat perhatian sebagai contoh kelebihan komponen kecil yang boleh menghasilkan faedah yang besar dalam kualiti pengeluaran kuasa. Jika litar direka dengan mengambil kira segala kemungkinan kelebihan serta kekurangan sesuatu parameter itu, ia mampu memberi impak terhadap produk yang bakal dihasilkan. Litar berstruktur kuasa LED yang sebelumnya terbahagi kepada dua peringkat iaitu struktur satu peringkat dan juga struktur dua peringkat telah di formasi oleh penyelidik yang terdahulu bagi membantu perkembangan bidang keberhasilan elektronik kuasa. Penukar adalah peranti yang menukarkan input DC dikawal kepada output DC dikawal dengan voltan yang dikehendaki. Aplikasi yang menggunakan penukar adalah bekalan dihidupkan-mode kuasa (SMP), DC motor kawalan dan caj bateri. Dibahagikan kepada dua bahagian yang tidak terpencil DC-DC penukar dan terpencil DC-DC penukar. Manakala dalam projek ini terdapat gabungan antara penggunaan terpencil dan bukan terpencil. Tujuan utama projek ini dihasilkan adalah bagi memenuhi objektif iaitu menghasilkan penukar AC-DC yang mampu mengeluarkan skala kuasa yang besar dan bersesuaian untuk semua aplikasi semasa. Experimen dijalankan bagi menguji samada ketiga-tiga litar dapat memenuhi syarat yang ditetapkan iaitu menghasilkan keluaran kuasa yang besar dan memberi kecekapan litar yang terbaik. Keluaran kuasa litar diuji dengan memilih kuasa 36W LED yang disambung secara siri berdasarkan konfigurasi LED. Pengiraan juga dilakukan bagi mengenalpasti keluaran mampu memenuhi syarat yang ditetapkan. Analisis dilakukan dengan menggunakan perisian Matlab Simulink versi R2010a. Voltan output harus menghasilkan 24V. Antara semua litar, prestasi litar terbaik adalah 'interleaved' penukar 'flyback' satu peringkat . Hasil dari analisis yang dijalankan, jumlah keseluruhan harmonik nilai gangguan terganggu adalah 15.94% dan kecekapan litar adalah 15.07%.

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3   *CHAPTER 3 – THEORY*

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LIST OF SYMBOLS

DC	-	Direct current
CCM	-	Continuous Conduction Mode
DCM	-	Discontinuous Conduction Mode
ISSF	-	Interleaved Single Stage Flyback
I/O	-	Input / Output
THD	-	Total Harmonics Distortion
Hz	-	Hertz
FFT	-	Fast Fourier Transform
SMPS	-	Switched Mode Power Supply
AC	-	Alternating Current
POL	-	Point Of Load
PF	-	Power Factor
Lm	-	Magnetizing Inductance
η	-	Efficiency
LED	-	Light Emitting Diode
sec	-	Seconds
%	-	Percentage

LIST OF APPENDIX

Appendix A: Flow Chart of Project Activities

Appendix B: Project Schedule of Project Activities (Gantt chart)

Appendix C: TURNITIN Report must be attached

Appendix A

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                    ┌──────────┐
                    │  Start   │
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              ┌──────────────────────┐
              │       Planning       │
              └──────────┬───────────┘
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        │ Data collection / Literature Review│
        └──────────┬───────────────────────┘
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           ╱─────────────────────────╲
          ╱   Development of design    ╲
          ╲   circuit and simulation   ╱
           ╲─────────────────────────╱
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        │ Design Circuit with selected parameter value │◄────┐
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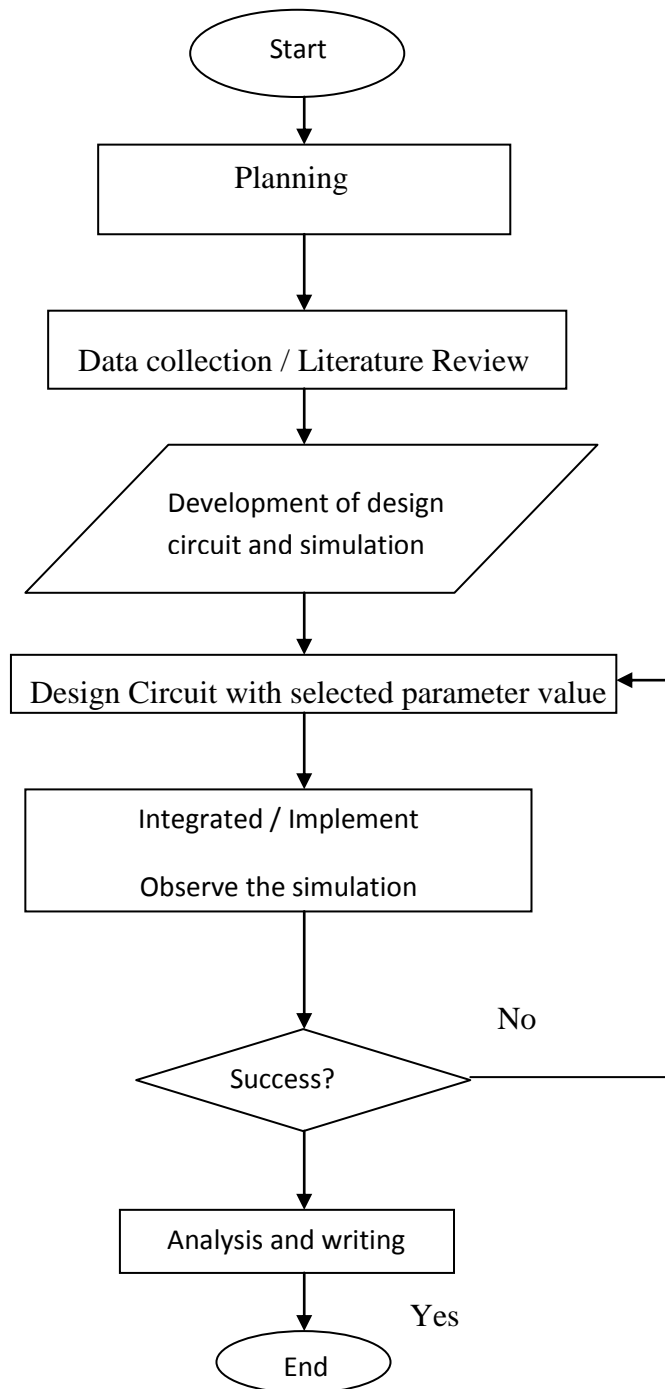
Appendix B

Gantt chart

	Project Planning										
	List major activities involved in the proposed project. Indicate duration of each activity to the related month(s).										
	2012				**2013**						
Project Activities	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mac**	**April**	**May**		
Topic discussed with lecture and the project to be well understood	■										
Details collected regarding topic, information and supervisor briefing every weeks and literature review studied		■									
The proposal completed for FYP 1 and prepared for the seminar presentation			■								
Simulation done using Matlab tools software				■	■	■					
Simulation design for load configuration						■	■				
Started doing improvement of the simulation design circuit						■	■				
Software part completed and tested							■	■			
Report for FYP 2 completed									■		

Appendix C

full report

ORIGINALITY REPORT

8 %	**0** %	**8** %	**0** %
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	SangCheol Moon. "An interleaved single-stage flyback AC-DC converter with.. *Publication*	**5%**
2	Moon, S. C., G.-B. Koo, and G.-W. Moon. "A New Control Method of Interle… *Publication*	**2%**
3	K. I. Hwu. "Development of AC-DC converter for laboratory power amplifier"… *Publication*	**1%**
4	Myung-Joong Youn. "A new single-stage AC/DC converter with high efficie… *Publication*	**< 1%**

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CHAPTER 1

INTRODUCTION

This chapter discuss an overview of the project background, activities and goals containing a common description of what is expected to be done within the project and will prior to the implementation process for the targeted goal. It will include the primary focus, a list of key reasons for launch, a very common description of how to perform this project and plain explanation of the desired outcomes.

1.1   Project Background

This project purpose of design and develop a converter 240-24 V for general purpose application. Project consists of analyze and develop an interleaved single stage flyback converter with wide output power range. By looking to the scenario nowadays modern electronics system surrounding us requires high-quality, small, light weight, reliable and efficient power supplies that construct operation of voltage or current divider. However all goods will faces the kind of problems such as limited power to output voltage and smaller than input voltage and also power density turns low because low frequency are required (50-60 Hz) for filters and line transformers. Another problems occur in the electronics device is Electromagnetic Interface (EMI) [15]. EMI is the leakage of electronics radiation from a device that can cause problem with electronic circuitry and communication systems. To reduce the EMI levels is to determine all the source of EMI or either develops alternative technologies [6]. Good factor that considering the electronics device is low Total Harmonics Distortion (THD) even the output power low. Total harmonics distortion is the measurement of all harmonics components of the voltage or current waveform against the fundamental component [16]. The purpose is to characterize the power quality of the systems. To make sure the system works fluently without

interruption, power electronics switches using IGBT's perform operate at high frequencies, lighter in the system. Analyze using Matlab Simulink comparison will be proving in term of simulation development. As the student that field in this power electronics courses, it is kind of responsibility to upgrade the system that we use now days so that it will make life easier, compact and sophisticated to young and future.

1.2   Problem Statement

From the survey on research of paper in power electronics systems, most of the equipment of power electronics usually faces the electromagnetic interface (EMI) at the input power stage. EMI produces in two forms such in the form of radiated, noise travels through the air. In this analysis will focus on conducted EMI which noise travel in electrical conductors, wires, electronics component for example capacitors, resistors, transformer, inductors, semiconductors and etc.

Other than that is about the total harmonics distortion (THD). The Total Harmonics Distortion is the summation of all harmonics components of the voltage or current waveform compared against the fundamental component of the voltage or current wave. Harmonics distortion for general can increase the current in power system which results higher temperatures in distribution transformers and neutral conductors. Recently, the required value of total harmonics distortion (THD) is less than 10% in the industry.

Thus, this project state that single-stage and two-stage structure faces problem of low efficiency and low power factor, as the solution of these problems, an interleaved flyback converter that can handle high output power, good PF and THD will be analyse.

1.3   Project Objective

Below show a few objectives to be accomplished in the end of this project:

- To design and develop wide output power range for general purpose application.
- To provide the high efficiency of the circuit.
- To provide the low harmonic distortion (THD) even the output power low.
- To analyze the difference between the circuits configurations.

1.4   Project Scope

The project scope will cover aspects such as design and develop a converter using Matlab / Simulink tools. Project cover of analyze mainly focus on an interleaved single stage flyback with wide output power range. The system also use converter switching elements to increase switching speed, allowing the cost of circuit magnetic to be reduced and keeping switching losses to a minimum. The systems also analyze the circuit parameter such without filter, with filter and also two-stage structure of driver. Monitoring the several circuit performance by looking of good power factor, low total harmonic distortion and high efficiency, this system will implement to the application and will fit to the general purpose application so that it help consumer to achieve high quality of power range better from our present technology.

1.5   Project methodology

The methodology involves in this project including of :

a)   Preparation (planning)

This is the earlier stage thus it needs a lot of research and observing related information about the project. This stage is to recognize what is the problem occur when relate to the power electronic device. Also to identify the solution by comes out with the problem statement and problem scope. As the result of this stage, the outline objective, scope and expected result will be determined.

b)   Data collection phase

Review the problem of the circuit system and self study of the description related due to the component use in the project. All the information that gain from supervisor was list down to improve the research observe. Also source from the internet, supportive comment and reference book were included also.

c)   Development (Design circuit & simulation)

Construct the circuit diagram in the Matlab / Simulink tools. The aim of this stage is to view the switching elements of the proposed control method requirement. The observing result was classified for further progress. Analyze consist of power factor, total harmonic distortion and efficiency. Design the switching converter.

d)   Implementation

Run the Matlab tools and make an observed if it is compulsory and make step of evaluation. Refer to the supervisor for further step of progress. After satisfied with the result, next do analyses with the data obtain and write the final full report.

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│  Planning   │
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┌──────────────────────────────┐
│ Data collection / Literature │
│           Review             │
└───────────┬──────────────────┘
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      Development of design
      circuit and simulation
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│ Design Circuit with selected          │◄──────┐
│ parameter value                       │       │
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│    Analysis and writing       │
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                ▼
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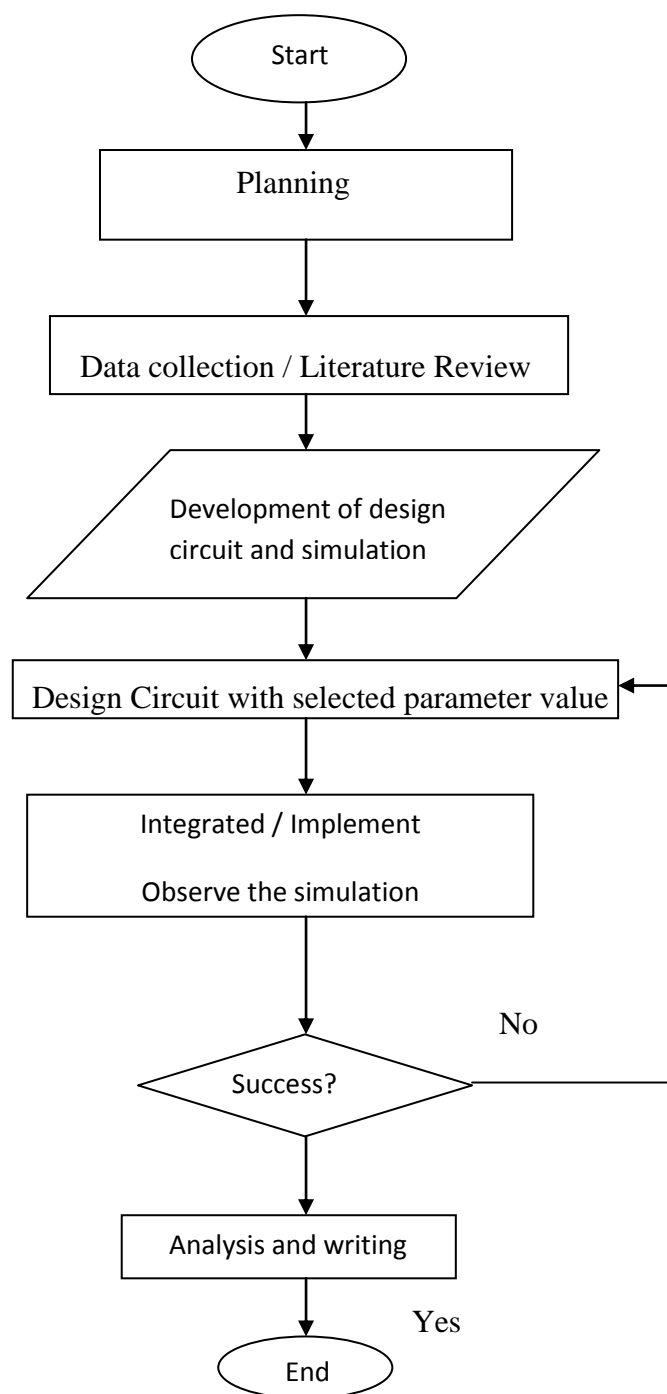
Chart 1.5.4 – Research Methodology Flow Chart