# DESIGN AND CONSTRUCTION

# OF

# AUTOMATIC TIME SOUNDER

BY

ALIYU IDRIS BALARABE

REG. NO: 97/5936EE

DEPARTMENT OF ELECTRICAL& COMPUTER ENGINEERING

SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY

FEDERAL UNIVERSITY OF TECNOLOGY

MINNA, NIGERIA.

SEPTEMBER, 2003

# DESIGN AND CONSTRUCTION

# OF

# AUTOMATIC TIME SOUNDER

BY

ALIYU IDRIS BALARABE

REG. NO: 97/5936EE

A PROJECT SUBMTTED TO THE DEPARTMENT OF ELECTRICAL

ENGINEERING

SCHOOL OF ENGINEERING & ENGINEERING TECHNOLOGY

FEERAL UNVERSITY OF TECHNOLOGY MINNA

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF

BACHELOR OF ENGINEERING (B.ENG) DEGREE IN ELECTRICAL AND

COMPUTER ENGINEERING

SEPTEMBER, 2003

## CERTIFICATION

This is to certify that the work titled "DESIGN AND CONSTRUCTION OF AUTOMATIC TIME SOUNDER" was carried out by **Aliyu Idris Balarabe** under the supervision of **Mr. S.N. Rumala** of the Department of Electrical & Computer Engineering, Federal University of Technology, Minna.

Mr. S.N. Rumala
(Project Supervisor)

Sign/Date

Engr. M.N. Nwohu
(H.O.D)

28/4/04
Sign/Date

External Examiner

Sign/Date

# DECLARATION

I hereby declare that this project work is an original concept completely carried out by me under the supervision of **Mr. S. N. Rumala** of the Electrical & Computer Engineering department, Federal University of Technology, Minna.

OCT. 16TH, 2003

**Aliyu Idris Balarabe** **Date**

**97/5936EE**

# DEDICATION

This project work is dedicated to my parents and to my late elder brother (Yusuf Aliyu).

.May his gentle soul rest in perfect peace. (Amen).

# ACKNOWLEDGEMENT

Praise be to God Almighty that has guided us to this extent by giving us life and good health to see the completion of this program.

My sincere appreciation to all those who contributed to my success financially, morally and otherwise. These individuals are too numerous to mention. May God reward them abundantly.

However I want to express my profound gratitude to all the lecturers of the Electrical &Computer Engineering Department particularly my lecturer and project supervisor **Mr. S.N. Rumala**. I must state that my supervisor provided almost all the idea and skills developed in this project work. I wish him good health long life and prosperous achievements.

I also wish to express my gratitude to the following members of my group who took part with me in carrying out the project successfully. They include Abenemi Abel, Ibrahim Abdulmalik and Mahmud Abdullahi. It has been wonderful working with you all.

Finally, all information derived from published work of others has been acknowledged.

# ABSTRACT

The automatic time sounder is a device, which incorporates an alarm clock with hourly chime into a power amplifier to give a louder output. An IC based power amplifier without feedback is used to amplify the low-level frequency signal of the clock melody output. It also comprises of a preamplifier to amplify and couple the low frequency signal of the microphone into the power amplifier for public addressing and other related purposes. The device could be described as a two input one output device. The clock melody and the microphone serve as the input devices while the megaphone is the output device.

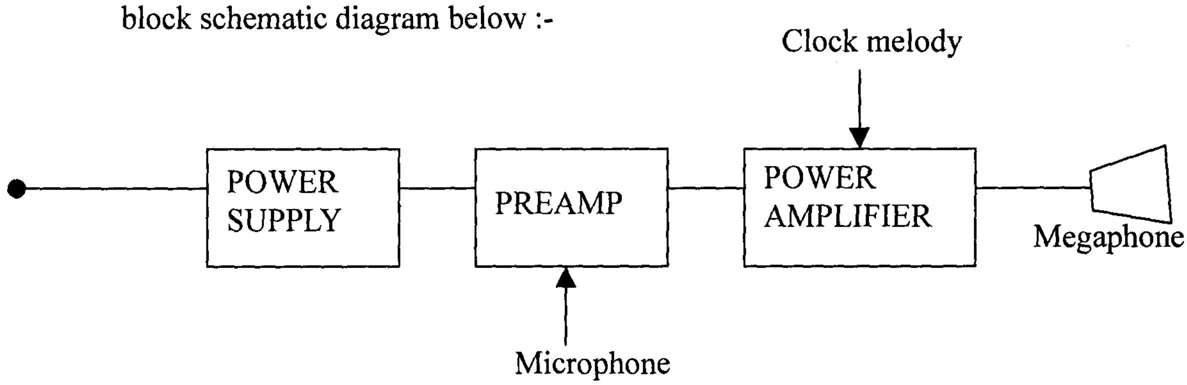
The design and construction of the automatic time sounder device demonstrates a simple application of the power amplifier to produce an output signal of exact replica similar in phase but with a higher amplitude with the original input signal.

# TABLE OF CONTENTS

# CHAPTER ONE

## 1.0 INTRODUCTION

The significance of time in all human endeavors cannot be overemphasized. It is therefore very necessary and important to provide a means of timing to aid human being in achieving a particular aim at the appropriate time. This particular timing device is designed to tell the time by means of an hourly and half hourly chime. It consists of a clock with inbuilt melody system to strike the time hourly. The entire device consists of three different units with each unit performing a particular function according to the design purpose. The different units are thus presented in block schematic diagram below :-




The major units of the system are listed below.

1. The power supply unit,
2. The preamplifier unit and
3. The power amplifier unit.

The clock and alarm form an external segment of the system, but it is powered through the zener voltage regulator and voltage divider circuit in the system.

Since timing is a continuous process and cannot be stopped, the need for a

Stable power supply without any interruption is a must. This is the reason why the entire system is powered by means of a lead-acid battery. The battery is placed on float charge to avoid rundown when discharging to the circuit. The charging unit is a full wave bridge rectifier connected to the battery terminals to charge the battery when the AC mains supply is on.

The preamplifier unit consists of simple microphone preamp to match the low frequency signal of the microphone into the power amplifier. The analysis of the types and mode of operation of the system is presented in the subsequent chapters of this work.

In the design and construction of the automatic time sounder device, the basic principle of circuit operations in each section of the system depend on certain parameters which were evaluated by means of theoretical assumptions and calculations to achieve the desired objective. As a beginner in circuit design, a simple design approach was adopted by means of testing each particular section under design to minimize errors.

The device is packaged in metal case that can be loosed when troubleshooting. It is of moderate size and shape for easy handling.

## 1.1 OBJECTIVES AND MOTIVATION

The main objective of this project work is to design and construct an automatic time sounder. This device provides a means of easy timing through a voice signal that can be heard from a long distance away from the source generated by the clock alarm, which strikes the number of hour(s). Also the device is to be used as a public addressing system to ease communication within the campus environment.

Despite that the device is primarily meant for time sounding and public addressing, the designed device is also intended to serve for some other purposes especially in religious activities. This is the major reason that motivated me to design this particular system.

## 1.2 LITERATURE REVIEW

Automatic time sounder of this kind is not the first of its kind because some similar devices have been in existence for timing purposes. This particular time sounder can be considered as a modified alarm clock sounder. Some major clocks that have been in use for quite a long period include the following;

(a) The Ogee clock: this clock sometimes called Og clock originated in the USA at about 1830. It is distinguished by a case on the outer edges that are curved into an S-shape (Ogee)

(b) The long case clock: This particular clock is also known as the grandfather clock. It is a tall pendulum clock enclosed in a wooden case that stands on the floor

(c) The Banjo clock

(d) Cesium clock: Also known as quantum mechanism.

(e) The bracket clock; this is the English pendulum clock.

However, a more closely related alarm clock to the one used is the ***WILLARD SIMON*** (1753) clock of the USA. He invented the brass movement clocks from 1765 to 1850.Particularly the alarm clock came to being by same Willard in the year 1819.

This particular automatic time sounder is designed in such a way that it can amplify the hourly chime to a fairly large distance from the source.

## 1.3 PROJECT OULINE

The concept of this project can be understood better by means of giving a brief description of the layout of the contents. This thesis has been divided into four different chapters, with each chapter containing detailed explanations on a particular aspect/section of the project work.

Beginning with chapter one, the entire project work is being introduced generally and an overview of related work is also presented. The chapter also presents the major reason for carrying out the project as a whole.

In chapter two, the analysis of system design and circuit operation is presented. It also contains all the details of design procedure and calculations carried out before using the values.

Chapter three deals with the circuit construction and packaging of the entire circuit, which forms the complete system.

The last chapter that is chapter four presents the testing methodology and a brief explanation of the entire work.

# CHAPTER TWO

## 2.0 INTRODUCTION

This chapter deals with the different sections of the circuit including the design techniques and the theoretical assumptions and calculations.

In order to achieve a perfect circuit design, the theoretical knowledge and mode of operation of circuits and their particular components must be analyzed.

The design of the automatic time sounder is made up of three major units which will be considered one after the other in this part of the write-up.

## 2.1 SYSTEM DESIGN

The automatic time sounder derive circuit consist of three different sections identified by the functions they each perform in the system. It comprises of simple components and direct design approach to achieve the desired objective.

## 2.2 <u>POWER SUPPLY UNIT</u>

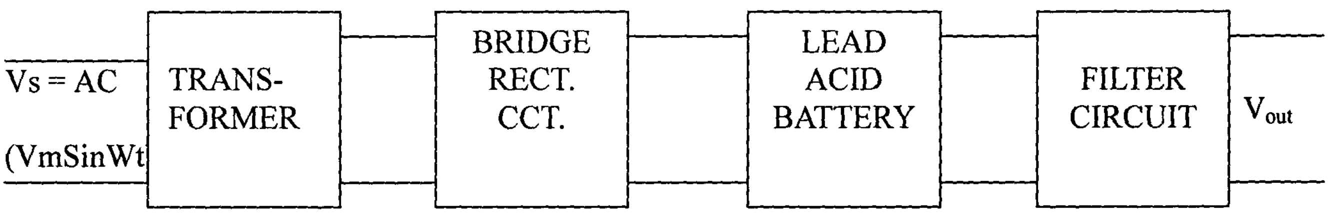



**Figure A: Block Diagram of power supply unit**

The design of the power supply unit consist of three segments. These include the full-wave bridge rectifier serving as a charging unit, the voltage step-down by means of a

Zener diode and the lead acid battery which powers the device and serves as a back-up during AC power off.

As mentioned in the previous chapter, the device is powered by means of the electrolytic battery supplying 12V DC to the entire circuit. The power supply section of the bridge rectifier is primarily meant for float charging of the battery to avoid run-down. The circuit diagram for the power supply unit is thus presented below.

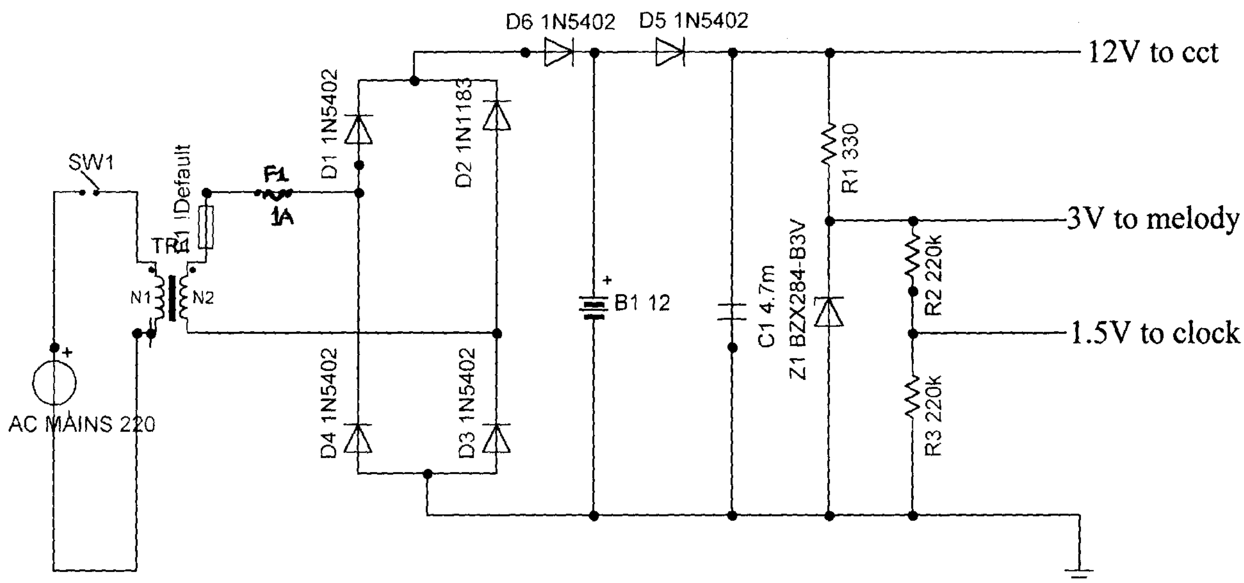



Fig 2.0 **Power Supply Circuit Diagram**

The power circuit connections shown in the above circuit diagram provides a means of enhancing a steady range of signal processing. The A. C. mains consist of 220V/240V AC (50HZ) signal passing through the primary side of the transformer. The transformer is rated to give 15VAC at the secondary side. However, an A.C. switch connected before the input to the transformer provides protection during high input current conditions because it has a fuse embedded into it.

As stated above, the transformer is a step-down transformer connected by means of a fuse to the circuit for continuous energy flow and processing.

## 2.3 CHARGING UNIT

The source of energy powering the entire circuit is from the 12V D.C battery. Thus it is necessary to provide a means of constantly preserving the stored energy in the battery otherwise it will fully discharge and run down. The charging unit consist of a full-wave bridge rectifier circuit.

The bridge rectifier is a four diodes channel connected in parallel with two each in series to form a bridge rectifier. The secondary side of the transformer which is normally an A.C. signal of the form $V = Vm\ Sin Wt$ assumes a sinusoidal wave form. By virtue of the diode mode of operation as a unidirectional device, the output of the transformer is applied through the anode-cathode joints of diodes $D_1$, $D_2$, $D_3$ and $D_4$ respectively is transformed into a pulsating d.c signal of 0HZ frequency. The combined cathode of Diodes D2 and D3 forms the position side in series with the positive terminal of the lead acid battery feedback to the joint of diodes $D_1$ and $D_4$ which is the negative terminal. The effect of overcharge cannot occur because the device is in constant operation, thus, discharging the battery which is placed on a float charge.

Diodes $D_5$ and $D_6$ are connected to provide a protection against back flow of energy when the mains source is off. Also, a shunt capacitor is connected across the output of the bridge rectifier to serve as a filter to the circuit. The capacitance value is chosen so large so as to minimize the ripple content of the rectifier output passing into the circuit.

## 2.4 VOLTAGE DIVIDER DESIGN

The voltage divider circuit consist of a Zener diode as the main circuit component for voltage regulations. A zener diode acts like a diode or closed switch when forward biased and the forward current increases as the applied voltage increases. When the diode is reverse biased, a small reverse current flows through the diode to a point where the diode reaches the zener breakdown region. At this point, the zener diode is able to maintain a fairly constant voltage as the current varies over a certain range. This action of the diode makes it provide excellent voltage regulation.

## 2.5 VOLTAGE REGULATION

The zener diode regulator has the ability of maintaining a constant output voltage even when either the input voltage or the load current varies. The zener action is achieved when the device is operating in its breakdown region. Atypical application circuit is shown in the figure below;

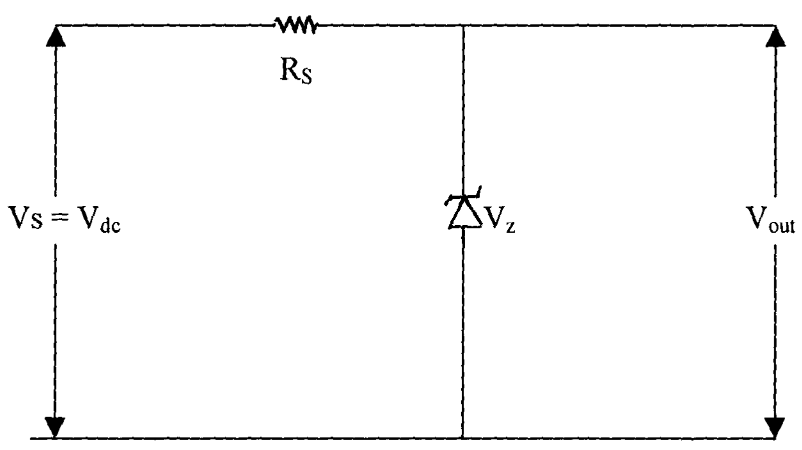



**Fig 2.2 Zener Regulator circuit**

### 2.6 ZENER REGULATOR CALCULATIONS

The voltage regulated is $V_{in}$ =12V which is the DC input, when the potential difference across the diode is greater than that of $V_Z$ i.e. 3V,the diode conducts. The load resistance Rl is the resistance of the clock melody unit, which is powered by a constant voltage Vout connected in parallel with diode.

Total current I passing through R is given by;

$$I = I_z + I_L \quad \text{.......................}(1)$$

Where;

Iz = maximum zener current

$I_L$ = load current

$V_{out} = V_z$ under all conditions

Also ; At $_{Iz\text{-}max}$, $I_L$=0

$$\text{Thus } R = \frac{V_{in} - V_{out}}{I_{z\text{-}max}} \quad \text{.......................}(2)$$

Equations (1) and (2) are the basis for calculating the current flowing through R and the series resistance(R) respectively.

From the data given for the zener diode (BZX84C):

Nominal voltage =3V

Minimum current =20mA

Load current = 50mA

Substituting the values into equation (1)

I = 50mA + 20mA

= 70mA

Also,

$$R = \frac{12.0 - 3.0}{70\ mA}$$

70mA

$$= \frac{9.0}{70mA}$$

$=128.6\Omega$

Maximum power rating of the zener is given as $P_{z\text{-}max} = 300mW$

But the power dissipated by the zener diode must be must be less than the maximum power rating. That is;

$$P_z < P_{z\text{-}max}$$

But

$$P_Z = IV_z \quad \text{.............................} \quad (3)$$

$$= (70mA)\,(3V)$$

$$= 210mW$$

Thus $P_z < P_{z\text{-}max}$

An approximate value of the series resistance was used to prevent the zener diode from easy breakdown due to overheating.

The voltage divider circuit is presented in the figure below;

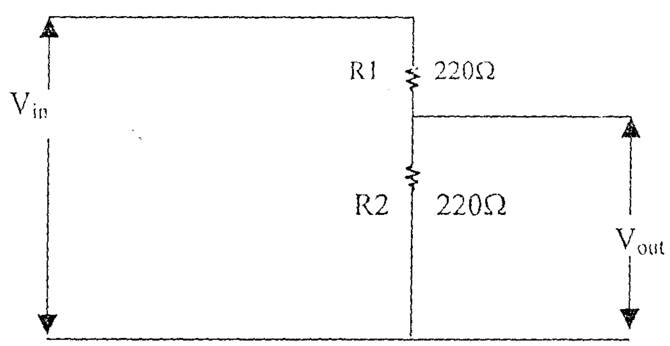



**Figure 2.3 voltage divider circuit**

Applying voltage divider theorem:

$$V_{out} = \frac{R_1\,(V_{in})}{R_1 + R_2} \quad \text{————————} \quad (4)$$

Substituting the values in the above equation;

$$Vout = \frac{220\ (3)}{220\ +}$$

$$= 1.5V$$

Current flowing into the clock;

$$I_{out} = \frac{V_{out}}{R_{eq}}$$

$$= \frac{V_{out}}{R1//R2}$$

$$R1//R2 = \frac{220*\ 220}{220\ +220}$$

$$= 110\Omega$$

Therefore;

$$Iout = \frac{1.5V}{110}$$

$$= 0.00136A$$

$$= 13.6mA$$

The current calculated approximately equals to the value measured from the clock.

## 2.7 PREAMPLIFIER UNIT

The preamplifier unit is made up of microphone amplifier to match the low frequency signal from the microphone into the power amplifier. It consist of a simple transistor amplifier circuit with two transistors directly coupled to form cascaded amplifier. The preamplifier circuit is shown in Fig. 2.4 below

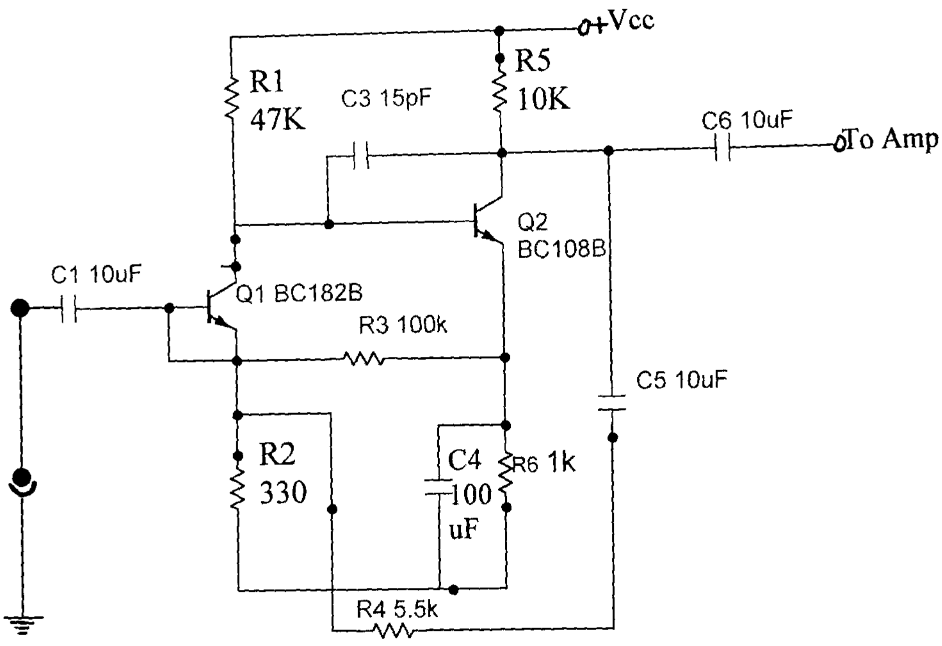



**Fig 2.4 Preamplifier Circuit**

## 2.8 MODE OF OPERATION

The input signal $V_i$ from the microphone is amplified by $Q_1$ with phase reverse because it is a common Emitter connection. The amplifier output of $Q_1$ appears across $R_1$ and this is coupled directly to the input of the $Q_2$. The signal at the base of $Q_2$ is further amplified and its phase is again reversed and the output appears across $R_4$. The output across $R_4$ is coupled by $C_5$ to the power amplifier.

Normally, the overall output of the cascaded amplifiers is twice the exact replica of the input signal Vi. The output signal V out is in phase with the input signal Vi because it has been reversed twice some of the basic features associated with this particular amplifier can be summarized as follows: -

1. The circuit can operate without the use of frequency sensitive components.
2. A.C signals with low frequencies are amplified by this type of preamplifier.

3. It has a simple circuit arrangement.

4. It is formed by direct coupling because the collector of $Q_1$ is directly coupled to the base of $Q_2$.

However, some limitations are associated with the preamplifier shown above. This is because it cannot amplify high frequency signal. Also any variation in Base current in one stage is amplified in the second stage thereby shifting the Q-point which results in poor temperature stability. This demerit has been checked out by using the emitter resistors $R_2$ and $R_5$.

## 2.9 GAIN CALCULATIONS

The ease the calculations, the circuit is reduced further to the one shown below:

**STAGE I**

$$\text{Voltage gain } (A_v) = \frac{R_1}{R_2}$$

$$= \frac{47000}{330}$$

$$= 142.424$$

$$= 142.4$$

**STAGE II**

$$A_{V2} = \frac{100k}{10k}$$

Overall gain

$$A_v = Av_1 \times Av_2$$
$$= 142.4 \times 10$$
$$= 1424$$

Gain due to feedback:

$Av_f = \frac{5.5 \times 10^3}{330}$ $Avf_2 = \frac{100 \times 10^3}{10^3}$

$= 16.67$ $= 100$

$= 16.7$ Total gain $= 16.7 \times 100$

$= 1666.67$

$= 1666.7$

Overall gain in dB

$Ap = Av.\ A_f$

$= 16.667 \times 100$

$= 1666.67$

$Civ = 10Log_{10}\ ^{1666.7}$

$= 10\ (3.2219)$

$= 32.22$

$= \underline{32.2dB}$

Base current of Q2 = collector current of Q1

$I_{C1} = I_{b2} = \frac{Vi}{R_1}$

$= \frac{12V}{47 \times 10^3} = 0.00026A$

$= \underline{0.26mA}$

collector current of Q2

$I_{C2} = \frac{Vi}{R_3} = \frac{12V}{10K}$

0.0012A

$= \underline{1.2mA}$

Emitter current of $Q_2$ = Bass current of $Q_1$

$$I_{E2} = I_{B1}$$

$$= {}^{Vi}/_{R4//R5}$$

$$R_4//R_5 = \frac{100k \times 1k}{100k + 1k}$$

$$= \frac{100K_\Omega}{101K_\Omega}$$

$$= 990.1_\Omega$$

$$I_{E2} = I_{B1}$$

$$= \frac{12}{990.1}$$

$$= 0.012A$$

$$= 12mA$$

## 2.10 POWER AMPLIFIER UNIT

The power amplifier used in this project work is an IC based amplifier. It consist of a single IC chip which is made up of a single. Solid structure (Monolithic). The IC (TDA 2006) is used in this case is a low frequency class "AB" amplifier without feedback.

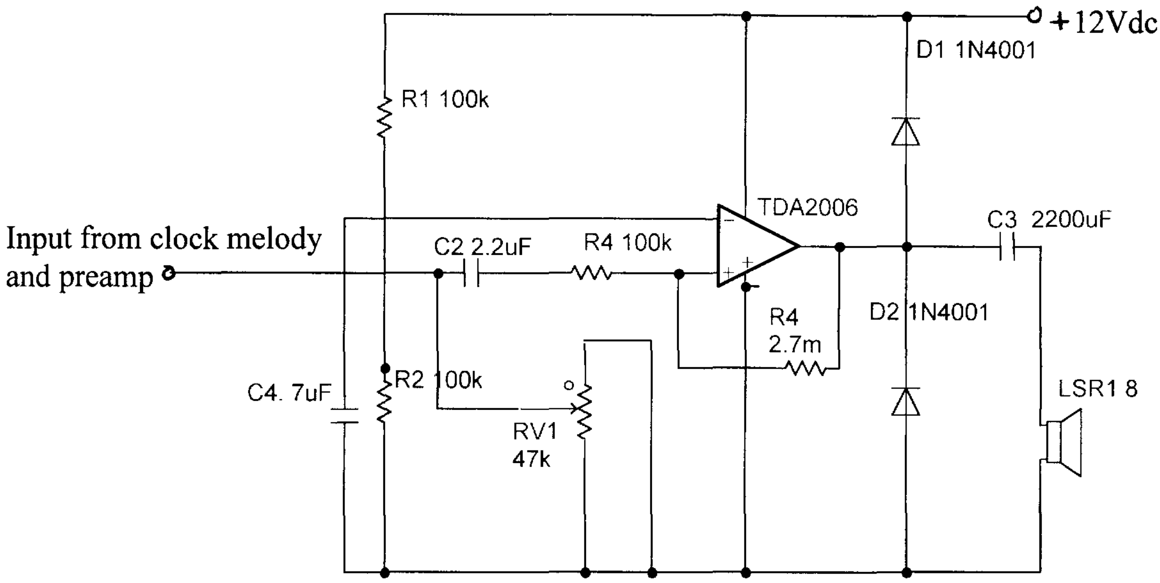



**Fig 2.5 Power Amplifier Circuit**

The amplifier unit amplifies the low frequency signal from the preamplifier and the clock melody which has an in built preamplifier. A typical application circuit used is presented above.

The output of the preamplifier is coupled to the amplifier by means of a coupling capacitor with low capacitance to allow passage of low frequency signal from the preamplifier. Also, the output of the clock melody is directly coupled by means of a potentiometer to enable volume control.

## 2.11 MODE Of OPERATION

The basic mode of operation of the power amplifier can best be described by considering the individual function of each component.

The input DC is coupled by means of $C_1$ and the inverting input DC decoupling by $C_2$. Also $C_3$ enhance frequency stability.

Inverting input biasing is achieved by $R_1$ and $R_2$ while $R_3$ serves as the input impedance.

The function of $D_1$ and $D_2$ is to protect the device against output voltage spikes.

## 2.12 AMPLIFIER GAIN AND FREQUENCY CALCULATIONS

The cut-off frequency is given by the formula;

$f_c = 1/2\pi RC$ .......................................... (a)

Lower cut-off frequency:

$f_l = 1/2\pi R_3C_2$ ................................ (b)

$R_3 = 100k\Omega, \quad C_2 = 2.2uF$

Substituting the values,

$f_l = 1/2\pi (100 \times 10^3)(2.2 \times 10^{-6})$

$= 0.7Hz$

Upper cut-off frequency;

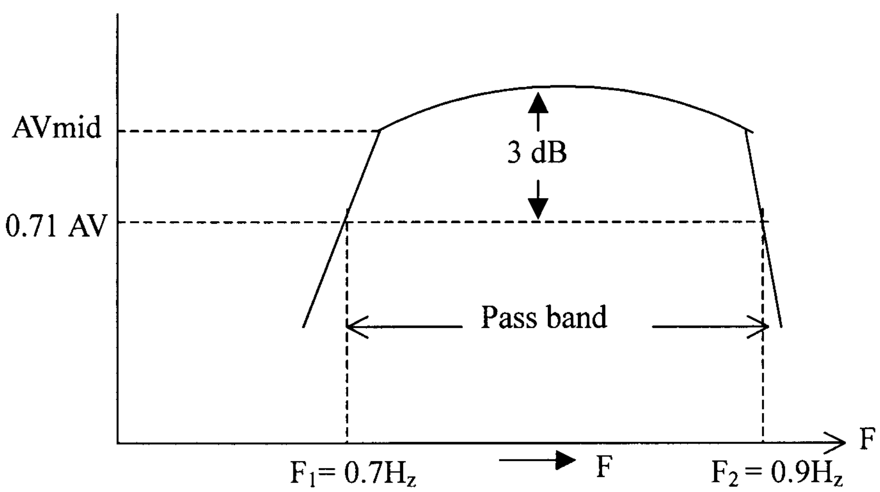
$f_2 = 1/2\pi R_L C_3$

$R_L = 8\Omega, \quad C_3 = 2200uF$

$f_2 = 1/2\pi (8)(2200 \times 10^{-6})$

$= 9.0Hz$

Frequency response of the power amplifier.



Gain of the amplifier

For an inverting amplifier; The gain is given by;

$$Av = \frac{Vout}{Vin} = \frac{-R_B}{R_A} = \frac{2.7 \times 10^6}{100 \times 10^3} = \underline{27}$$

Input impedance = $R_A$ = 100K// 100k = 50k

The amplifier has a fixed gain of 27 i.e

$10 \text{ Log}_{10}{}^{27} = 14.31\text{dB}$

## 2.13 BASIC DATA ON TDA 2006 OP-AMP

Absolute maximum ratings:

Supply Voltage (Vs) = ± 12V

Input Voltage = Vs

Differential input Voltage =± 12V

Maximum power dissipation = 20W

Storage and junction Temperature = 40 to $150^0$C

Drain current (Id), ($R_L$ = 8Ω) = 500mA

Frequency response (_3dB) = 20Hz to 100KHz

**PIN CONNECTION**

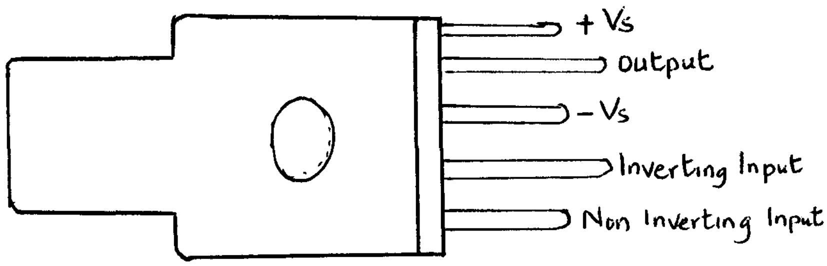



**Figure 2.6 TDA 2006 op-amp**

# CHAPTER THREE

## 3.0 CONSTRUCTION

The circuit construction was carried in stages to achieve a complete circuit set up. Normally, the components are first investigated to ensure proper functioning in accordance to the specifications and circuit ratings. Also the circuit connections was carried out on the breadboard to provide a means of testing the circuit operation and easy amendments. It also gives an insight of a proposed circuit layout.

The tested circuit is then transferred to the Vero board for soldering. Before any soldering was effected, the circuit layout was presented on the Vero board with each component placed on its appropriate position in the circuit diagram.

The surface of the Vero board was made very neat and clean to ease soldering of each component. In the process of soldering, all components were spaced from each other to provide easy means of identification and troubleshooting during fault. Also, all necessary precautions to prevent short-circuit and damage of components were duly observed to avoid failure of the device right from the construction stage. The overall construction techniques can be summarized as follows:

i. All components should be tested to ensure properly compliance with the manufactures data given for the component.

ii. The circuit must be tested on the breadboard to provide a means of modification or otherwise.

iii. An appropriate layout should be chosen to ease component identification and troubleshooting.

iv. The veroboard must be kept clean during and after soldering.

v. All soldered points must be cross-checked to prevent short circuit and bridging.

vi. Almost all the connections were made in parallel and neatly spaced for easy replacement.

vii. Soldering temperature must be kept at a moderate level depending on the type and nature of the components.

Although the circuit layout cannot be presented diagrammatically. It will be of importance to give an insight of what as presented on the verobaord.

The circuit is made up of three different units.

1. The power supply unit comprising of a bridge rectifier as charging unit, the voltage divider and LED indicators all on a separate veroboard.
2. The preamp circuit also placed on a separate verobaord with its input and out put terminals provided by means of jumpers.
3. The amplifier. This is identified as the most vital segment of the entire circuit because all the units are connected to at.

## 3.1 CIRCUIT PACKAGING

The entire circuit is packaged in a metal case of moderate size to form a complete system. The dimensions are given below:

| | | |
|---|---|---|
| Length | = | 8 inches |
| Breadth | = | 8 inches |
| Height | = | 4 inches |

All input and output terminals are provided outside at the appropriate position for easy access. The sides are coupled by means of screw to ease opening during troubleshooting. Also, all external components are input device like the microphone, the lead acid battery, megaphone and the clock has their input/output terminals provided at the sides of the casing for easy access.

# CHAPTER FOUR

## 4.0 TESTING

All components used in the design of the device were tested individually before being used in the construction.

Also, by means of the digital multimeter, the voltages at the power supply unit were measured. First starting with the output of the bridge rectifier, to the battery and the voltage step down, the values gave the required output. The battery voltage was fairly constant during the testing at about 12.4V

The preamp and the amplifier were also tested separately. Starting with the amplifier, the microphone was used to test the amplifier directly without the preamp and the output was fairly large enough. However, it was louder when tested with the clock alarm. Also with the preamp coupled, the output was louder implying that the preamp was functioning.

The only problem encountered during the testing was the powering of the clock and melody until. It was however tested ok after series of trial and the clock and alarm functioned perfectly.

All the testing were carried out before and after soldering the components on the breadboard and veroboard respectively.

# CHAPTER FIVE

## 5.0 SUMMARY

The design and construction of an automatic time sounder is a very simple task depending on the type in question. In the case of this particular one, the components used were all readily available and a simple design approach based on the principles of operation op-amps was used. The power supply was designed in such a way as to serve as the battery charger for continuous timing without any power cut off. The preamp and the power amplifier on the other hand were designed using a tested circuit which requires no any additional device or component except for the modifications that were carried out to suit the required objective.

A device like this could be termed as a portable device because of its simplicity and light weight and in-built protection, by means of a fuse and switch.

## 5.1 CONCLUSION

The design and construction of an automatic timing sounder interfaced with an alarm clock with megaphone has been successful. The device has been constructed as a complete set up for use as a public address system and timing device perfectly.

Although it is impossible to construct an ideal amplifier with an output which is an exact duplication or replica of the input, the design and construction of the automatic time sounder interfaced with public addressing system has been successful. The distortion of the amplifier could be considered as almost negligible. This is because, the frequency distortion normally associated with low or small signal amplifiers is limited in this particular amplifier at about 10%.

The design approach adopted in this project work was very simple because of the nature of the circuit used. The input from the clock was directly coupled to the IC based power amplifier while the low frequency signal of the microphone is coupled by means of the preamplifier. The entire circuit design and construction was carried out with minimum complexity.

Finally, the circuit was split into different units for easy identification and troubleshooting or otherwise. This imply that any modification or correction could be easily carried out on any part of the system without dismounting the entire circuit in the system.

## 5.2 RECOMMENDATION

The design of the automatic time sounder was mainly presented as an aid of timing for appropriate scheduling of events. Also, the overall output of the device i.e. the loudness of the time sounder was limited to a certain level because of some certain Parameters in the circuit that could not be modified. In this regard I therefore recommend the following improvements to achieve a better performance of the system.

(a) The gain of the preamp can be increased or decreased to make the circuit fit for other applications.

(b) The preamp could also be modified to amplify small signals from a magnetic tape head for signal reproduction.

(c) A digital clock with similar mode of operation as the one used may be incorporated in the device to form a complete timing system with a complete arrangement.

(d) Cascading two or more of the power amplifier will give an output twice or more depending on the number of the cascade connection as the one produced by this particular system of single stage amplification

(e) The cost of the megaphone used is one the demerit of the system, therefore any modification that will allow the use any other speaker of different rating as the one specified would automatically reduce the cost of the device.

# APPENDIX

## COMPONENTS AND PARTS LIST

**RESISTORS**

| | | |
|---|---|---|
| $R_1$ $R_5$ | = | 330Ω |
| $R_2$ $R_3$ | = | 320Ω |
| $R_4$ | = | 47KΩ |
| $R_6$, $R_{10}$, $R_{11}$, $R_{12}$, | = | 100KΩ |
| $R_7$ | = | 10KΩ |
| $R_8$ | = | 1KΩ |
| $R_9$ | = | 5.5KΩ |
| $R_{13}$ | = | 2.7mΩ |
| RV1 | = | 47K Log |

**CAPACITORS**

| | | |
|---|---|---|
| $C_1$ | = | 4700ЧF |
| $C_2$, $C_5$, $C_6$ | = | 10ЧF |
| $C_3$ | = | 15PF |
| $C_4$ | = | 100ЧF |
| $C_7$ | = | 4.7 ЧF |
| $C_8$ | = | 2.2ЧF |
| $C_9$ | = | 2200ЧF |

**DIUDES**

| | | |
|---|---|---|
| $D_1$, $D_2$, $D_3$, $D_4$, $D_5$, $D_6$ | = | IN5402 |

$D_1, D_8$ = IN4001

$D_Z$ = 3V Zener(BZX 834)

**TRANSISTORS**

$Q_1, Q_2$ = BC 108B

$IC_1$ = TDA 2006

**OTHERS**

$B_1$ = 12V Lead acid battery

$T_1$ = 15V Transformer step down transformer.

$F_1$ = 2A fuse

$K_1$ = 250VAC switch

$IN_1$ = Mic. Jack

LSR = 8Ω (30ω) megaphone

HEAT SINK

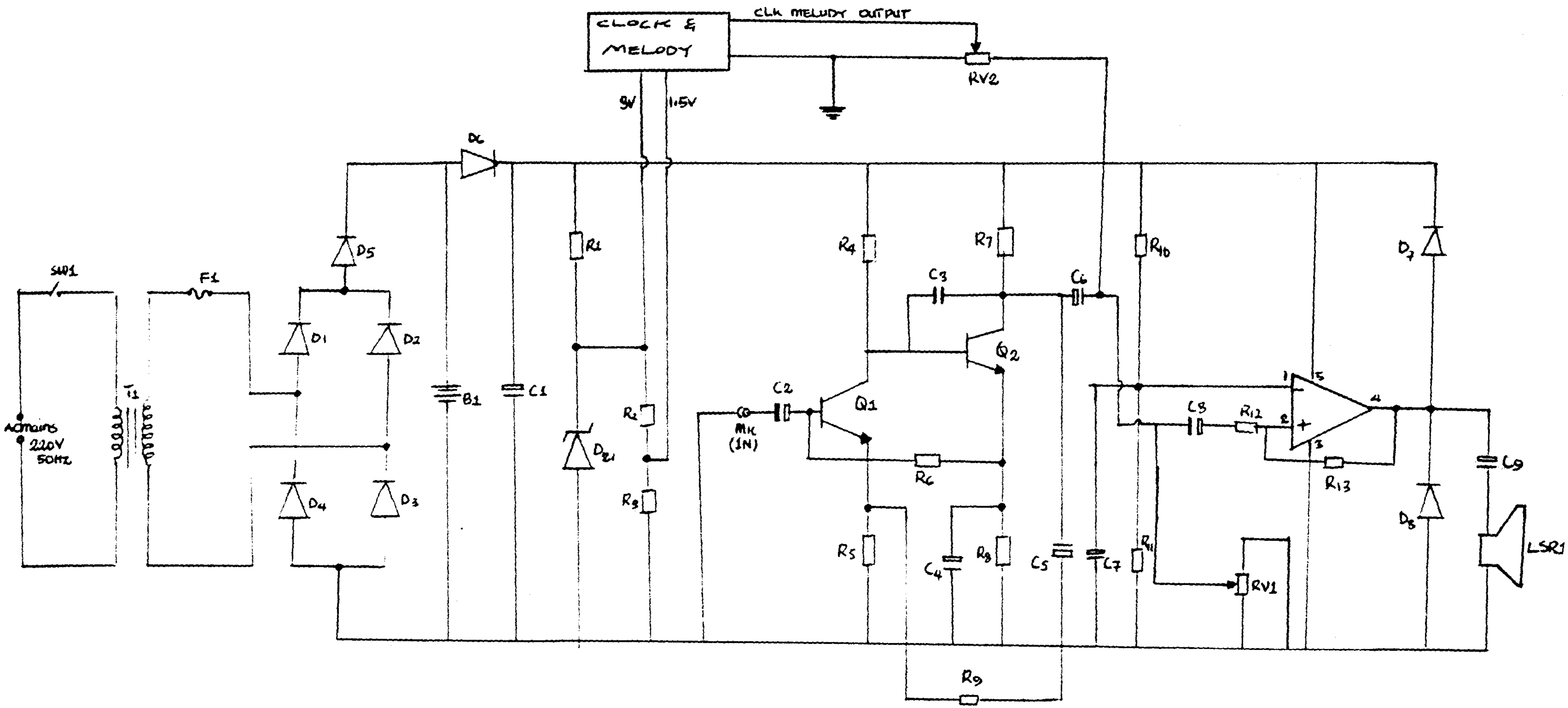



Fig 2.7 Circuit Diagram of Automatic Time Sounder

# REFERENCES


1. THERAJA, B.L., THERAJA, A.K (1999) " A TEXTBOOK OF ELECTRICAL TECHNOLOGY",

   S.chand & Company Ltd. India.

2. PAUL, H., WINFIELD, H. (1980) " THE ART OF ELECTRONICS",

   Cambridge University Press, USA.

3. HOWARD, H. GERRISH, WILLIAM, E. DUGGER, (1996) "ELECTRICITY AND ELECTRONICS", The Goodheart-Willicox Company, INC. (USA).

4. MIKE, T. "EVERYDAY ELECTRONIC DATA BOOK", Third Edition,

   McGraw-Hill Book Company, New York, USA.

5. ENCYCLOPEDIA BRITANNICA (Vol.2)

   Published in the United Kingdom