

## CHAPTER I

### INTRODUCTION



#### 1.1 Introduction

The introduction of transistors and other semiconductor devices have been well-established since the late 1940's. The interest in all types of dc power supplies including dc inverters and converters have grown considerably rapidly. In particular, a dc regulation power supply is playing an important role to all electronics equipment and there are several methods of obtaining stabilized dc power supplies. In the simplest form, a dc power supply may consist of a transformer, a rectifier circuit and also a smoothing circuit. The most popular circuits which are commonly used at present time may be divided into four main groups as follows.

##### (a) Controlled Ferroresonant Transformer<sup>5</sup>

This is a conventional approach which uses a 50 Hz transformer or ferroresonant transformer to step down the line voltage for the rectifier and regulator circuits. It has been more economical in the past, but is bulky and generates more heat than the high frequency approaches.

##### (b) SCR Phase Control<sup>7</sup>

This approach uses a high voltage regulator to power the inverter which drives the low voltage rectifiers and filters. The SCR may be preferred because the economy is concerned.

##### (c) Linear Regulator<sup>7</sup>

The term linear regulator power supply denotes a circuit which obeys a proportional control with continuous regulation.

Linear regulator power supplies can be of either a shunt or a series type.

(d) Switching Regulator<sup>4</sup>

This system is similar to those of SCR except that the regulation is accomplished in the inverter circuit by using pulse control techniques. It conserves power devices but does require a more elaborate high current LC output filter. This appears to be the most practical approach because the power is handled only once and its regulation is sufficient for most applications.

It can be seen that this type of dc power supplies is now considered for use in most new designs and becomes a very popular topic among design engineers.

## 1.2 Historical Background

It is known that the linear or series-pass regulator has been employed in many electronic equipments for a long time. Several series voltage regulator circuits have been well published by many authors. This type of dc power supplies has some advantages due to its easy construction and design. However, for some kind of works that require dc power continuously, a dc series regulator may not be satisfied those situations because it has low efficiency.

The switching mode regulator is just coming of age and is able to replace the linear regulator in several applications such as communication equipment, process control equipment and a present day digital computer system. A switching mode dc power supply which is the power supply without transformer is now a proven design concept and being

considered for use recently in the market. This new idea of designs has become a very popular topic of conversation among the electronic engineers.

In 1950,<sup>2</sup> a switching transistor or SCR has been operated at pulse repetition rates around 2500 Hz. Later, this switching frequency was raised up to 10 KHz, but these frequencies are in the audio-range the problem of acoustic noise occurs, and therefore switching techniques are not commonly well known because they used to have certain difficulty due to noise. The age of switching regulator dc power supplies began when William Dudley and Robert D. Peck<sup>2</sup> had designed and constructed a switching regulator which had been employed in many electronic equipments. Recently, high speed semiconductors have been greatly developed and switching techniques are more practically used in several electronic circuits. Transistors that are rated at 400 volts and can switch up to 5 amperes in a switching time of less than 0.1  $\mu$ s are now available at reasonable prices. Concurrently, high current, and fast recovery rectifiers, new ferrite materials with high-efficiency magnetic properties are also available from the manufacture. It is therefore possible to design a switching dc power supply to operate at a high pulse repetition rate above the audio range in order to overcome the difficulty of acoustic noise problem.

### 1.3 Purpose of the Research

The purpose of the thesis is to study the behaviour of the switching regulator dc power supply and design a prototype power supply in order to prove the new concept about the switching mode regulator. The mathematical analysis of this system is also provided for an easy reference. The sequence of this research may be summarized as follows.

(a) Study a method of construction a switching regulator dc power supply.

(b) Study the performance and characteristic of the switching regulator system with a negative feedback path.

(c) Compare the advantage and disadvantage of the switching regulator with the linear dc power supplies.

### 1.5 Outline of the work.

The outlines of this research may be summarized as follows.

(a) The block diagrams and the system description about the switching regulator system are presented in chapter 2

(b) A typical model and analysis of the switching regulator is presented in chapter 3

(c) A high frequency transformer design is illustrated in chapter 4

(d) A step by step design of the circuits and systems of the switching regulator are described in chapter 5

(e) Conclusions and discussion are summarized in chapter 6.

(f) Related data and informations are also given in appendices.