HIGHER TECHNICAL INSTITUTE

ELECTRICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

FIRING CIRCUITS IN POWER ELECTRONIC SYSTEM

E. 1232

BY: CHARALAMBOUS SOLOMOS

JUNE 2000

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SUBMITTED BY : Charalambous Solomos

In partial satisfaction of the award of diploma of technician Engineer in Electrical Engineering of the Higher Technical Institute of Cyprus.

PROJECT SUPERVISOR:DR CC MAROUCHOS

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This project is dedicated to my family and my friends who gave me strength during the construction of the project.

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CONTENTS.

SUMMARY

Firing circuits in power electronic systems by Charalambous Solomos.

This project deals with the design and construction of thyristor driving circuits using op-amps, gates and the SG3524 regulating pulse width modulator.

The first chapter deals with the thyristor in general, its characteristics, and its gate requirements, how to turn it on, how to turn it off, applications etc.

The second chapter deals with thyristor firing circuits. It refers to the requirements of firing circuits and presents some typical firing circuits. It also refers to some gate protection circuits.

The third chapter deals with design, construction, and testing of a firing circuit using the 741CN op-amp. It analyses each of the six parts of the circuit in detail and provides waveforms for the output of each part. It also provides detailed pictures of the finished box containing the driving circuit and also pictures of the complex internal wiring of the circuit.

The fourth chapter deals with the construction and testing of a dual output driving circuit using the SG3524 regulating pulse width modulator.

Introduction

Power electronics is based primarily on the switching of power semiconductor devices. With the development of power semiconductor technology the power handling capabilities and the switching speed of the power devices have improved tremendously.

In 1956 the first thyristor was invented in the Bell laboratories and until 1970 the conventional thyristors had been used for power control in industrial applications.

A thyristor as we know has three terminals, an anode, a cathode and a gate. When a small current is passed through the gate terminal the thyristor conducts, provided that the anode terminal is at a higher potential than the cathode. Once a thyristor is in the conduction mode the gate driving circuit has no control and the thyristor continues to conduct. It can be turned off by making the potential of the anode equal to or less than the cathode potential.

Based on the above information we needed to construct some circuits using today's technology in order to control the on and off states of the thyristor or silicon controlled rectifier as it was defined in 1956. This is basically the idea of the project that will follow. The construction of some thyristor firing circuits, which will connect to the gate of the thyristor and provide sufficient current for sufficient time so as to turn on the thyristor.

In this project we will deal with the construction of two thyristor driving circuits. The first one will be able to control a single thyristor only while the second one will be able to control two thyristors.

The first circuit can be connected to the gate of a single power thyristor in order to turn on a large motor. Of course a large heat sink must be used in order to cool down the thyristor otherwise it will get burned due to the excessive heat. By conducting this experiment various results can be obtained like the current and voltage required to turn on the thyristor. Also this circuit can be used to control the thyristor in a single-phase half wave rectifier.

The second circuit can be used in applications involving two thyristors like a dc to ac converter. By employing more than one of these circuits we can control circuits involving more than one thyristors like a full wave rectifier, a square wave inverter, a complementary impulse-commutated inverter.

Also the fact that ready made driving circuits were too expensive to buy played an important role in the decision to design and construct the thyristor driving circuits that are going to be presented in the chapters to follow.