

HIGHER TECHNICAL INSTITUTE

ELECTRICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

ANALYSIS OF POWER ELECTRONIC
CIRCUITS USING THE
SWITCHING FUNCTION TECHNIQUE

E. 1263

TSIRTOU ELENI

JUNE 2001

HIGHER TECHNICAL INSTITUTE

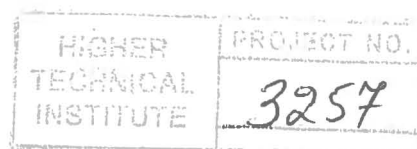
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ANALYSIS OF POWER ELECTRONIC CIRCUITS USING THE SWITCHING FUNCTION TECHNIQUE

By

TSIRTOU ELENI

Project report submitted to
the Department of

Electrical Engineering

of the

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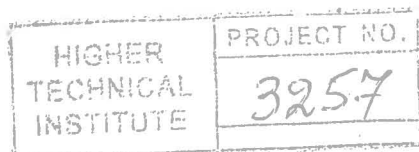
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in

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**I dedicate this thesis to all those
who take their life into their own hands...**

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Analysis of Power Electronic circuits using the Switching Function technique

Summary

The objective of this project is to analyze a number of Power Electronic circuits using the Switching Function technique. This technique is a rather new method for analysis of Power Electronic circuits appearing in very few books and mostly in research publications. The main reference for my work were my class notes in power electronics. There are four categories of Converters. All Converters are grouped in relation to their function: DC to DC, DC to AC, AC to DC and AC to AC Converters. For each category the most basic configuration is selected for analysis.

The Switching Function is a signal consisting of a train of positive or positive and negative pulses. These pulses have unity magnitude and period T . The Switching Function is multiplied with the input voltage to give the output voltage.

In each circuit we present the power circuit, we explain its operation, present the modes, derive the mathematical model giving the frequency analysis of parameters.

As the various semiconductor switches are operated in sequence the circuit is modified accordingly. A mode presents the circuit for a specific state of the switches.

Primarily single phase circuits are presented in this work.

Introduction

Power Electronics have already found an important place in modern technology and are now used in a great variety of high power products, including heat controls, motor controls, power supplies e.t.c. It is difficult to draw the boundaries for the applications of Power Electronics circuits especially with the present trends in the development of power devices and microprocessors, the upper limit is undefined.

The dominant application of electronics today is to process information. Power Electronic circuits are principally concerned with processing energy. They convert electrical energy from the form supplied by a source to the form required by a load. For example the part of a computer that takes the ac mains voltage and changes to the 5V dc required by the logic chips is a power electronic circuit.

Power Electronics Applications can be divided into seven categories:

- Residential, Refrigeration and Freezers, Air Conditioning, Cooking, Washing machines, etc,
- Commercial
- Industrial
- Transportation
- Utility systems
- Aerospace
- Telecommunications

The project is divided into five Chapters. Some topics like Fourier Analysis, Switching Function technique are reviewed in the Appendices at the end of the project.

Each Chapter begins with an overall introduction of what is presented in it. Then, it presents the detailed examination of each circuit (operation, power circuit, modes of operation, timing diagrams, etc).

Chapter 1 presents DC to DC Converters. In it they examine two configurations, the Step-up and the Step-down Converters.

Chapter 2 addresses DC to AC Converters. In this Chapter they are examine Single Pulse Single Phase Inverter and the Double Pulse Single Phase Inverter.

Chapter 3 presents AC to DC Converters. In this Chapter they are examine two circuits which are the Single Phase Full Wave thyristor controlled rectifier and the Three Phase Half Wave thyristor controlled rectifier.

Chapter 4 deals with AC to AC Converters. Single phase cycloconverters are examined in some detailed in this chapter.

Chapter 5 presents conclusions and discussions that result from the examination of all circuits.

Finally, all Appendices are provided at the end. They provide a background theory or data that is used in the main text for understanding.