CHAPTER I

INTRODUCTION

Introduction

Generally the graph recorder or the tape recorder is used in scientific and industrial field for recording low frequency signal. Those equipments are rather expensive and need special design for particular purpose, such as rate of fluid flow, temperature change, rate of change of conductivity, and rate of change of pressure, etc.

This research is done in order to find out what is the most economical way of data recording and storing media. The answer to the abovementioned question is an ordinary recorder and cassette tape by using different recording techniques via data translator.

The data translator will enable analog data from D.C to 300 Hz or digital data up to 600 bits/sec so that they can be recorded on almost low-cost cassette. Subsequently this information can be played back and reproduced through the translator at any desired instant.

In a similar manner as in audio recorder (1), the input signal which is converted into a suitable high frequency signal for commercial recorder will produce a magnetic field on a magnetic head and this magnetic field magnetizes the tape which passes along the head. The magnetic signal thus on the tape will correspond to the signal applied to the head.

The major difference between direct recording which is the conventional method of recording changes in signal amplitude as it varies the size of magnetic pulses on the moving tape, and the recording through the translator is then attributed to the frequency ranges in which they operate. Direct recording operates in the frequency ranges which extend from 30 Hz to 20 KHz. This gives optimum reproduction fidelity when frequency is several hundred cycles or more. But most of the scientific and industrial phenomena takes place at frequency between a few Hz and 1 KHz, this low frequency information demands special electronical steps.

This research describes how the signal is processed and how it is recorded on the tape in an optimum manner and low cost. In this respect an essential factor is the speed of the tape related to the head and air-gap in the head.

The Limitation of Tape Recorder (2)

When a tape passes the air-gap of a record head, this tape will be magnetized by alternating magnetic field in the head which is produced by the input signal. The frequency band which can thus be recorded and reproduced is limited by a number of factors. Some of these are

- The speed of the tape related to the head.
- The width of the air-gap in the head.

1. Tape Speed

When a signal is written on a tape, this requires a certain length of tape. One period of this signal covers a small part of the tape length. The length of this small part of tape occupied by

one period is determined by the frequency of signal and speed of the tape.

$$\text{Wave length} = \frac{\text{tape speed}}{\text{frequency}}$$

As the period becomes shorter the distance covered by the tape is shortened. For high frequency, the length of tape occupied by one period is so small that various periods can no longer be distinguished from each other. However, if the tape speed is increased, each period will cover a greater length of tape, and the same high frequency can now be distinguished. It obviously shows that the maximum frequency that can be recorded and reproduced increases as the tape speed increases.

2. The Width of Air-gap

The width "l" of air-gap also limits the maximum frequency that can be recorded and reproduced. The smaller the air-gap, the shorter the length of tape on which one period of the written signal will be. A small length of tape in this case means a high frequency.

The magnetization strength determines the magnitude of the signal. The maximum magnetization is obtained if one pole of the head corresponds to a south pole (or north pole) of the tape and the other side corresponds to a north pole (or south pole) respectively.

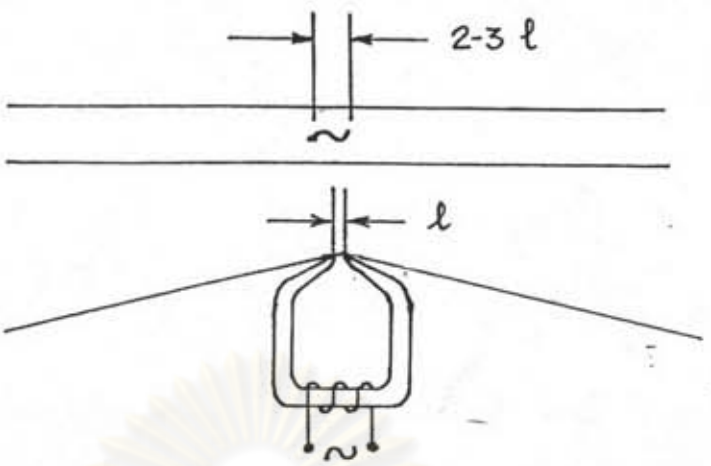

Figure 1 : The air-gap of tape head

This magnetization is obtained when one period of the tape occupies a length of two to three times the width of the air-gap. At higher frequencies magnetization will decrease again if the period on the tape is equal to the gap width, the head is no longer magnetized and the output signal becomes zero.

Low frequencies occupy a greater length of tape for one period. The difference between the strength of magnetic field near one pole of the head and field near the other pole is not much. This difference becomes less as frequencies decrease.

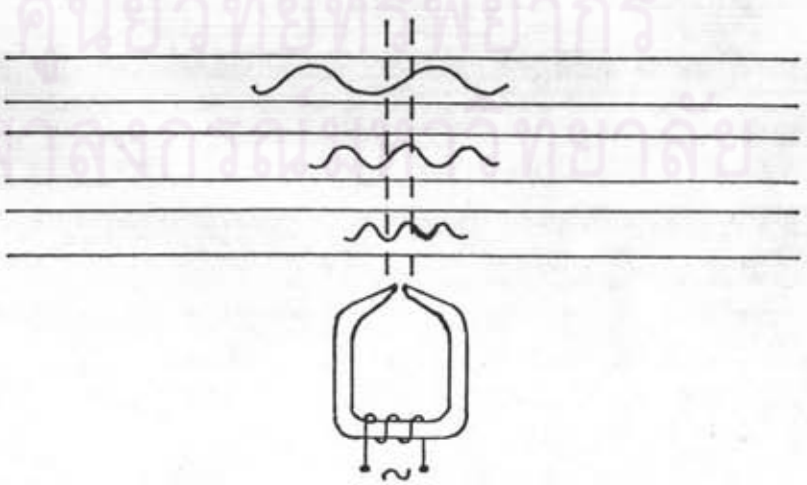

Figure 2 : Magnetic field at various frequencies

As the strength of the output signal of the head is proportional to the difference in strength of magnetic fields, the output signal will also be less. Thus, the air-gap will limit the frequency range that can be recorded on low frequency end.

3. Innovation of Low Frequency Recording and Reproducing (3)

At low frequency, the small effect of magnetization difference will determine the small amplitude variations of the record signal. Therefore, frequency modulation technique is introduced to overcome this problem.

For frequency modulation, carrier frequency is more important than carrier amplitude and less susceptible to noise. However, the use of frequency modulation has some inherent limitation that tape speed must be kept constantly, since any deviation in tape speed will appear as a change in carrier frequency and will effect the signal amplitude both recording and reproducing.

Purpose of Research

The purpose of this thesis is to study the behaviour of commercial tape recorder, design and construct data translator by using electronics components that can easily be found in the local market. The sequence of this research may be summarized as follows:-

1. Study the performance and characteristic of commercial tape recorder.
2. Design and construct the prototype data translator.
3. Testing data translator with various waveform inputs.

Outline of Work

The outline of this research may be summarized as follows:-

1. The block diagram and specification are presented in Chapter II.
2. The step by step design of the circuits are described in Chapter II.
3. Results and discussions are summarized in Chapter III.
4. Conclusion and suggestions for future research are summarized in Chapter IV.
5. Related data and information are also given in appendices.