"I have read this report and in my opinion, it is suitable in term of scope and quality for the purpose of awarding The Bachelor Degree in Electronic Engineering (Industrial Electronic)"

Signature : .....

Name of Supervisor : Puan Anis Suhaila Bt. Mohd. Zain

Date : .....1April 2005.....

DIGITAL AUDIO FREQUENCY METER

HASNIZAH BINTI HJ. GENO

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Faculty of Electronic Engineering and Computer Engineering
Kolej Universiti Teknikal Kebangsaan Malaysia

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"I hereby declared that this report is the result of my own effort except as clearly stated in the source of reference"

Signature : .....

Name of Author : HASNIZAH BT. GENO

Date : .....1April 2005.....

To my beloved parent, brother's and sister's

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ABSTRACT

Instrumentation system can be divided into two broad categories, analog system and digital system. With progressing technology, digital meter is design to make the measuring value more accurate. The project of digital audio frequency meter is the hardware design to detect the frequency value of a given an audio signal. The frequency meter will detect the sound and display frequency measured. The sound can be from speech, any musical instrument or a stereo system then will convert the signal into digital that applied in a combination of 7 segment to display. The Digital Audio Frequency Meter capable to measure the audible sound frequency that measure in Hertz in between 90 Hz to 1999Hz.A device can be apply to many kind of circuit such as in computer to detect the sound and measure the frequency to solve the problem setting an equalizer in order to obtain a flatter frequency response.

ABSTRAK

Sistem instrumentasi terbahagi kepada dua kategori iaitu sistem analog dan sistem didgital. Dengan kemajuan teknologi, meter digital direkabentuk untuk mengukur nilai frequenci dengan lebih tepat.. Meter digital frekuensi audio akan mengesan frekuensi bunyi dan memaparkan nilainya. Isyarat bunyi adalah hasil daripada percakapan, sebarang penggunaan alatan muzik atau stereo sistem yang kemudiannya akan ditukarkan ke dalam bentuk digital dan dipaparkan menggunakan gabungan 7-paparan. Meter digital frekuensi audio ini berkebolehan untuk mengukur frekuensi bunyi dalam unit Hertz bagi julat audio diantara 90Hz hingga 1999Hz.Peralatan ini boleh diaplikasikan pada pelbagai jenis litar untuk mengesan bunyi audio dan mengukur frekuensi bunyi tersebut.

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T	-	Time
F	-	Frequency
R	-	Resistance
C	-	Capacitor
IC	-	Integrated Circuit
PCB	-	Printed Circuit Board
PIC	-	Peripheral Interface Control
Hz	-	Hertz
KHz	-	KiloHertz (10^3 Hz)
MHz	-	MegaHertz (10^6 Hz)
GHz	-	GigaHertz (10^9 Hz)
Thz	-	TetaHertz (10^{12}Hz)
Phz	-	PetaHertz (10^{15} Hz)
Ehz	-	EkaHertz (10^{18} Hz)

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CHAPTER I

INTRODUCTION

1.1 OVERVIEW

The development of Digital Audio Frequency Meter was simplified an accurate frequency measurement. Usually to measure the frequency, calculation in manual process is make although the modern technology is used. With the literature review, Digital Audio Frequency Meter is design to make the measuring value more accurate and no more manual calculation is needed.

The project of digital audio frequency meter is design to detect the frequency value of a given audio signal (sound) and displays the frequency measured. The sound can be from speech, any musical instrument or a stereo system then will convert the signal into digital then display the value in 7-segment combination. The combination of 7-segment capable to display the frequency followed the range. The project can stand-alone or can be applied to many kind of circuit such as in computer to detect the sound and measure the frequency to solve the problem setting in music instrument.

1.2 PROJECT OBJECTIVE

An objective of this project is to measure audio frequency and shows the value of audio frequency in digital. Digital concept of measurement equipment makes the measurement process become easier. The idea of this circuit is to keep the design as simple as possible. The goal is to reduce the cost of hi-precision measurement instrument that are utterly expensive and also completely too much of a good thing for any common audiophile's purpose. The project can help kind of process which user needs to know value of frequency. Objective of this project is also to gain knowledge about circuit design and learn how to produce one new project or product by the combination circuit.

1.3 SCOPE OF PROJECT

Scope of their project is a circumstance of limitation Digital Audio Frequency Meter. The application of this project is applied:

a) To electronic equipment (music instrument)

Generally in recording studio used music instruments that need adjustment. Digital Audio Frequency Meter is one of electronic equipment that can help process adjustment to make modifying process quality become easier. It's because like an equalizer offer the capability of both compensating for defects and fine-tuning the system. Equalizer groups the frequency spectrum into band of various sizes and then use electronic adjustment to modify those bands by increasing or decreasing their power to achieve a reasonably flat frequency response. Adjustment is so difficult because of the value of frequency is unknown. The frequency spectrum can be divided up

division. Typical frequency bands are bass, mid bass, mid-range and treble or high frequencies. So digital audio frequency meter is needed to measure the frequency audio at the time. When the frequency is known, modifying is making at what band for the frequency value measured.

b) Combination circuit

Digital audio frequency meter is also can be categorized as floating circuit. This circuit can combine with another circuit and give the output in another way and function. This circuit can combine at kind of circuit like television circuit, radio or computer circuit. Combination circuit at computer is maybe needed when the computer is used as laboratory equipment or as accessories of television and radio.

1.4 PROBLEM STATEMENT

Problem of this project was found after literature review process is done. Among the problem to be studied is the value of frequency difficult to read in analog. The development of Digital Audio Frequency Meter has simplified accurate frequency measurement. That also cause of hi-precision measurement instruments are utterly expensive and hard to find. Meanwhile hi-precision measurement instruments completely too much of a good thing for any common audiophile's purpose like function generator and oscilloscopes. Although the function generator has an advantage like widely range frequency measurement, limitation of use will misspend the advantage and also the price. Most of oscilloscope usage, frequency is measured in analog and user must to calculate the division first and multiply with the scale to get a time for one cycle before get a value of frequency using formula.

1.5 METHODOLOGY

The project was carried out in sequence while research was performed in parallel time with the project development. Initially the range of frequency measure to be developed had not been determined as an objective. Thus, the research was performed throughout the course of the year. The research pertained to theory of design and the benefits and drawbacks of this type of education. Digital audio frequency meter is developed by using calculation, troubleshoots and tries and error method. When the Digital Audio Frequency Meter was completed, the effectiveness was evaluated by testing the project.

1.6 REPORT OUTLINE

This report document has been arranged into four chapters. Chapter one was meant to be a general introduction and outline of the report project. This chapter provides an introduction to the proposed report project. The objectives of the project and the methodology used to implement these objectives were discussed. A literature review was given in chapter two in this report to provide insight into the background and previous product related. Chapter three discuss the methodology of Digital Audio Frequency Meter which were developed and implemented. Project finding is discussed in chapter four, meanwhile chapter five is an overall summary and conclusion of the project. A summary of the project, accomplishments and any further project that could be done is discussed. Some future prospects for this project have been suggested.

CHAPTER II

LITERATURE REVIEW

2.1 OVERVIEW

This chapter discuss about literature review to provide insight into the background and previous work related to this project to developed and implemented.

2.2 AUDIO FREQUENCY BACKGROUND

Frequencies that produce sound waves audible to humans are said to be audio frequencies (AF). According the Stanley Wolf and Richard F.M Smith [1], audio is a Latin word meaning " I hear " which is why the term audio frequency ranges includes all of the frequencies that the human voice can produce and the human ear can respond. An electronic device, digital audio frequency meter is used to detect the frequency value of a given audio signal. It measures the level of the frequency sound generated by a musical instrument, a stereo system or speech, by means of a built-in microphone. A device converts the signal in digital meter.

Measurement in hertz of the frequency of force exerted by a sound wave on the environment with increasing pressure generating increased loudness or higher volume (creating more pressure in the ear increases perceived loudness). Frequency level is essentially how loud a sound is. Very loud sounds, such as aeroplane engines, have high frequency level. The maximum level of human hearing is around 20kHz, which is the level where people begin to pain due to the high frequency. Conversely, soft sounds have low sound frequency levels. 20 Hz is the minimum level that would be a very low sound that would almost feel instead of hears.

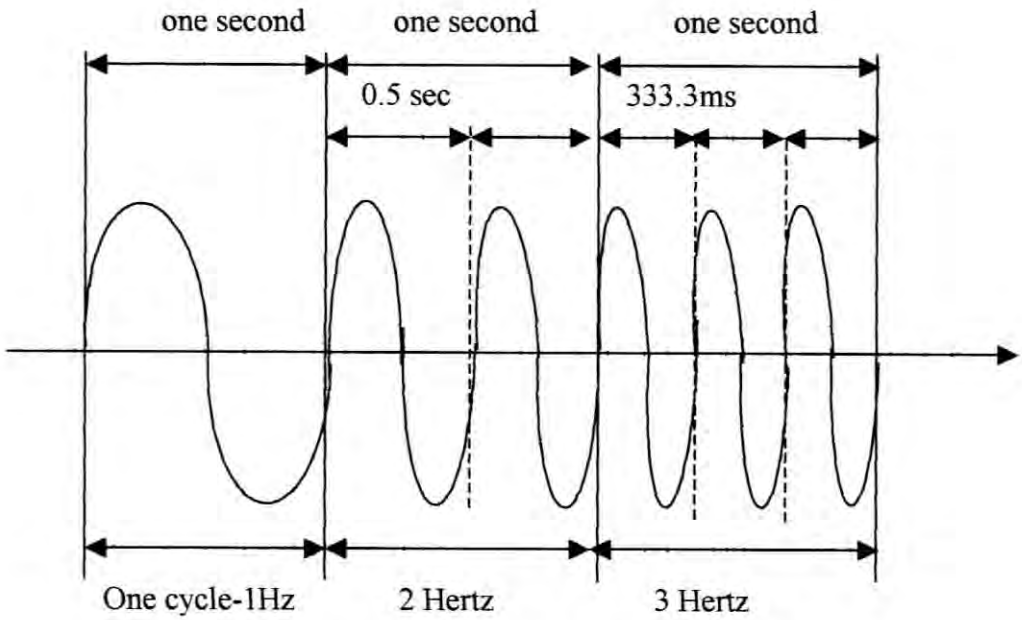

Figure 2.1: Frequency Measurement

Figure 2.1 show how the frequency measurement is made based on the wave. Frequency is the number of repeating occurrences of a particular distinct and complete element (the positive and negative crest and trough of a single sound wave in audio) in a given time (one second). A 20 Hz frequency contains 20 cycles of individual components each second (think of 20 distinct waves passing by in one second) or a 20kHz frequency contains 20000 cycles per second. It also can prove by the equation.

$$f = 1 / T \quad (2.1)$$

f = frequency

T = time

According in example of frequency measurement in Figure 1, the wave shown that the cycle complete by one second, then has two cycles complete in one second and also three cycles complete in one second. The value of frequency is calculate by:

$$f = 1 / T$$

$$f = 1/ 1\text{second}$$
$$= 1\ \text{Hz}$$

$$f = 1/ 0.5\ \text{second}$$
$$= 2\text{Hz}$$

$$f = 1/ 333.3\text{mili second}$$
$$= 3\text{Hz}$$

2.3 LITERATURE REVIEW

Many equipment of measurement are available to use. They are used primarily to measure the frequency of ac power, 60 Hz. However, such instruments do not have a wide frequency range. The most common instruments available for the measurement of audio frequencies are oscilloscopes and frequency counters. Vast majorities of this equipment have potential to measure high frequencies with different usage method. For this project development, three type of frequency measurement is used for analysis. There are function generator, oscilloscope and frequency counter.

2.3.1 Function Generator Analysis

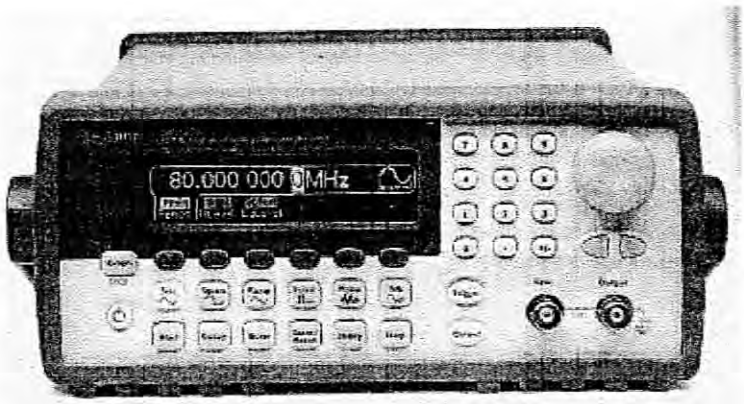

Figure 2.2:Function/Arbitary Waveform Synthesizer (Source from Agilent)

Function generator is used as a product of literature review. A function generator is to generate or outputting any of the major waveform including sine waves, square waves, pulses, triangular waves and ramps. User typically use pulse

generators to create pulses for characterizing digital devices. A pulse generator is well suited for applications that require fast transition times, high accuracy or frequencies. A function generator offers multiple channels, pattern generation, double pulses, RZ (return-to-zero) pulses, and the ability to add jitter to the pulse train. These applications include creating trigger signals, clock signals, and controlling logic. Usually the function generator specify the parameters for a pulse either:

a. Shortest and longest period
b. Shortest and longest pulse width expressed in either seconds or duty cycle percentage.
c. Shortest and longest variable edge time,
d. Percentage overshoot
e. Jitter, expressed as a percentage or ppm.

The function generator 33250A that created by Agilent is a modern function/arbitrary waveform generator that has built-in 50 MHz pulse capability. Pulse parameter. Specifications for the 33250A are listed in Table 2.1.

Table 2.1: 33250A Specification

Period	20.00 ns to 2000.0 s
Pulse width	8.0 ns to 1999.9 s
Variable edge time 5	5.00 ns to 1.00 ms
Overshoot	<5%
Jitter	100 ppm + 50 ps

The function generators offer robust pulse functionality meanwhile completely too much of a good thing for any common audiophile's purpose. Although function generator has an advantage like widely range frequency measurement, limitation of use by user will misspend the advantage and also the price.