

HIGHER TECHNICAL INSTITUTE

ELECTRICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

POWER ELECTRONIC CIRCUIT:
APPLICATION
OF THE THYRISTOR AND ITS
DRIVING CIRCUIT

E. 1244

NEOFYTOS A. NEOFYTOS

JUNE 2000

HIGHER TECHNICAL INSTITUTE

ELECTRICAL ENGINEERING DEPARTMENT

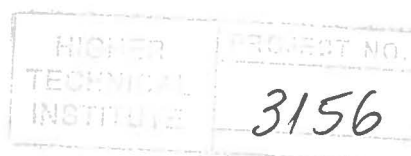
DIPLOMA PROJECT

**POWER ELECTRONIC CIRCUIT:
APPLICATION
OF THE THYRISTOR AND ITS DRIVING CIRCUIT**

E. 1244

NEOFYTOU A. NEOFYTOS

JUNE 2000



**POWER ELECTRONIC CIRCUIT:
APPLICATION
OF THE THYRISTOR AND ITS DRIVING CIRCUIT**

This project is submitted in partial fulfillment
requirements for the award of
the

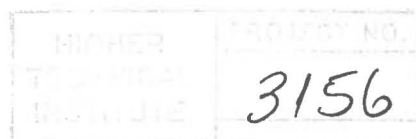
**DIPLOMA IN ELECTRICAL ENGINEERING
of the
HIGHER TECHNICAL INSTITUTE**

E.1244

Project supervisor: Dr. C. Marouchos

NEOFYTOU A. NEOFYTOS

JUNE 2000



CONTENTS

Acknowledgement

Introduction

Chapter 1: Thyristor and triac as switches in power electronic circuits

1.1 General information.....	1
1.2 Thyristor as an electronic switch.....	2
1.3 Internal structure of thyristor.....	4
1.4 Static characteristics.....	5
1.5 Holding and latching current.....	6
1.6 Dynamic characteristics.....	7
1.7 Protection of thyristor.....	9
1.8 Bi-directional triode thyristor.....	11

Chapter 2: Driving requirements of the thyristor and driving circuit description

2.1 Requirements of firing circuit.....	14
2.2 Circuit analysis and explanation.....	16
2.3 Gate drive circuit.....	17
2.4 Operating considerations of CA3059.....	19
2.5 Gate drive circuit arrangement.....	21

Chapter 3: Thyristor applications

3.1 Inverters: dc to ac conversion.....	22
3.2 Square wave thyristor inverter.....	23
3.3 Complementary impulse commutated inverter.....	24
3.4 Inverter output voltage analysis.....	25
3.5 Pulse Width Modulated inverter.....	27
3.6 Voltage regulators.....	29
3.7 Voltage rectifiers.....	32

Chapter 4: Construction of the circuits

4.1 Heat sink base construction.....34

4.2 PCB design and circuit construction.....36

Chapter 5:

Conclusions.....37

Appendices

Bibliography

ACKNOWLEDGEMENT

I would like to express my gratitude to Dr. C. Marouchos, lecturer in Higher Technical Institute for his guidance and motivation and his wiliness to offer every possible help for the preparation and evolution of this project.

I would also like to express my thanks to my family for their moral and financial support.

INTRODUCTION

In the following pages an attempt to an understandable approach of the semiconductor device called thyristor will be made. Some details about the physics of semiconductor materials or the design of thyristor internal structure may be considered unnecessary but might proved important in the manner of understanding the operation of the device.

Thyristor is the internationally recognized name for the particular semiconductor also known as SCR. The name (thyristor) is derived from the greek with the first part 'thyr' meaning switch and the second part an association with the transistor family.

Its trade name SCR (silicon controlled rectifier) is derived from the fact that is a silicon made device and it is used as a rectifier which can be controlled. As a controlled switch it forms a group with other devices used in power electronics which are the power transistor, the IGBT, and the MOSFET.

However the general interest, development and use of the thyristor indicates that for many cases its many advantages make it superior to the other devices.

As it will be obvious in the pages to follow one text can not cover all aspects referring to thyristor as an electronic switch in detail. The important aspects of operation, protection and control are described carefully and any additional information or specification of the device are provided in the manufacturers data sheets in the appendices.

Chapter one attempts to give an overall picture of the thyristor as a switch in power electronics circuits by description of its static and dynamic characteristics and by reference to the protection measures which are necessary for safe operation.

In chapter two the driving requirements of thyristor are described and a brief description of CA3059 IC used in the driving circuit is provided.

In chapter three some thyristor applications are presented and finally in chapter four the construction procedure of the firing circuit and the heat sink base of the thyristor and triac is described.