

# **THE FORCE COMMUTATION CHOPPER CIRCUIT**

**Thesis submitted to the Faculty of Electrical Engineering,  
University Teknologi MARA in fulfilment of the requirement for the  
Degree of Bachelor of Engineering**



**MOHD SUBHI BIN ABU BAKAR  
Faculty of Electrical Engineering  
UNIVERSITI TEKNOLOGI MARA  
40450 Shah Alam  
Selangor Darul Ehsan**

**MAY 2008**

## ACKNOWLEDGMENT

Thanks to Allah who has given me the strength and ability to completed this final project and thesis. With this opportunity I would like to express a special gratitude to my project supervisor Prof. Madya Dr. Ahmad Maliki Omar for the guidance and support throughout the development of this project. I would also like to express my utmost gratitude to Mr Abu Bakar for their help and all who have been involved directly or indirectly.

I also would like to thank to my parent for their support an understanding to me in order to do this project. Without them, I would never to finish-up this project. Not forget a milhon of thanks also to all my friends who given me support and contribution to finish this project. May Almighty Allah bless and reward them for their generosity.

## ABSTRACT

A force commutated thyristor chopper is disclosed in which a single commutation inductor is coupled in the free-wheeling path of the chopper together with a free-wheeling diode. The single inductor provides a chopper of relatively simple configuration in which main and commutator thyristors couple a commutation capacitor to opposite ends of the commutation inductor, and a charging diode is coupled in parallel with the commutator thyristor to facilitate charging of the commutation capacitor in opposite senses. The resulting circuit arrangement operates in a highly effective and efficient manner, minimizes trapped energy and protects the various component parts thereof by preventing dangerously high current and voltage transients.

## TABLE OF CONTENTS

Title	1
Declaration	iii
Acknowledgement	iv
Abstract	v
Table of Contents	vi
List of Abbreviation	ix
List of Figures	x

CHAPTER	DESCRIPTION	PAGE
INTRODUCTION		
1.1	Introduction	1
1.2	Objective	2
1.3	Scope of the thesis	3
1.4	Organization of the thesis	3
FORCE COMMUTATION		
2.1	Introduction	4
2.2	DC/DC converter	4
2.3	Inverter	5
2.4	Single Reactor force commutated chopper	6
2.4.1	Circuit arrangement	6
2.4.2	Circuit operation	8
SWITCHING DEVICES		
3.1	Introduction	14
3.2	Driver Circuit	14
3.3	SCR	15
3.3.1	Function of the gate terminal	16
3.3.2	Switching Characteristic	17

# CHAPTER 1

## INTRODUCTION

### 1.1 INTRODUCTION

The force commutation chopper is frequently a need for devices which can be used to control selected parameters of a DC signal such as the voltage thereof. For example, in the case of a DC motor it may be desirable to provide a device or devices for selectively lowering the voltage of a DC signal as applied to the DC motor from a fixed voltage source to effect speed variations of the motor. While the voltage regulator represents one common device used for such applications, such devices have inherent limitations which may render them unsuitable. For example, the resistors typically employed in voltage regulators so as to dissipate energy as the voltage is stepped down may create an intolerable heating problem. Then too the jerkiness upon acceleration and deceleration of motors using such devices may prove to be highly disadvantageous. [1]

An alternative approach to the problem of regulating a DC voltage is to use a time ratio controller (TRC) or chopper which effectively acts as a switch coupled to a DC source so as to periodically apply the DC source in the form of a series of pulses to an output. An inductive filter used to couple the load to the output terminals effectively filters the pulses to provide a DC voltage of desired value to the load. The pulses at the output may be generated using two or more controllably conductive devices such as thyristors. Alternate conduction or commutation of the thyristors may be accomplished using a number of different techniques, one of the most common of which involves the use of inductive and capacitive elements to force-commutate the thyristors.

Time ratio controllers or choppers of the type described often comprise a highly effective means of regulating the voltage or other parameters of a DC signal without the disadvantages usually present in equivalent devices such as