

HIGHER TECHNICAL INSTITUTE

ELECTRICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

DIGITAL AMPLIFIERS

CLASS D AMPLIFIER

E/1363

NEOPHYTOS NEOPHYTIDES

JUNE 2004

HIGHER TECHNICAL INSTITUTE ELECTRICAL ENGINEERING DEPARTMENT

DIGITAL AMPLIFIERS CLASS D AMPLIFIER

BY NEOPHYTOS NEOPHYTIDES

Project report submitted to the department
of Electrical Engineering of
the Higher Technical Institute,
Nicosia, Cyprus,
in partial fulfilment of the requirements
for the Diploma of Technician Engineer
in Electrical Engineering

June 2004

HIGHER TECHNICAL INSTITUTE	PROJECT NO 3519
----------------------------------	--------------------

CONTENTS

Acknowledgements	I
Summary	II
Terms used in amplifiers	1
Chapter 1	8
Introduction—What is a power amplifier	9
1.1 Class D power amplifier operation	10
1.2 History of class D	12
Chapter 2	14
Background	15
2.1 The difference between linear and switch mode amplifier	15
2.2 Amplifier classes	16
2.2.1 Class A amplifier	16
2.2.2 Class B amplifier	17
2.2.3 Class AB amplifier	18
2.2.4 Class C amplifier	19
2.2.5 Class D amplifier	20
2.2.6 Other classes of amplifiers	21
Chapter 3	22
Design theory	23
3.1 Pulse width modulation (PWM) technique	23
3.2 Switching and conduction losses	25
3.3 Shoot-through	26

3.4 Output filter-Demodulation of the PWM	26
3.5 Close loop control-Negative feedback	27
3.5.1 Close loop system	28
3.5.2 Gain and phase margins	29
Chapter 4	30
Design implementation	31
4.1 Input stage	31
4.1.1 Triangular wave generation	32
4.2 Pulse width modulation (PWM) stage	35
4.3 Power stage	36
4.3.1 Using a single NPN BJT transistor	36
4.3.2 Using two BJT transistors (NPN, PNP)	37
4.3.3 Using a single IC as a non-inverting amplifier	38
4.3.4 Using MOSFETs	39
4.4 Output filter stage	41
Chapter 5	43
Design results	44
5.1 Result on the carrier generation stage	44
5.2 PWM stage	44
5.3 Power stage	45
5.4 Output filter (demodulation stage)	46
Chapter 6	47
Conclusion	48
Future work	48
References	49

with (name)
Mr O Larré
project pers

I would like
Mr Michael
contribution

And of us
11

Acknowledgements

With gratitude, I would like to express my sincere thanks to my project supervisor Mr.D.Lambrianides for his helpful assistance and guidance offered during the project period.

I would also like to express my thanks to the lab assistants Mr.Costas and Mr.Michael of the electrical engineering department for their useful help and contribution in this project.

And of course I would like to thank my family and friends for their moral support.

Summary

The purpose of this project is the design of a high efficiency, compact size class D power amplifier. Also it involves a general study of conventional and digital amplifiers.

This design will consist of 4 stages. The input stage, the PWM (Pulse Width Modulation) stage, the power stage and output filter stage.