DESIGN AND CONSTRUCTION

OF

MINIMUM-MAXIMUM TEMPERATURE INDICATOR AND ALARM FOR AQUARIUM

BY

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A THESIS SUBMITTED TO THE

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING OF THE FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEERING DEGREE (B.ENG.) IN ELECTRICAL ENGINEERING.

MARCH, 2000

CERTIFICATION

This project has been supervised and deemed fit to fulfil one of the requirements of the award of the bachelor of Engineering degree in Electrical and Computer Engineering Department of the Federal University of Technology, Minna, Niger State Nigeria.

....
H.O.D OF DEPARTMENT

8/4/2000
....
DATE

....
EXTERNAL ~~SUPERVISOR.~~ EXAMINER

6/4/2000
....
DATE

....
PROJECT SUPERVISOR.
[MR. PAUL ATTAH]

24/03/2000
....
DATE

DECLARATION

I hereby declared that this project was constructed by me under the supervision of MR. PAUL ATTAH, Electrical and Computer Engineering Department, Federal University of Technology, Minna.

MR. OLASEHINDE M. O. 23RD OF MARCH, 2000

STUDENT'S SIGNATURE Date

MR. PAUL ATTAH ....

SUPERVISOR'S SIGNATURE Date

DEDICATION

The project is dedicated to God the Father, the Son and the Holy Spirit

And

My parents: MR. & MRS. RAPHEAL OLASEHINDE

And

My brother and his wife: MR. & MRS. J. S. OLASEHINDE

ACKNOWELDGEMENT

FIRST AND FOREMOST, I acknowledge with great awe the central part that God had in bringing forth this project and the report. Glory, Honour and majesty be to God the Father, God the son, and God the Holy Spirit.

I wish to express my appreciation to the H.O.D. of Electrical and Computer Engineering Department Dr. Y. A. ADEDIRAN, my able and lovely supervisor MR. PAUL ATTAH.

I also appreciate the effort of my parents Mr. Rapheal Popoola Olasehinde and Mrs. Mobolaji Olasehinde for all your love and sacrifices while I was going through this course My prayer to Almighty God is to grant you long life and many more years to eat the fruits of your labour in Jesus name.

I also thank my brother and his wife Mr. Joseph Sunday Olasehinde and Mrs Adebola Olasehinde for your love and care, may you really be blessed in Jesus name. My gratitude also goes to my sister Mrs Ayodele Adeboye, Miss Bunmi Olasehinde for your encouragement and word of advice.

I also thank all the lecturers in the department of electrical and Computer Engineering and the non academic start. And infact, my able and dynamic class Rep. BABA NEE, and all my class mate.

I must not forget the effort of my brothers and sisters in Lord like: BRO TOYIN ADEDOKUN, BRO. DELE ADEOTI, BRO. WALE ADUNMO, BRO. BOLA AFOLABI, BRO. FEYI AJAYI, BRO. LAYI SALAMI, BRO. KUNLE ADEGBITE, BRO. YINKA OLAWUYI [OLOMU], others that I can not mention. I must also acknowledge the love of my daughters in the Lord: BUNMI ASERE, OMOTAYO TITILOYE, KEMI OJO, JUMOKE YAKUBU, FUNKE TAIWO, ANNE EGBO, FOLAKE EMMANUEL, NIHINLOLA ABOLARIN, BIMBO ABE and BOLA MARTHINS. May God almighty grant you success in all your endeavors in the name of Jesus.

My gratitude also goes to MR. GANIYU ATOLAGBE and his wife for their love over me and concern. I also appreciate the effort of MR. & MRS. OLUSEGUN BUKOLA OLASEHINDE, OMOLOLA COMFORT OLASEHINDE, OLUBUKOLA OLASEHINDE, FOLASHADE OLASEHINDE, MR & MRS. ABRAHAM OLASEHINDE. May God bless you all real good.

My gratitude is due to a good classmate MR. CHIDI for the great part he took to see to the success of this project. Also, I must appreciate a lovely friend MR. SUNDAY DOYIN AKANDE for his support in getting this project done.

An adage says ※ A friend in need is a friend in deed※ MR. EMMANUEL OLAYINKA ADENIGBA has always been a helping hand to me. Sir, ※ YINKUS※ , may the showers of blessings from God continue to come upon you. I also appreciate the effort of Sis. TEMILOLA AGBOOLA and BUKOLA ADENIGBA, I can't forget you.

Similarly, I am thankful to MR. LAWRENCE OLANIYAN who is presently in United State of American and, a friend in need is a friend indeed. Wishing you all the best and happy stay in Jesus name.

My gratitude goes to all members of Drama Union of

ABSTRACT:

This write-up for the construction of "MIN-MAX. TEMPERATURE NDICATOR AND ALARM", is made-up of four chapters which are dequately defined below:

Chapter one is the introductory part of the write-up which contains the motivation of the project, the literature review, the aims and the objective of the project, the project outline which ncudes, the circuit diagram and the details about the most important part of the circuit which is the sensor (THERMISTOR), the comparator (Operational amp.) and the IC 555 timer used as on astable multivibrator in the alarm circuit. It also contains the likely causes of the abnormality in the temperature of the water.

Chapter two deals with the system design which entails the power supply unit. Here, a step-down transformer of 12v is required. The 12v a-c is this rectified to d.c which is then regulated for stability after undergoing filtering with the help of an electrolitic capacitor.

Chapter three is the most sensitive part of the project where the abnormality in the water temperature is sensed and then converted into an electrical signal. The voltage at the junction of the thermistor and series connected resister is then compared with the reference voltage by the operational amplifier. It also deals with the indicator used to indicate any abnormality. Also relays serves as switch in the project to connect the alarm unit with supply so as to give an audio sound when the temperature exceeds normal level. It also deals with the various test carried out on the construction work and also the way and manner in which the construction was carried out.

Chapter four is the last chapter which only deals with the conclusion, the recommendation and cost of the project and the reference.

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CHAPTER ONE:

1.0 INTRODUCTION:

1.1 MOTIVATION OF THE PROJECT:

It is high time we stop paying less attention to the environment of the animals of which we depend for protein.

Let us have a work at the various fishes we have around us in the seas, rivers, in our markets and even in our fish pend and also in aquaria for both consumption, decoration and recreation.

Those of us that are find of decorating our sitting rooms with either big or small aquarium , do we really care for the environmental comfortability of the fishes in these aquaria? How often do we clean up the inner part of the aquarium? Do we really even care to know the temperature which these fish could tolerate? It is better we know this today that if the fish in our aquarium is subjected to either low or high temperature which it could not tolerate, the fish would die, due to the effect an it's metabolic activities.

This project is thus undertaken to provide a conducive environment for the fish in the water in an aquarium, by monitoring the temperature of the water at both low and high situation.

The temperature used as the case - study for this project is that of an controllable fish known as TILLAPIA. Tillapia is a fresh water fish which could not safely tolerate a temperature lower than 23°C and a temperature higher than 40°C. Any temperature lower or higher than this range would create discomfort for the fish.

.2 AIMS AND OBJECTIVES OF THE PROJECT:

The aim of this project is to sense or detect the abnormal environmental temperature of the water in which the fish dwells. If at any point in time, the temperature falls below 23°C or rises higher than 40°C, a temperature sensor which is immersed into the water would sensed the temperature which would then be converted into an electrical signal. This would be indicated by the led for the two temperature either low or high.

Also, at the sometime when the indicator comes on or displayed, an alarm sound is heard also to signify the abnormality in the environment of the fish.

Some of the factors that can causes abnormal situation in the temperature of the water are decomposition of the reminant food, direst exposure to rays of sun-light and extremely low atmospheric temperature.

1.3 LITERATURE REVIEW:

The temperature sensor used in this project is the THERMISTOR. Other temperature indicating devices exist that basically uses almost the same type of principle but different types of input and output units, though there are some whose principle is drastically different from that used in this project. Some system are designed based on the principle of thermocouple, which is a device that uses the voltage developed by the junction of two dis-similar metals to measure temperature difference. One junction called the sensing junction is placed at the point of interest (Aquarium), while the other end, called the reference junction is maintained at known reference temperature. The accuracy of the temperature measurement depends upon the accuracy with which the reference junction temperature is, then as well as the accuracy with which the electrical signal is measured.

Other systems use analogue to digital converter, a device that convert analogue signal to digital signal with the aid of a decoder. Others like platinum resistance sensors are relatively expensive.

Hence the system used in this project is very simple and efficient. It is sensitive to the same environmental errors that affect any immersion sensor. Its accuracy depends on the care with which it is designed for that particular environment. Based on availability, reliability and its low-cost, the THERMISTOR was used as the temperature sensor for this project.

1.4. PROJECT OUTLINE:

1.4.1 THE CIRCUIT DIAGRAM:

The complete circuit diagram shown below is that of the project which is titled MIN-MAX TEMPERATURE INDICATOR AND ALARM FOR AN AQUARIUM.

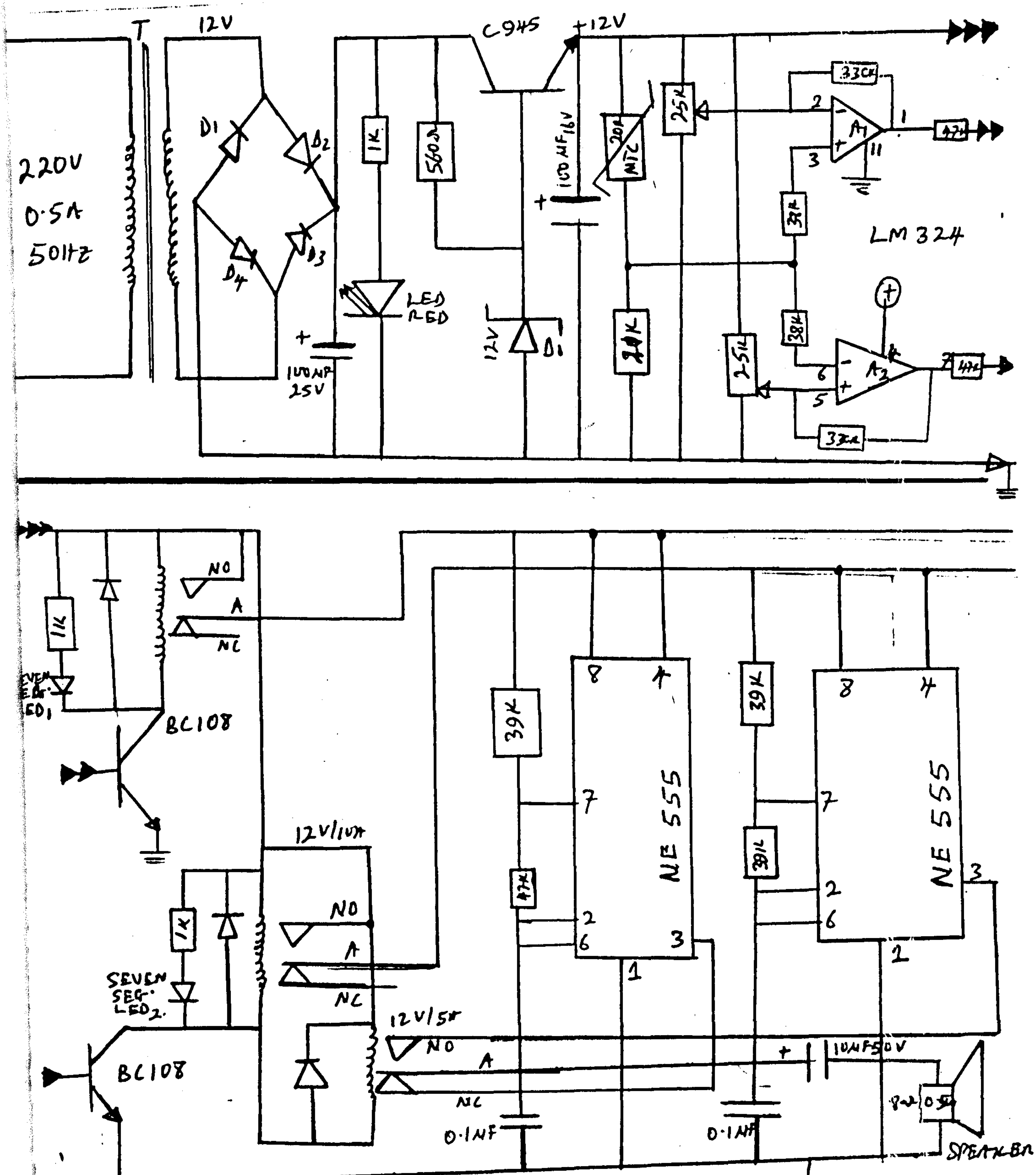
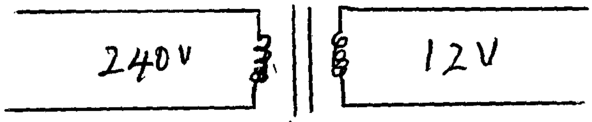


Fig. 1. Complete circuit diagram.

1.4.2 LIST OF THE COMPONENTS USED IN THE PROJECT:

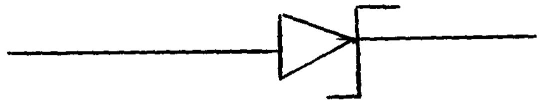
COMPONENTS — **SYMBOLS**

1. 12V - TRANSFORMER



2. SILICON DIODE

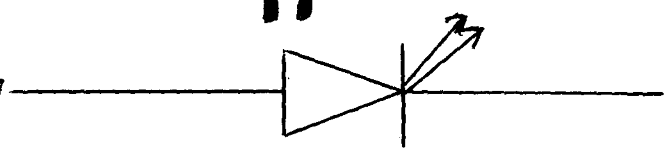
3. ZENER DIODE



4. ELECTROLYTIC CAPACITOR

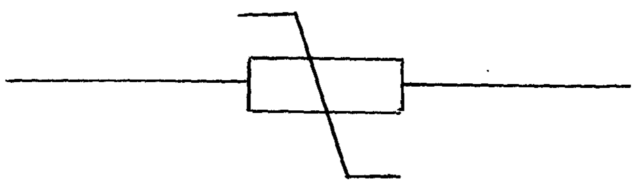
5. CERAMIC CAPACITOR

6. LIGHT EMITTING DIODE [LED]

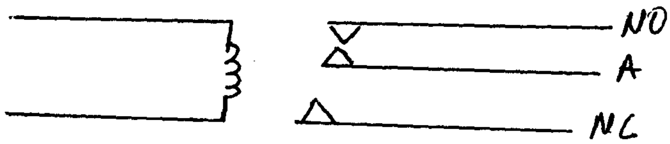


7. RESISTOR

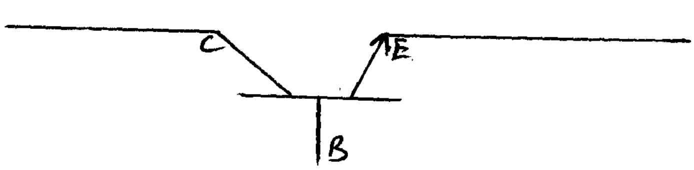
8. THEMISTOR (MTC)



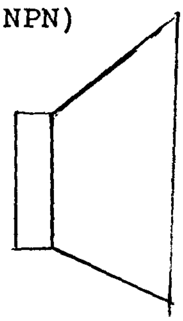
9. ELECTRO-MAGNETIC RELAY



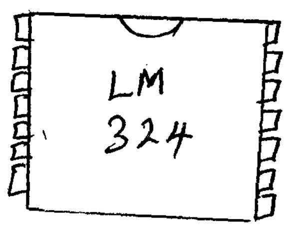
10. TRANSISTOR (NPN)



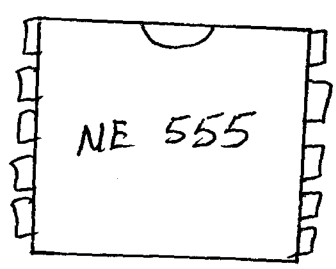
11. SPEAKER



12. ICI: LM 324



13. IC $_2$; IC $_3$; ME 555



1.4.3 CHARACTERISTICS OF MAJOR COMPONENTS:

i. THERMISTOR (NTC)

Thermistors are semi-conducting resistors with a large negative temperature coefficient of resistance. Thus if the temperature increased, the resistance decreases.

The temperature change can be caused either in the surrounding in which the thermistor is immersed or by heat generated within its element due to the passage of current through it. Over a specific temperature range, the

temperature coefficient of resistance, $\propto = \frac{dR_T}{R_T dT}$

And $\propto = \frac{(R_2 - R_1)}{R_1(\theta_2 - \theta_1)}$

Thermistor could be in the form of rods, or pressed into discs or formed into bends between two platinum wires. Miniature bend thermistors are often glass encapsulated or enameved for protection, which are shown in the fig. 1.1 below:

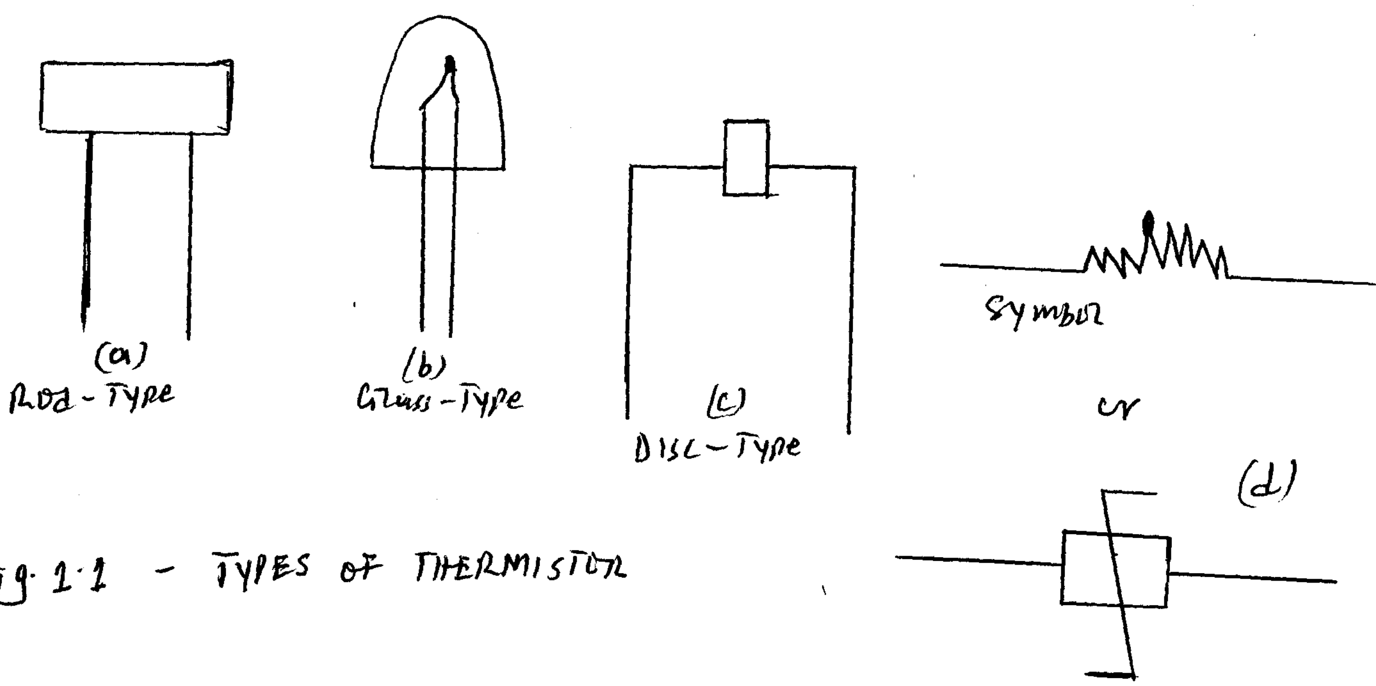


Fig 1.1 - TYPES OF THERMISTOR

If the resistance (R) of the thermistor is plotted against temperature (^0C), a curve is obtained which shows the characteristic of the particular thermistor (NTC).

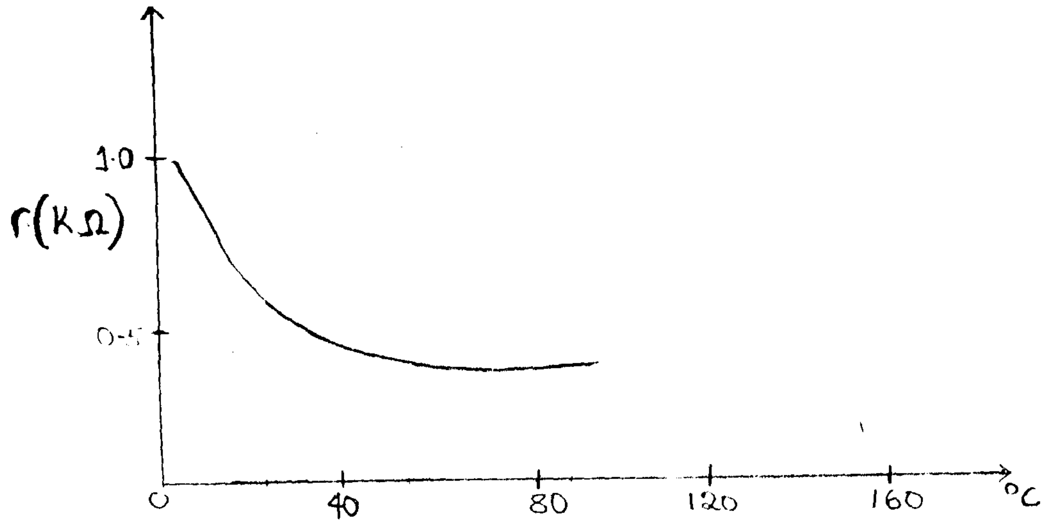


Fig. 1.2 Resistance against temperature characteristics.

ADVANTAGES OF USING THERMISTOR FOR TEMPERATURE MEASUREMENT:

a. It has a useful temperature range -70^{0}C and 300^{0}C.

b. It has high sensitivity: 6% change in resistance per degree Celsius charge in temperature at room temperature.

c. Because of the high resistance of the thermistor, the length of the connecting leads and their change of resistance with temperature is generally of no consequence.

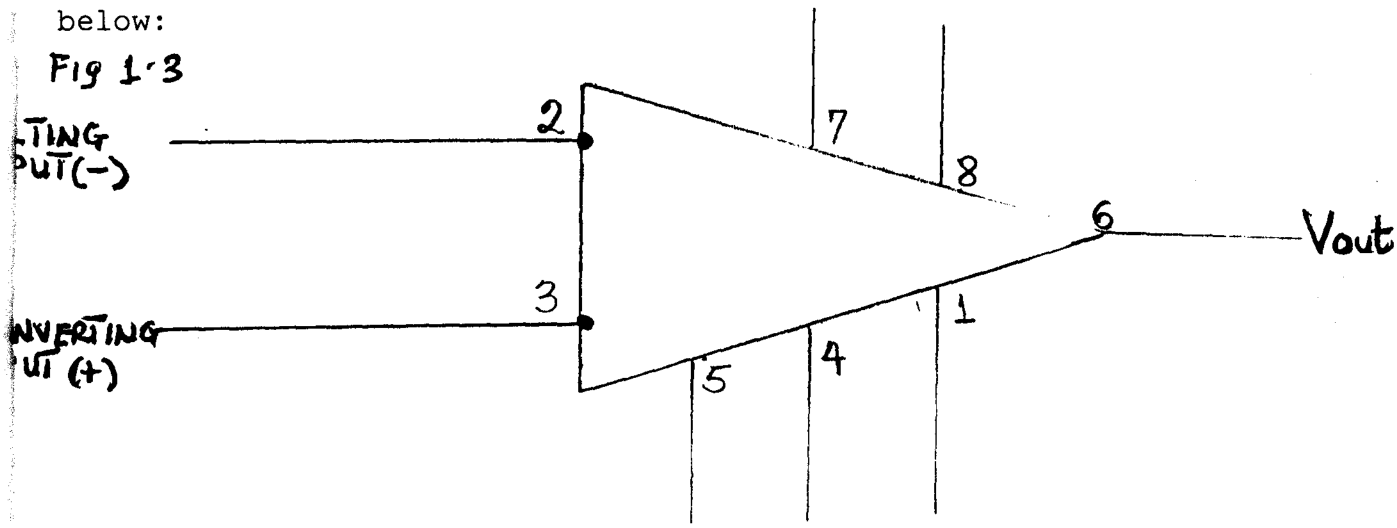
d. A small thermistor based has a very small heat capacity as an temperature - sensing device. It is consequently able to respond to rapid change of temperature.

e. The element is more robust than the thermo-couple and the platinum resistance thermometer.

viii) Good stability, being free of parasitic oscillation.

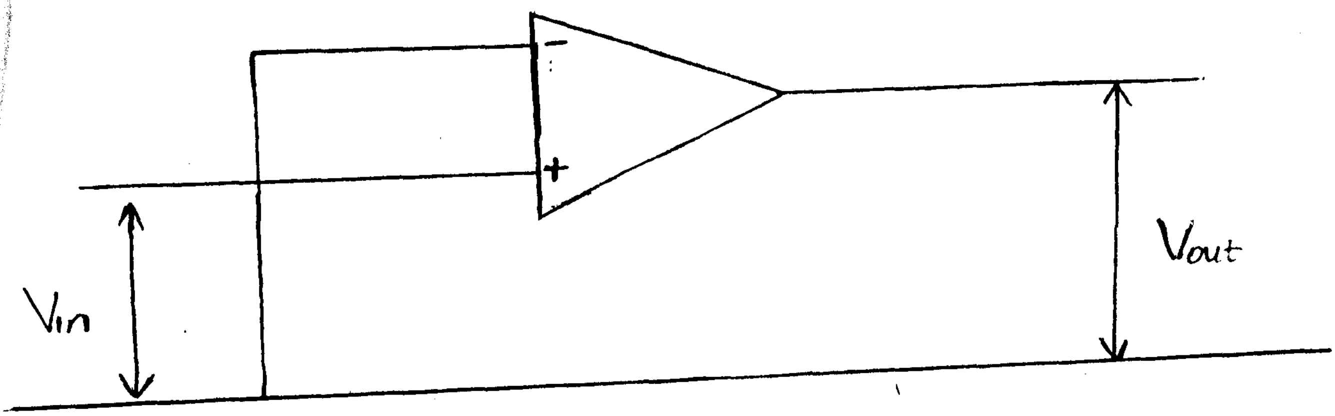
The basic form of operational amplifier is shown in fig. 1.3 below:

Fig 1·3



Operational amplifier has some functions which includes voltage amplifier, summer, voltage follower, integrator, differentiator, voltage comparator etc.

If an opamp is connected as in the simplified circuit of fig. 1.3, it acts as a non-inverting amplifier. This means that the output is the exact, amplified copy of the input as shown in the fig. 1.3. So the output voltage [V(out)] is in-phase with the input voltage [Vin].



1.4 Non-Inverting amplifier.

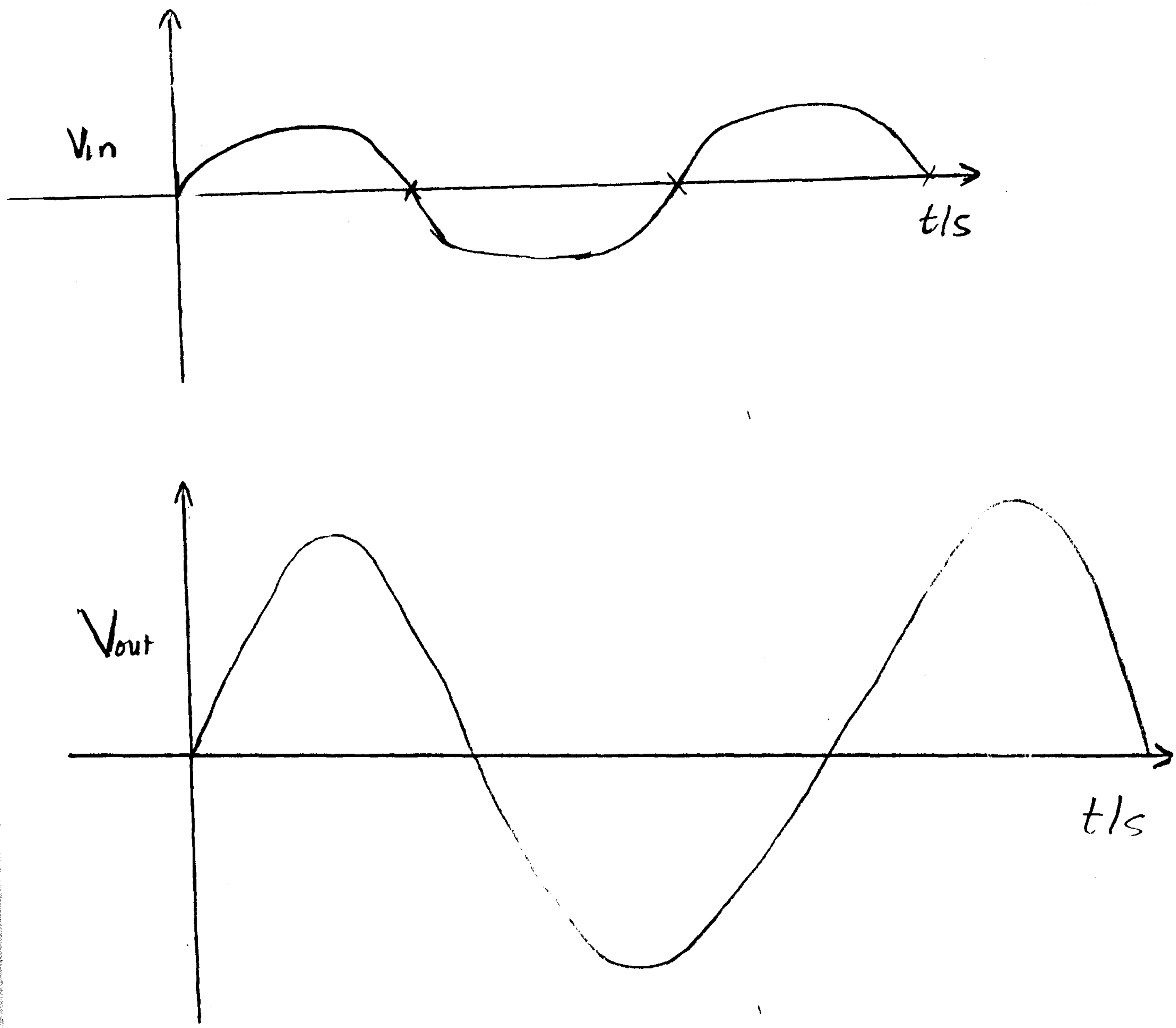


Fig. 1.5 Output voltage in phase with input voltage [non-inverting amplifier].

If however, the amplifier is connected as shown in fig 1.4 it is said to be connected as an inverting amplifier. In this case the output is ~~an~~ exactly opposite, amplifier copy of the input, as shown in fig. 1.5. So V_{out} is 180° out of phase or in anti-phase with [Vin].

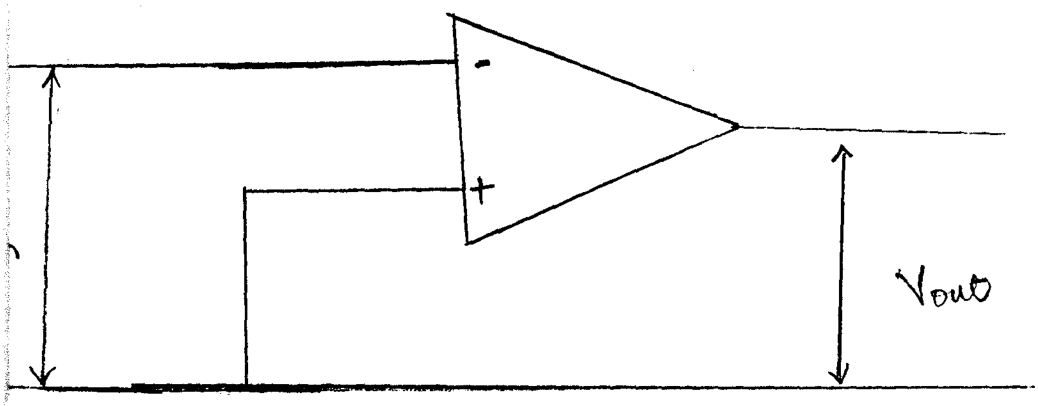


Fig. 1.6 Inverting Amplifier.

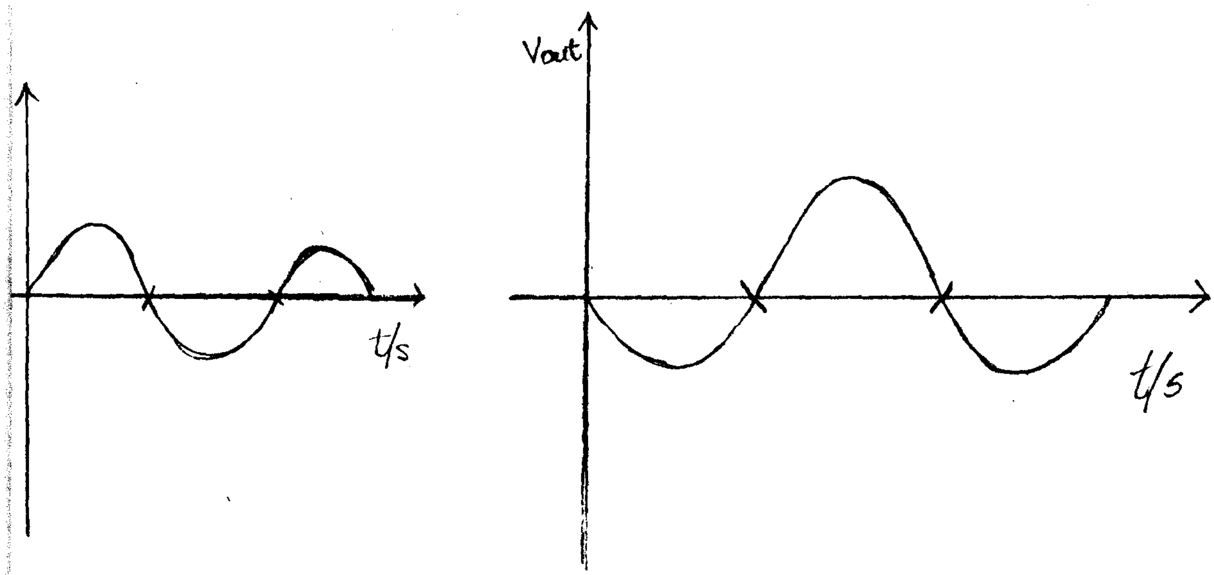


Fig. 1.7 Output voltage anti-phase with input voltage (Inverting amplifier).

NEGATIVE FEEDBACK:

Negative feedback is said to occur when a little of the output signal is feedback to the inverting input. As we saw in fig. 1.7, the output is 180° out of phase with the input. So the feedback reduces the signal that the amplifier has to amplify and therefore reduces the gain. The amount of the output feedback is controlled of a resister R_2 as shown in the fig. 1.8 below:

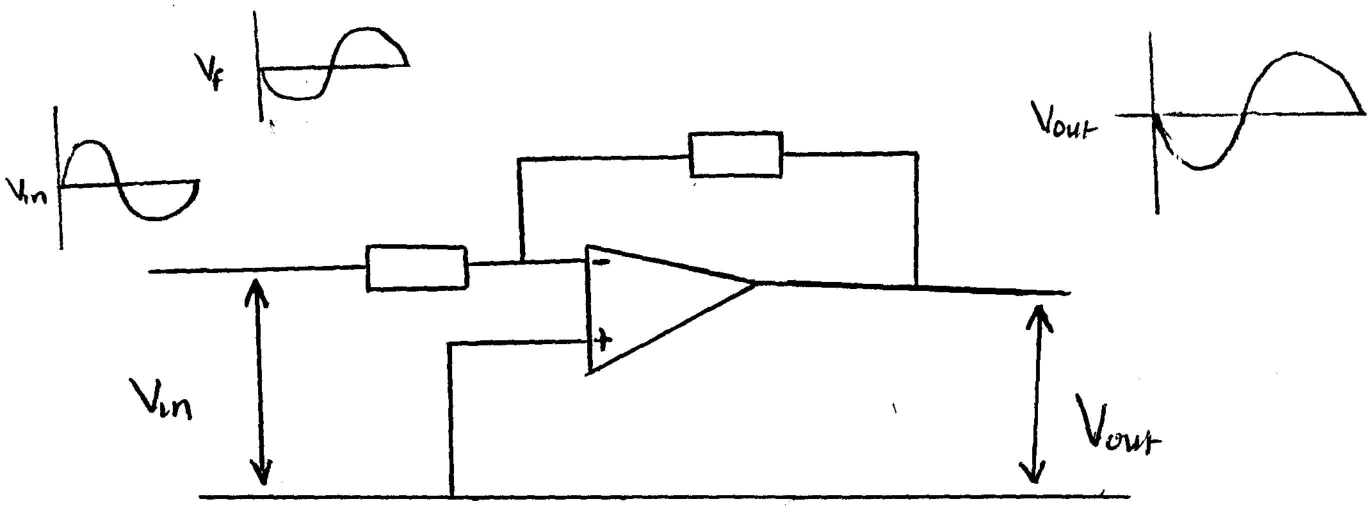
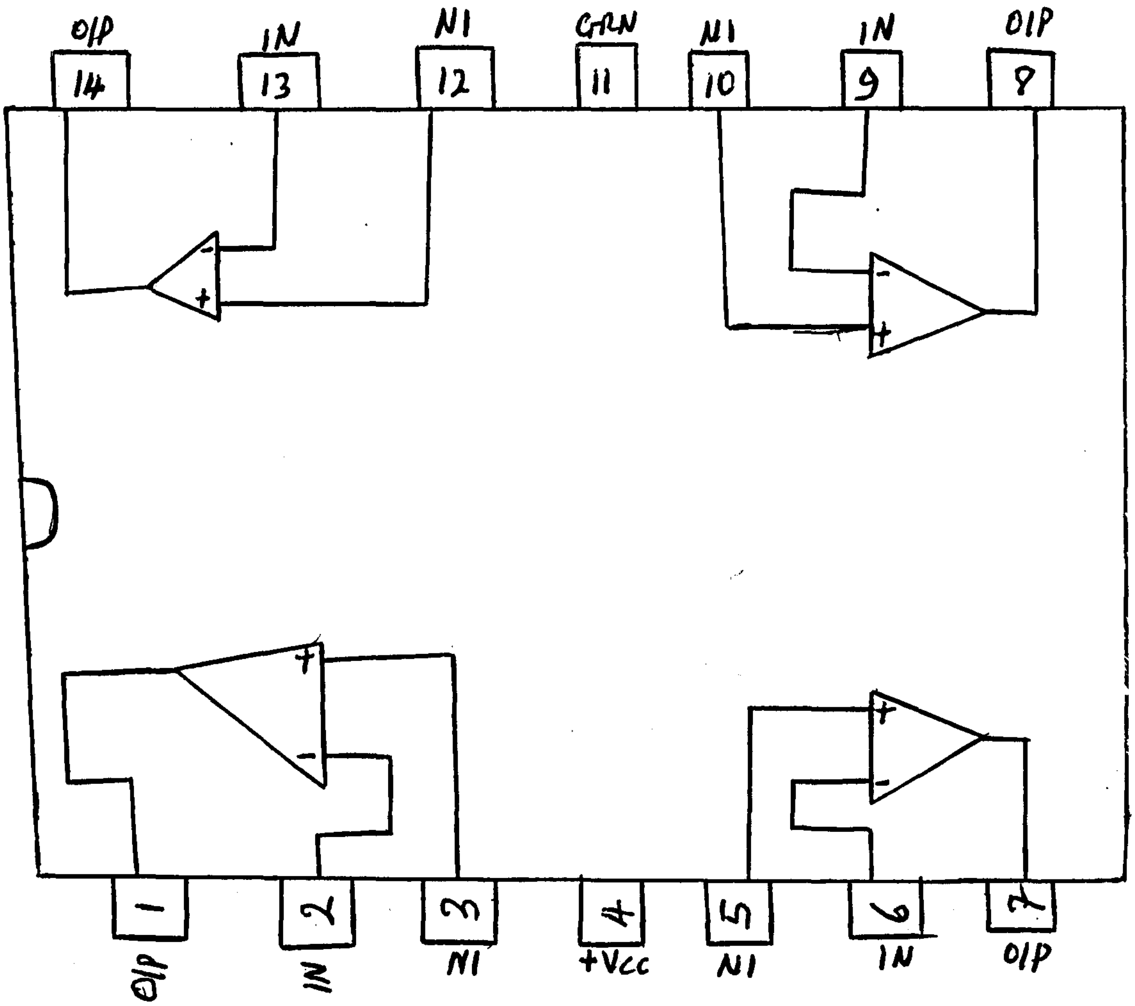


Fig. 1.8 Negative feedback - Input and output voltages.

The operational amplifier used in this project is LM 324 which contains 4 different operational amplifiers in one integrated circuit (IC). It's internal connection is shown in the fig. 1.9 below:



O/P = OUTPUT

NI = NON-INVERTING INPUT

IN = INVERTING INPUT

V_{cc}^{+} = POWER SUPPLY

GRN = GROUND

Fig. 1.9 Internal structure of IC LM 324.

(ii) 555 TIMER AS AN ASTABLE MULTI-VIBRATOR:

The I.C timer 555 is available in an eight-pin dual-in-line (DIL) package in both bipolar and CMOS forms. The 555 time is basically a very stable IC capable of being operated either as an accurate bistable, mono-stable or astable multivibrator. The internal structural configuration of the IC 555 time is shown in fig. 2.0 below:

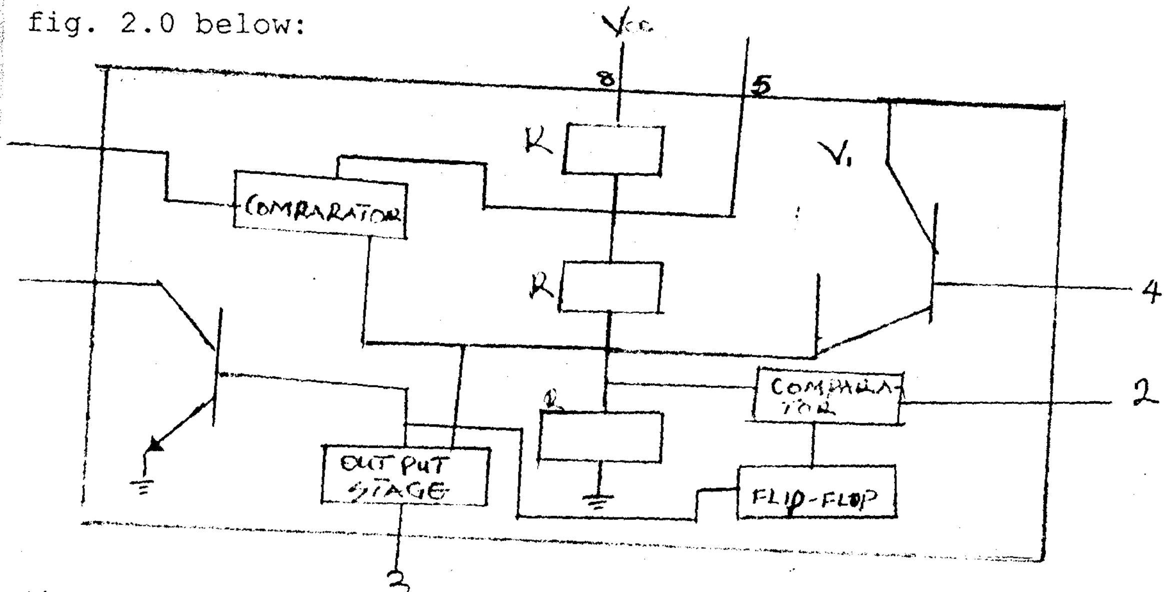
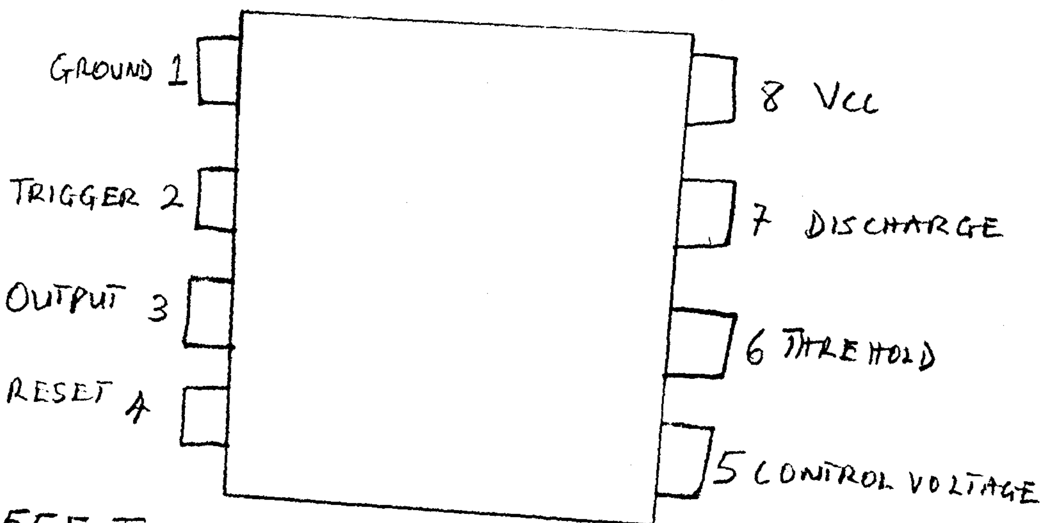


Fig. 2. . Internal structure of IC 555 Timer.

It consist of two comparators, a flip-flop, two control transistors and a high current output stage. and the pin-out connections for the 555 timer are show in the diagram below:



2·1 The 555 Timer I C

Frequency(F):

$$F = \frac{1 \cdot 44}{C[R_1 + R_2]} Hz$$

SYSTEM DESIGN:

2.1 POWER SUPPLY UNIT (P.S.U):

This unit could simply be called P.S.U. Is the unit which supply power to the whole unit so as to carry out the expected monitoring of the temperature, indication and also actuation of the warm.

The voltage supply for the control system is 12v.d.c which is the output at the secondary winding of the transformer via the rectification unit.

Drawn below in fig. 2.2 is the diagram of the power supply unit which is made up of the transformer, rectifier, filter, and voltage regulator.

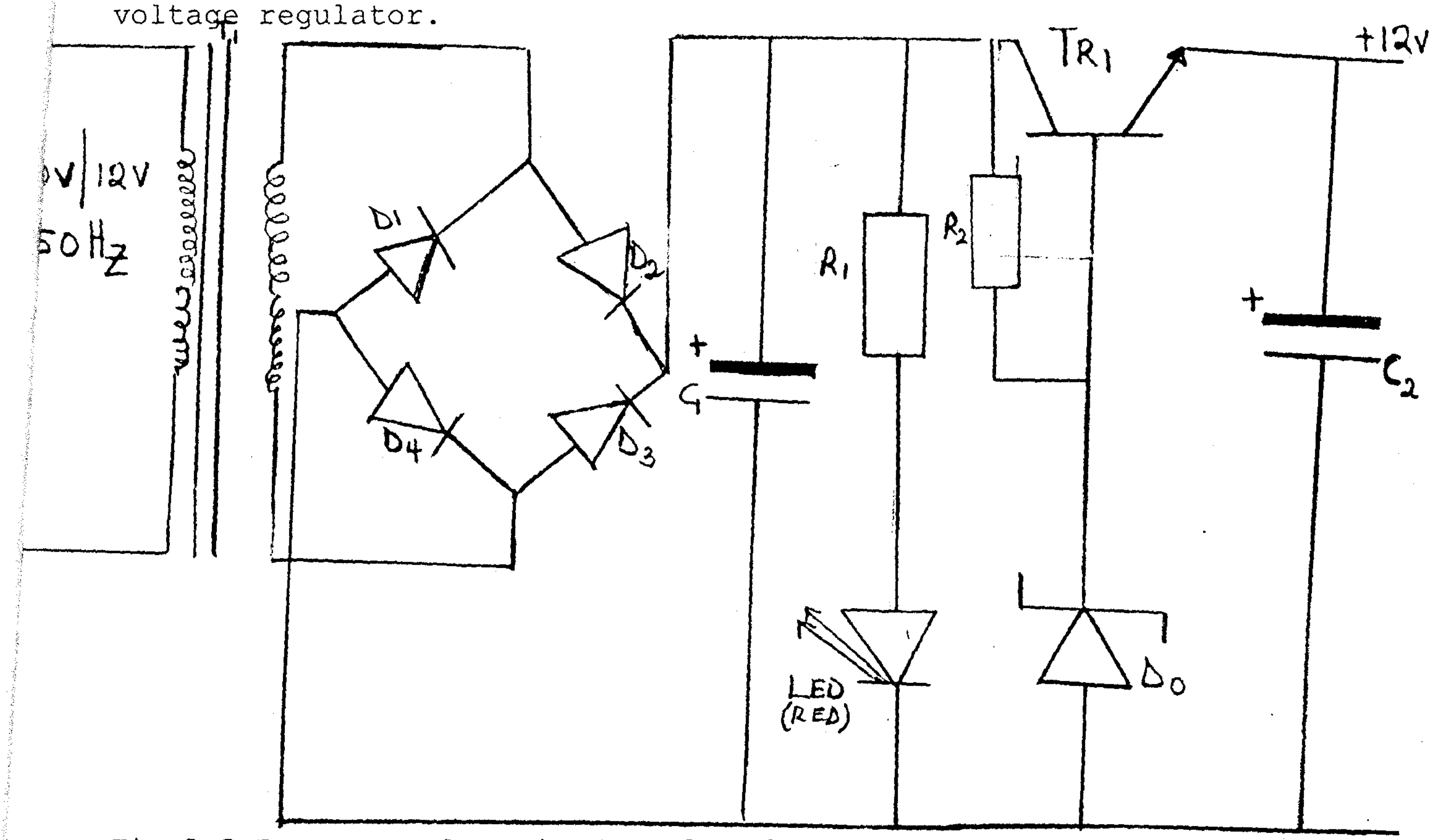


Fig 2.2 Power supply unit (Regulated supply).

2.2 VOLTAGE AND CURRENT TRANSFORMATION.

THE TRANSFORMER:

The power transformer is the static electrical machine which either step-up or step down the electrical components (Voltage and current). The transformer used in this project has it primary voltage to be 220v while the secondary voltage is 12v. the transformer help in the transformation of the 220v into the suitable 12v. This 12v output is then fed to the bridge rectifier for rectification.

2.3 RECTIFICATION:

Rectification is the process of converting an alternating component into a direct component. The reason for the rectification of the a.c supply is that, since the components for the project are designed to operate on d.c supply, so we need to rectify the supply. For proper operation and to prevent damage to the component. That is, we need to convert 12v a.c into 12v d.c The silicon diodes (the 4) used as the rectifiers is the IN4001 type. The output of the rectifier could then be calculated thus:

Vd.c = 1.41 x 12Va.c = 16.9Vd.c

Invariably, the output of the rectifier is always higher than the input depending on the size of the silicon diode used.

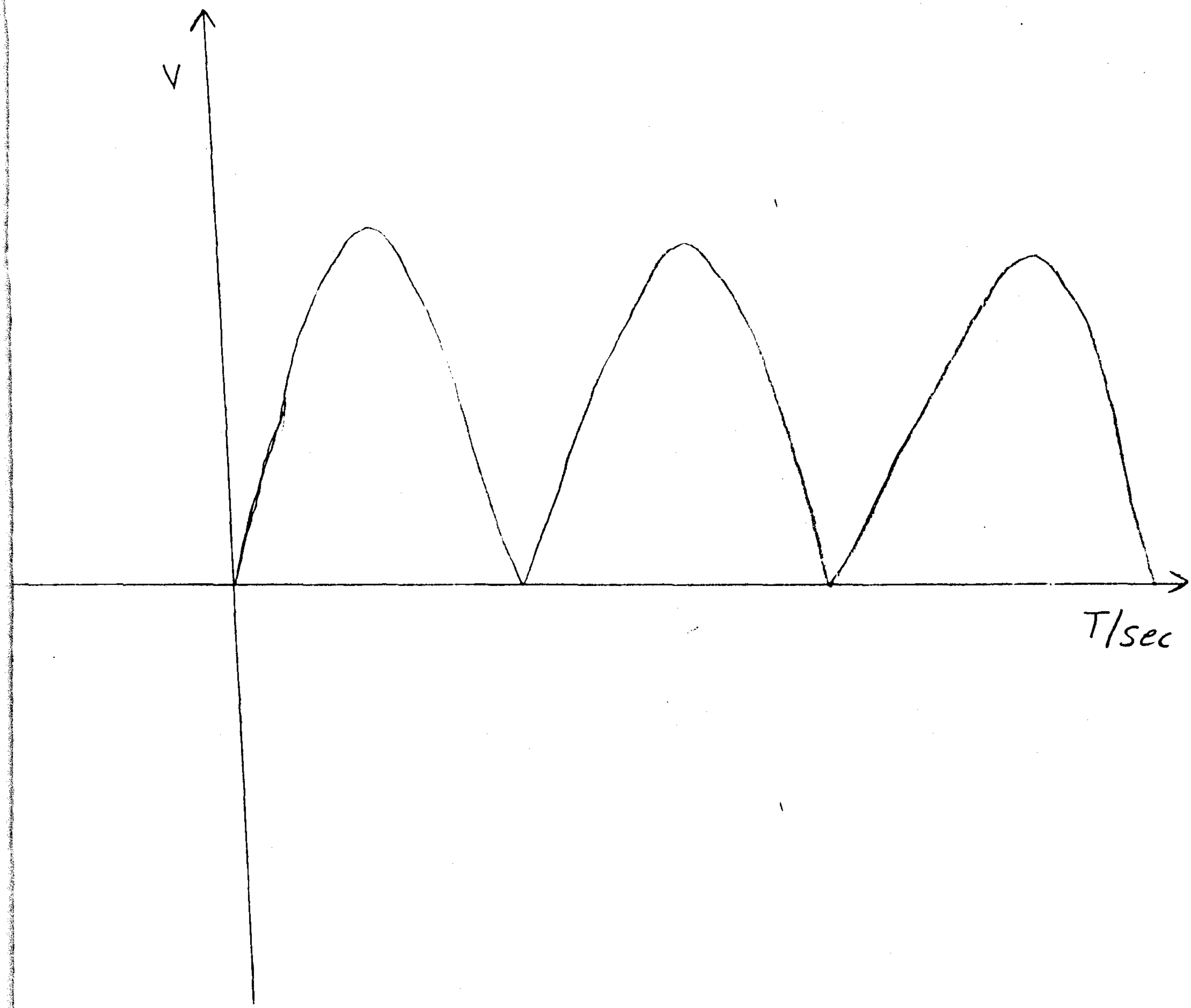


Fig. 2.3 The output rectification.

2.5 POWER SUPPLY INDICATOR:

A red colour LED is used as an indicator in this project. It's main function is just to indicate whether there is power supply in the system or not. A current limiting resistor is connected in series with the RED LED so as to prevent the LED from getting damaged due to possible flow of high current into the component.

2.6 VOLTAGE REGULATION:

The basic zenler diode regulator circuit enables a supply of voltage to be stabilised and is frequently used when the current demand is small. The limitation is the power handily capacity of the zenker diode. In general, if the current demand exceeds 50mA or if increased stability is needed, or if a variable output voltage is required, a series transistors voltage regulator is used. Fig 2. shows the diagram of the series transistor regulator used in the construction of the project.

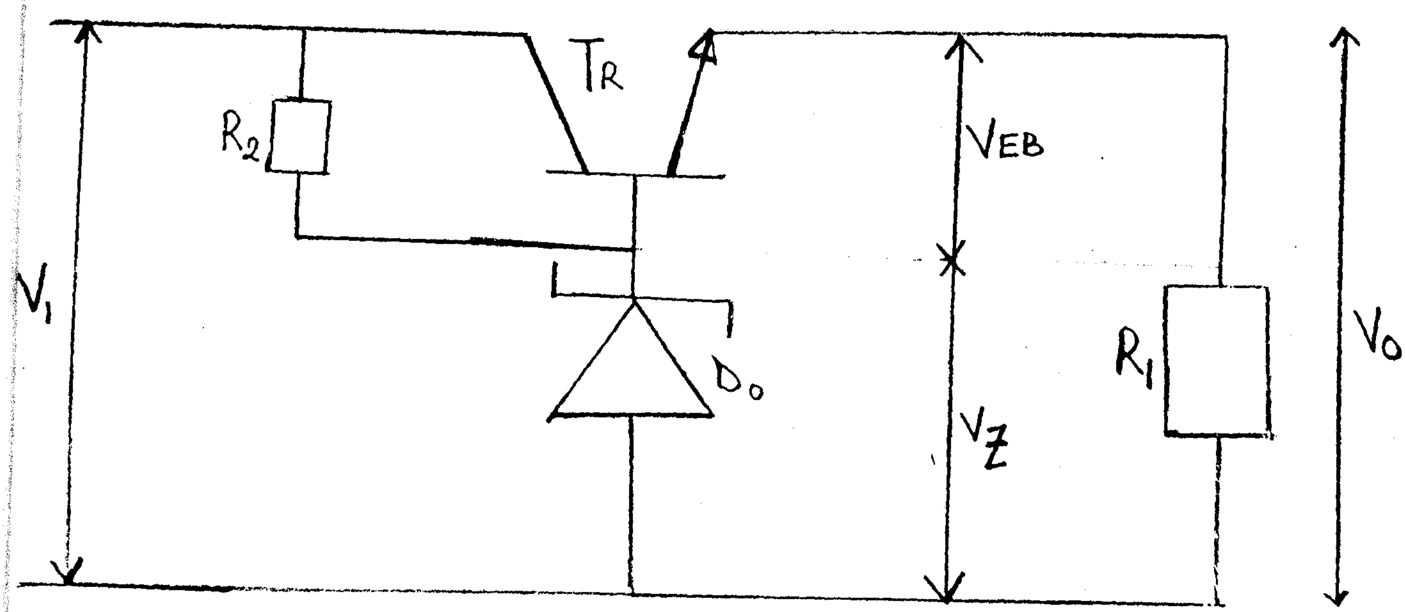


Fig. 2.5: Series transistor regulator.

The stable zenker voltage is applied between the base and the emitter of the n-p-n bipolar transistor. The p.d across the resistor R_2 provides the collector base voltage. The output voltage V_o is given by:-

$$V_0 = V_z + V_{EB}.$$

Where V_{EB} is approximately o.6V, Vo = Vz, where Vz is the constant p.d across the zenner diode.

If the input voltage V_1 change for any reason, the collector base voltage V_{1B} (across Z) change by the same amount because $V_1 = V_{CB} + V_Z$ (across R_2) and V_x is constant. The series control transistor is said to be operating in emitter follower connection, because any voltage applied between its base and emitter is produced across any load in its emitter lead. The output voltage Vo remains unchanged however, because the change of V_{EB} is neglibly small.

The control system is known to be supplied with a regulated supply so as to make the temperature sensing and operational amplifier to work effectively to give a desired result and the require time of abnormality.

CONSTRUCTION, TESTING AND RESULT:

3.1 TEMPERATURE SENSING AND VOLTAGE COMPARISON UNIT:

The degree of hotness or coldness of environment in which the fish dwells need to be sensed by a component known as THERMISTOR. This thermistor used in this project is the negative temperature coefficient type. This type has the characteristics of reducing in resistance whenever the temperature around it is high. Also the lower the environmental temperature, the higher its resistance.

Resistance of the thermistor could be verified or a particular temperature by setting up the verification diagram draw below:

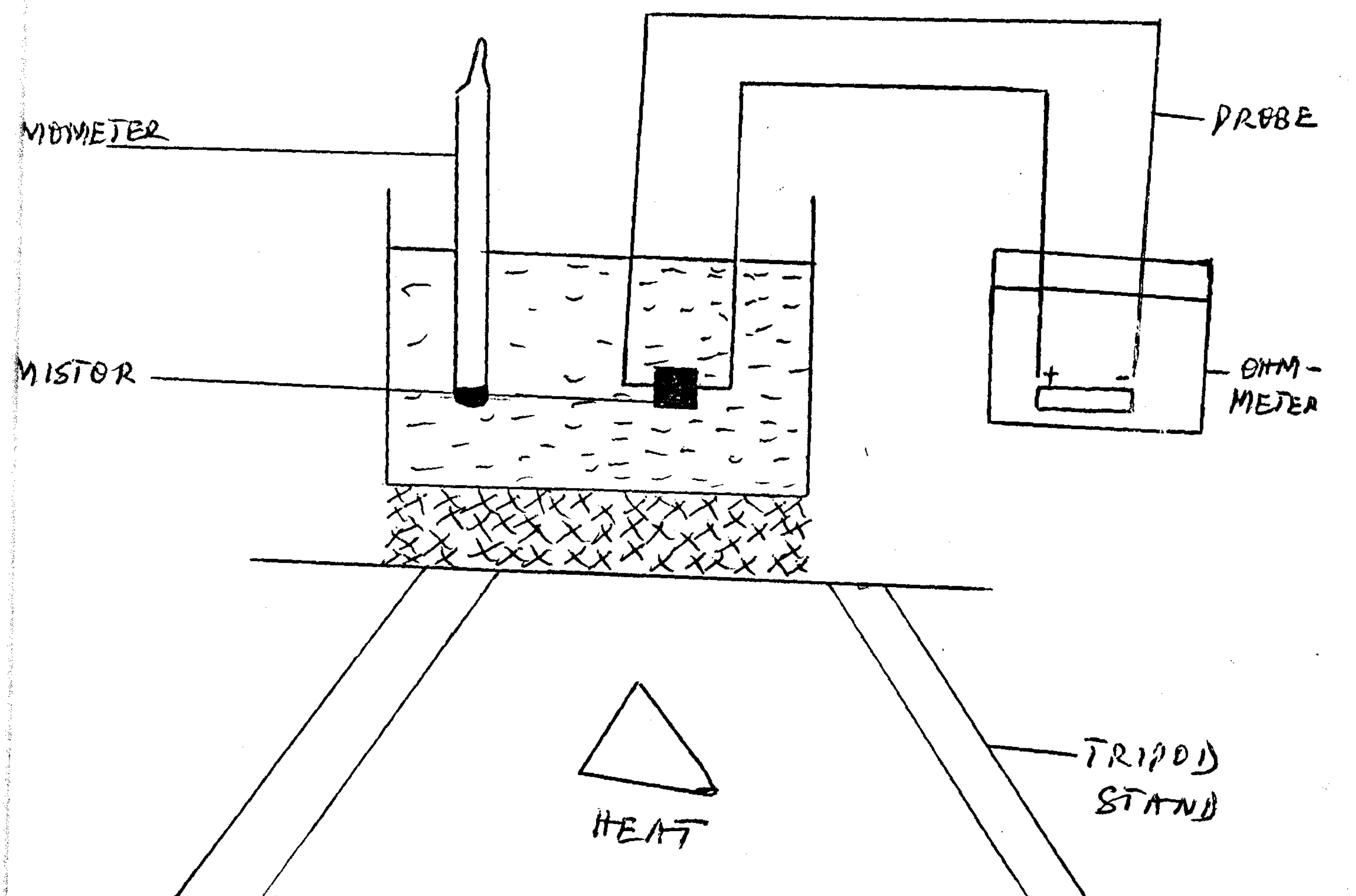


FIG.2.6 Experiment to determine the temperature coefficient of resistance of the thermistor

At room temperature $\varphi_o = 27^0C$,

The thermistor resistance R_{THO} is 25k

When $\varphi_1 = 23^0C$, R_{THO} is 25k

When $\varphi_2 = 23^0C$, R_{THO} is 18k

3.2 <u>TEMPERATURE SENSOR (THERMISTOR)</u>:

The experiment carried out to determine the temperature coefficient of resistance of the thermistor is stated below:

AIM: To determine the temperature coefficient of resistance of thermistor (20^R)

APPARATUS REQUIRED: A thermistor, boiling beaker, tripo-stand, wire-gauze, burner, ohm-meter.

PROCEDURE:-

- Pour some quantity of water into a boiling beaker.
- Insert a thermometer into the water.
- Connect the terminals of the thermistor to the probe of the ohm-meter.
- Insulate the thermistor so as to prevent water from affecting the resistance reading on the meter.
- Insert the thermistor into the water beaker.
- Set the knob of the ohm-meter to $1x10^R$.
- Take not of the temperature reading on the thermometer and the assistance reading on the ohm-meter.
- Put the beaker on the tripod stand and apply heat.
- Take not of the reading on the ohm-meter at different temperature in ^0C.

RESULT:

Resistance (K)	5	10	15	20	25	30	35	40	45
Temperature (^{0}C)	47	40	38	33	31	28	25	22	20

OBSERVATION:

It was observed that, the higher the applied heat, the lower the resistance of the thermistor.

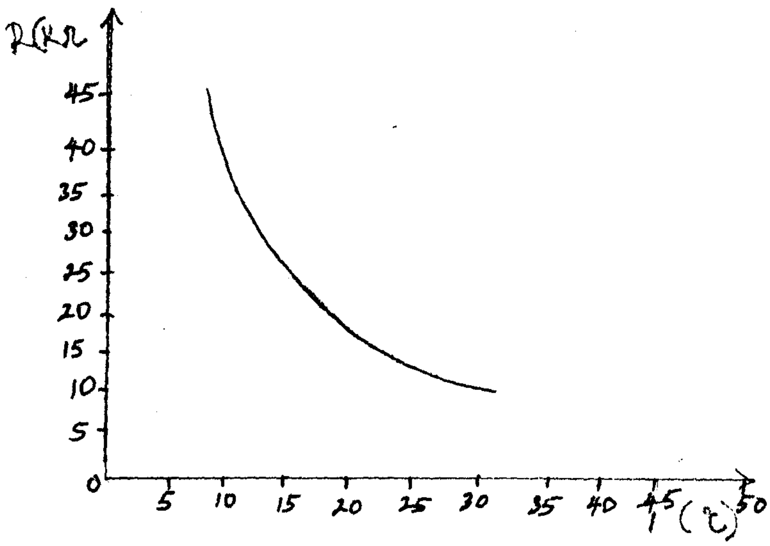


Fig. 2.7: Resistance against temperature characteristics for NTC 20k thermistor.

The temperature coefficient of the resistance α of the thermistor used in the project could be calculated thus;

$$\alpha = \frac{(R_2 - R_1)}{R_1(\varphi_2 - \varphi_2)}$$

$$= \frac{(10 - 5)_R}{5_R(40 - 47)^0C}$$

$= -0.1429^{o}C^{-1}$

Therefore $\alpha = -0.1429$ per degree Celsius.

At different temperature, different amount of current I flows in the circuit.

Consider the diagram drawn below, which is the combination of the temperature sensor and the operational amplifier connected as a voltage comparator.

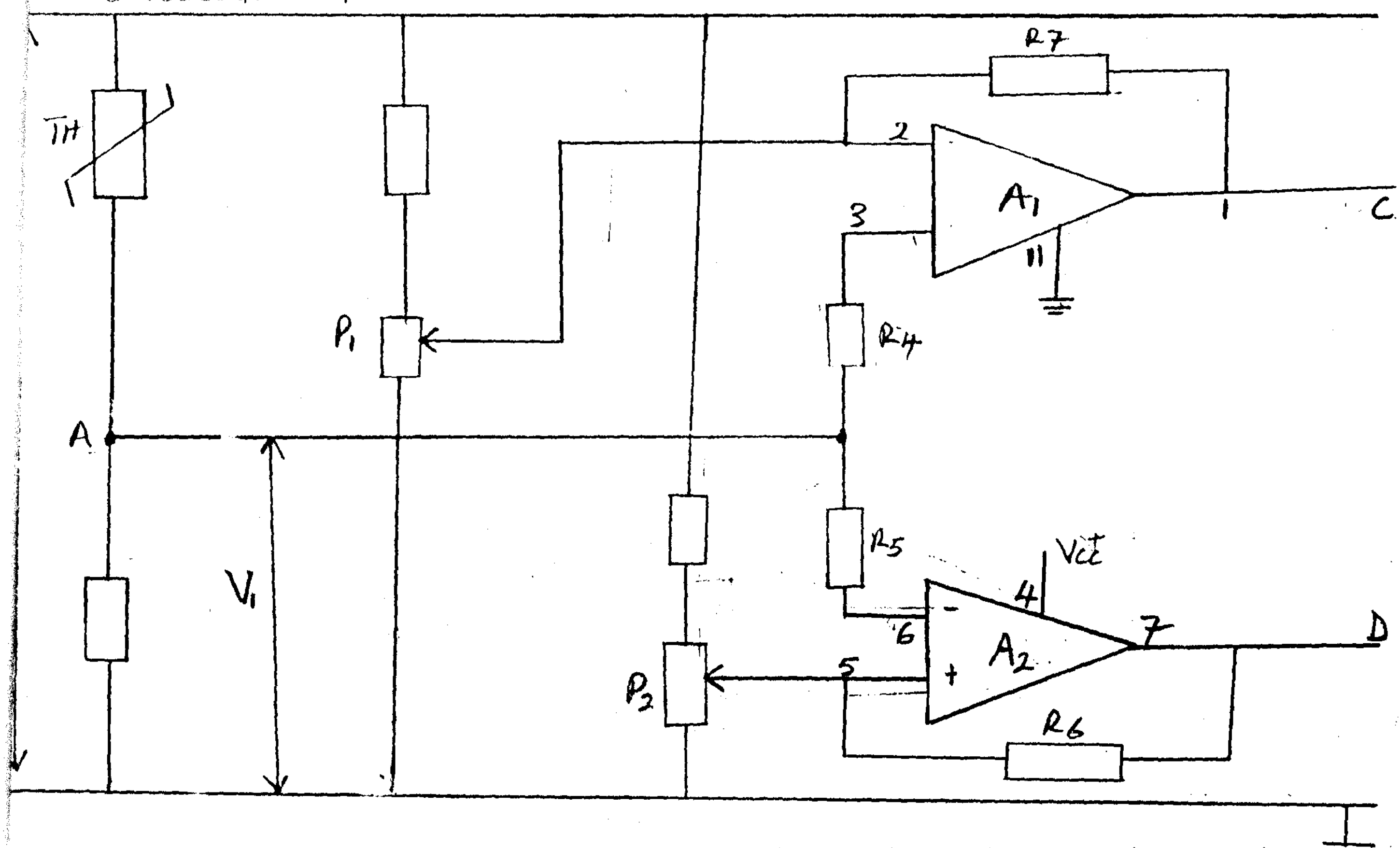


Fig. 2.8: Circuit diagram of the sensing unit and comparison unit.

From the figure above, it is clearly seen that thermistor (TH) and resistor R_3 are forming a potential divider, where point A is the junction of the potential divider TH - R_3.

The voltage V and current I at the junction A could be calculated using these formulas:

$$\text{Current } I = \frac{\text{Input voltage } V_o}{R_3 + R_{TH}.}$$

and

$$\text{Voltage } V_1 = \frac{R_3}{R_3 + R_{TH}.} \times V_o$$

At $\varnothing_0 = 27^0C$, $R_{TH0}. = 25k$

$$\text{therefore; } I = \frac{12v}{(11 + 25)k}$$

$$= 0.33mA$$

$$V = \frac{11K}{(11 + 25)K} \times 12V$$

$$= 3.67v.$$

At $\varnothing_2 = 37^0C$, $R_{TH1}. = 26k$

$$\text{then ; } I = \frac{12v}{(11 + 26)k}$$

$$= 0.324mA$$

$$V = \frac{11K}{(11 + 25)K} \times 12V$$

$$= 3.57v.$$

At $\varnothing_1 = 40^0C$, $R_{TH1}. = 26k$

$$\text{then ; } I = \frac{12v}{(11 + 18)k}$$

$$= 0.414mA$$

$$V = \frac{11K}{(11 + 18)K} \times 12V$$

$= 4.55V.$

At $\varnothing_3 = 23^0C$, $R_{TH1}. = 26k$

then ; $$I = \frac{12v}{(11 + 17)k}$$

$$= 0.429mA$$

$$V = \frac{11K}{(11 + 17)K} \times 12V$$

$$= 4.71V.$$

The above calculated voltages are at pin3 and pin6 of operational amplifier A1 and A2 respectively. Pin3 is the non inverting input of opamp A1 while Pin6 is the inverting input of opamp A2.

For the voltage comparation to be carried out, a reference voltage is applied to pin2 which is the inverting input for opamp A1 and at Pin5 which is the non-inverting input for the opamp A2. This could be achieved by varying potential divider P1 and P2 respectively.

At a particular temperature, if the voltage at Pin3 is higher than the reference voltage at Pin2, there would be a positive output at pin1 of the opamp A1. But if the voltage at pin 2 is higher than that at pin3, there would be a negative output at pin1.

Also considering opamp A2, if the voltage at Pin6 is higher than the reference voltage at pin5, a negative output is got at pin7. But at a point in time when the reference voltage at pin 5 is higher than voltage at pin6, a positive signal is got as the output at pin7.

The project is meant to detect a temperature lower than 23°C and temperature higher than 40°C. So at a temperature lower than 23°C, the voltage at pin6 at opamp A2 is lower than the reference voltage at pin 5 of the opamp A2. So a positive signal is output at Pin7 to bias transistors TR_1 .

Also, if at higher temperature of more than 40°C, pin3 has a voltage higher than reference voltage at pin2 so, a positive signal is at pin1 to bias transistor TR_2.

From these illustration of the voltage comparation, a temperature greater than 23°C but less than 40°C would result into no output from the opamp A1 or A2. The function of the resistor R6 and R7 is to reduce the given of both opamp and present distortion of the system during switching action. Pin 4 of the operational amplifier LM 324 is connected to the +12V supply while pin11 is grounded.

3.3 INDICATION, SWITCHING AND ALARM UNIT.

This is the unit which gives both visual indication and switching to the alarm unit to give an audible tone of any particular abnormal temperature which is chosen to be 23°C to 40°C.

3.4.1. BIASING OF THE TRANSISTOR AND RELAY ENERGISING.

Considering the diagram draw below which comprises of both the indicator (LED) and the switching unit which serve as a change over for the alarm section.

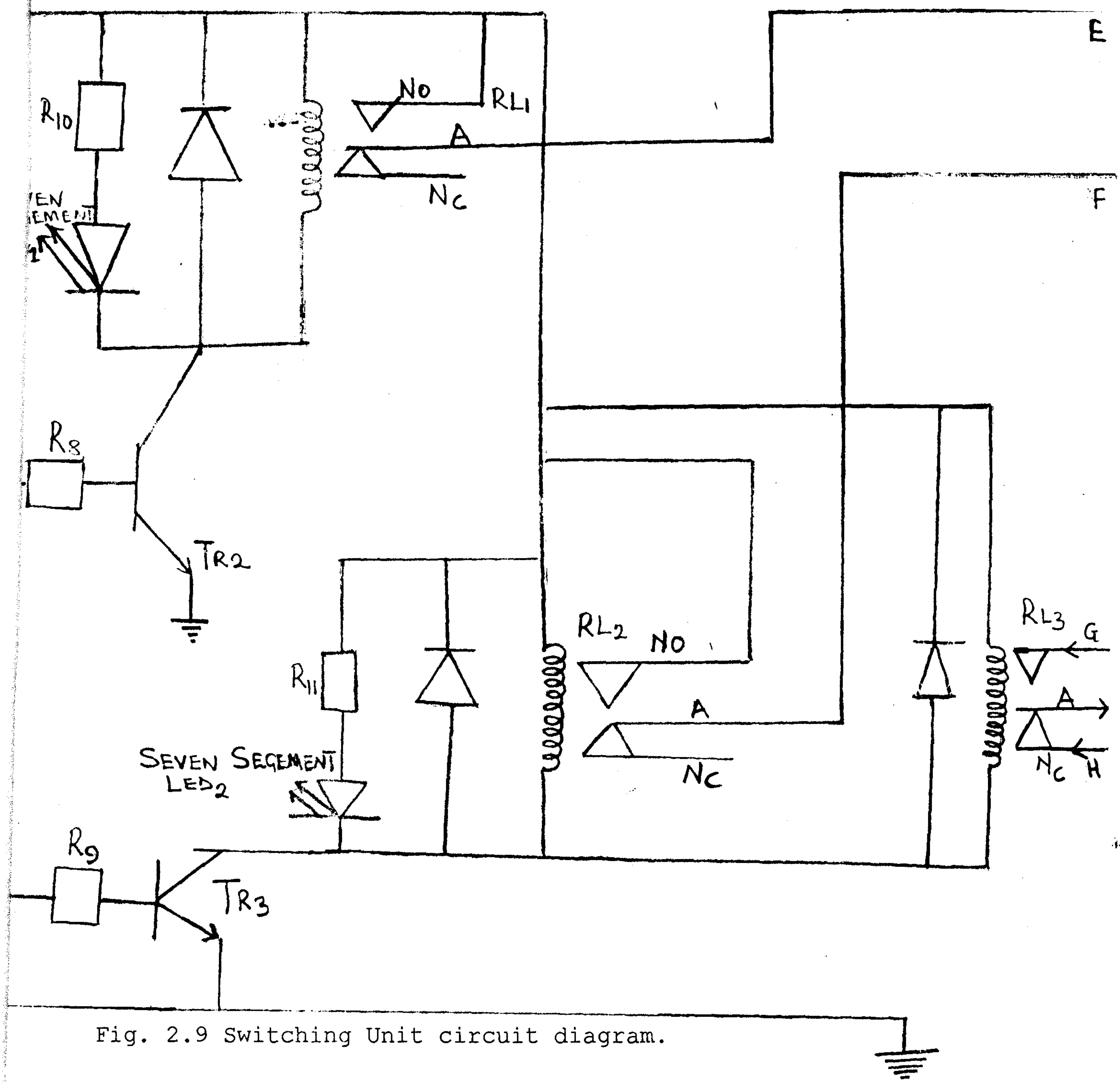


Fig. 2.9 Switching Unit circuit diagram.

As stated in 3.2, that operational amplifier A1 takes care of high temperature abnormality while operational amplifier A2 takes care of the low temperature abnormality.

A positive output voltage from opamp, A1, which is the biasing voltage for transistor TR_2 biases the transistor which eventually gives a zero voltage (OV) at the negative terminal of the relay 1.

This relay RL1 is energised and make the normally opened (ND) terminal to be closed. The closing of this (ND) terminal connect the alarm circuit to the positive supply (VCC). At the same time, the LED1 comes on to indicate the abnormality in the sensed temperature.

Similarly at low temperature, opamp A2 gives a positive voltage to bias the transistor TR_3 which now energies the relay RL2 and makes the LED_2 comes on. Resistor R_8 and R_9 limit the biasing current I_B of both transistor.

The relay used is the miniature electromagnetic type. This work on the principle of electro-magnetic induction. When it is energised, the current flowing in the coil set up a magnetic flux which attracts the armature of the relay to make and break contact at the No and Nc terminals respectively.

ALARM UNIT:

This is the unit that gives an audible tone to alert anybody that is around in where the aquarium is placed. The time produced at high temperature is at a frequency of 1.5KHZ while the time produce at low temperature is at a frequency of 800HZ. The kind of connection used in the alarm circuit is shown as an ASTABLE MULTIVIBRATOR. The diagram of the alarm unit is drawn below in fig 3.0.

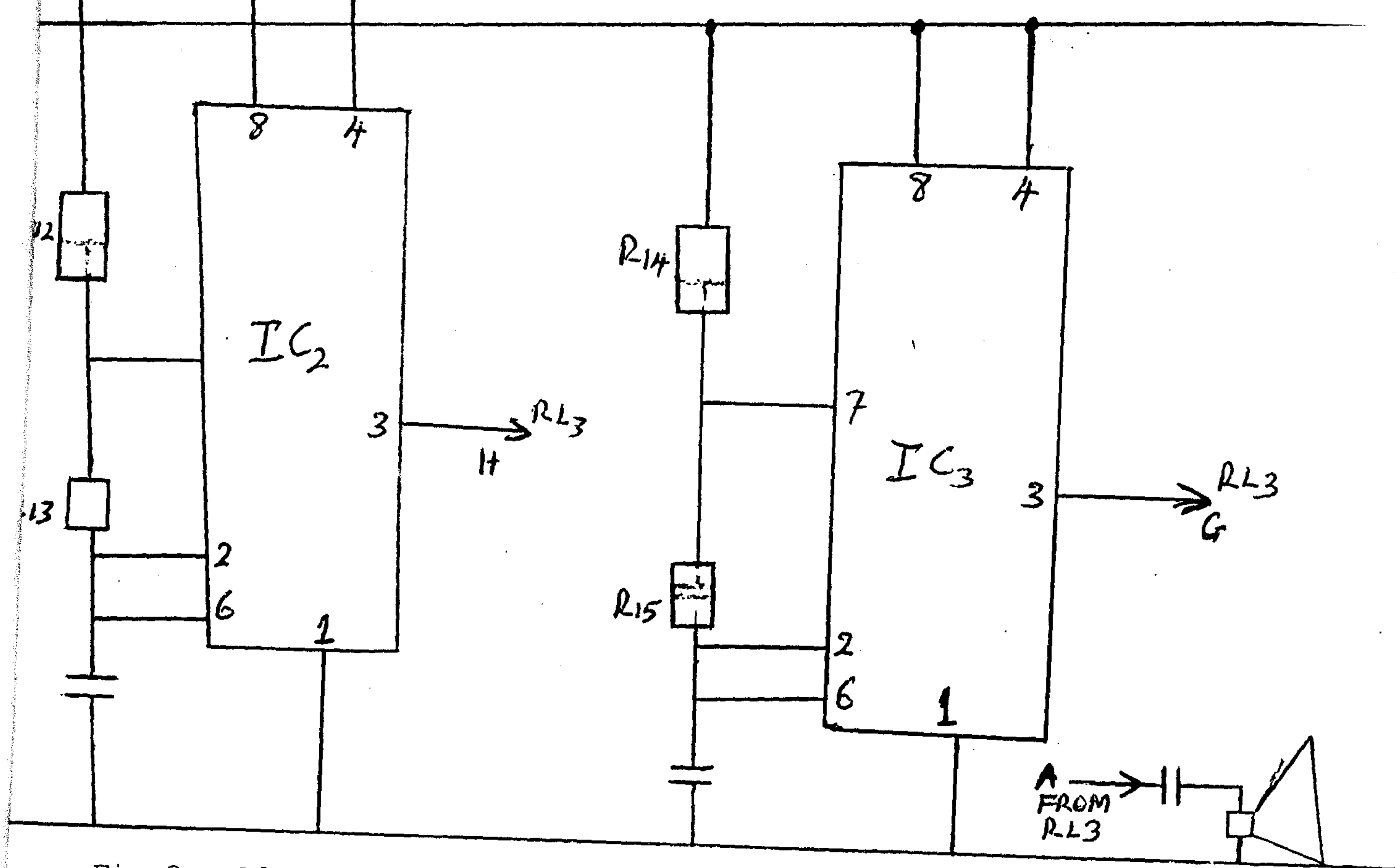


Fig 3. Alarm circuit diagram.

As stated in the first paragraph of this chapter the alarm circuit gives two different times at frequencies 800HZ and 1500HZ.

$$\text{Low frequency } FL = \frac{1.44}{C5(R_{14} + 2R_{15})} = 800HZ$$

$$\text{period } TL = \frac{1}{FL}$$

$$\text{High frequency } FL = \frac{1.44}{C5(R_{12} + 2R_{13})} = 800HZ$$

Now referring to the circuit

$$FL = \frac{1.44}{1000\ (X10^{-9}(8K + 2 \times 5K)} = 800HZ$$

$$\text{period } T_L = \frac{1}{F_L} = \frac{1}{800HZ} =$$

$$FH = \frac{1.44}{100 \times 10^{-9} (8K + 2 \times 5R)} = 1.5KHZ$$

Considering IC2 which takes care of the indication of high temperature. A square wave is generated at Pin3 which now bias the power transistor TR4. This make the speaker (TRANSDUCER) to be energised to give an audio at a frequency of 1.5KHZ. Also IC3 produces an audio sound at a frequency of 800HZ to indicate a low temperature. The speaker is rated for 8 1.0W.

3.5 CONSTRUCTION :

The components required for the construction of this project, were mounted first in the bread-board in order to test if the circuit is correct. For the construction. They were latter (after tested and sure that the circuit will work) mounted on a vero-board which is rectangular in shape for the permanent soldering. The vero board has copper lines at it's back for the continuous flow of electric current to make a complete circuit for a proper function of the system.

Electric soldering iron was used in permanent soldering of the mounted components. The electric soldering iron used is rated 220V/40w. This 40W is used so as to prevent the component from being over heated.

Further more, the vero-board with components mounted in it is then assembled in a wooden case that is rectangular in shape. The dimension of the case is show in the diagram below.

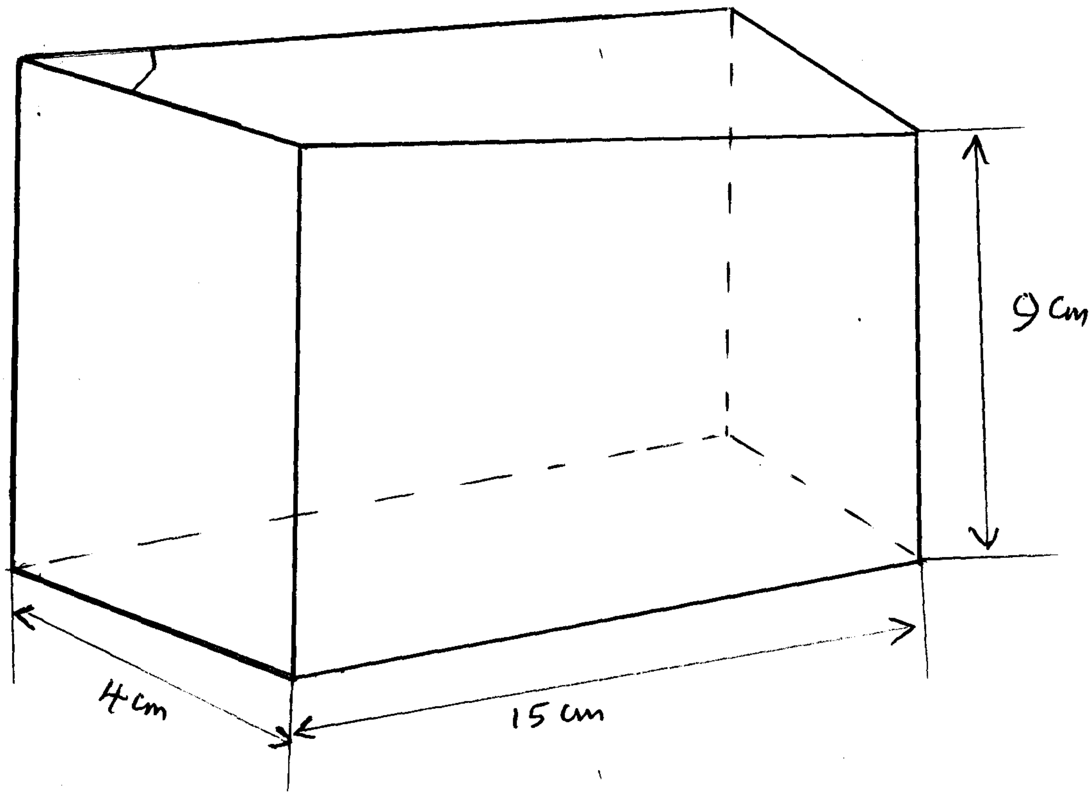


Fig. 3.1 **PROJECT CASE**

Since the project is constructed for an Aquarium, we need to insert the insulated temperature sensor into the water in that particular Aquarium where the fish dwells. The installation of the thermistor (sensor) was done by melting polythene on it and coating the external part with Aradite. This insulation is of great importance so as to prevent the resistance of the sensor from being affected by water.

3·6 TESTING AND RESULT

After the project has been constructed and assembled in the wooden bus, there is need to test the work constructed in order to be sure that the project work in accordance to its specification.

The testing of the project was done by covering the thermistor, which is the sensor for the sensing unit, with Polythene leather and was melted together. Araldite was used to rub it to serve as Insulator. It was dipped into a bowl of water, a thermometer was placed beside it and the whole was placed on heater.

The two variable resistors were set to their respective values for both minimum and maximum temperature to be read. As the temperature of the water was increasing (as indicated by the thermometer) the rising in the thermometer was noticed. At the temperature of indication.(i.e. above maximum 40^0C), the green LED was on and the alarm blew.

The thermistor was quickly removed from the hot water and was dipped into an ice for the cooling effect to take place. As the thermistor was cooling, the temperature was noticed in the thermometer. At the temperature of indication (i.e. below minimum 23^0C), the yellow LED was on and the alarm blew.

The result of this testing indicated that the aim and the objective of the project was achieved. Since the project is meant to indicate and blow alarm at temperature above the maximum temperature of a typical tillapia (40^0C) as a case study. And to indicate and blow alarm at temperature below the minimum temperature of the same case study (Tillapia: temperature 23^0C).

The result of the project was that, the green light indicate the maximum temperature of the Aquarium. This shows that whenever the green light is on the temperature at that time is above maximum (which is 40^0C) and a remedy to reduce it must be taken.

The yellow light indicate the minimum temperature of the aquarium. This shows that whenever the yellow light is on, the temperature at that time is below minimum (which is 23^0C) and a remedy to increase it must be taken. In both situations, the alarm will blow, but it is the light that gives the particular temperature indication.

CHAPTER FOUR.

CONCLUSION: CONCLUSION AND RECOMMENDATION

The write up I have done so far is based on the construction of a temperature monitor which indicates and gives an audio sound, at an abnormally low or high temperature in the environment of a fish in an aquarium. These temperature at which the indication and audio sound are expected to come on are 23^0c as low temperature, and 40^0C as high temperature. The green LED indicates low temperature while the yellow LED indicates high temperature.

Also the audio sound at low and high temperature are 800HZ and 1500HZ respectively.

The water in that particular aquarium where the fish dwells.

The insulation of the thermistor (sensor) was done by melting polyethylene on it and coating the external part with aerated. This insulation is to great importance so as to prevent the resistance of the sensor from being affected by water.

4.1. RECOMMENDATION:

This project is a "THESIS" which is liable to modification in the future. It is an interesting project that can be work on to see any modification that can be done in order to improve the project and make it more marketable.

The project can be further improved by the addition of digital display (Seven segment) to display the minimum temperature and the maximum temperature at the interval of the audio sound. The idea was restricted due to lack of money. I hereby recommend it to future project tittle for the next coming students for the modification.

The important component required the Thermistor (NTC) was difficult to get and this contributed to a delay in the project work.

The project has introduced me to some of the likely problems which an electronic circuit could have and also method and ways of trouble shooting the fault.

I do strongly recommend that the school should hence-forth encourage the students to lay their hands on new project and adequate support as much as possible to make the required components available for the students should be given.

REFERENCES

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2. HUGES Electrical Technology, Sixty Edition, Addison Wesley Longman Limited, 1987
3. Nelkon and Parker Advanced level physics, sixty edition, Heinemann Educational books Limited, 1987

4.2 <u>COST OF CONSTRUCTION OF THE PROJECT</u>:

S/NO	COMPONENTS	QTY	COST	
1.	12V Transformer	1	150	00
2.	Silicon diode (IN4001)	7	70	00
3.	Capacitor (100μF 16V)	1	30	00
4.	Capacitor (100μF 25V)	1	30	00
5.	Capacitor (0-1μF 50V)	2	60	00
6.	Capacitor (10μF 50V)	1	30	00
7.	Resistors (Coloured)	17	170	00
8.	Led (Red, Yellow, Green)	3	30	00
9.	Transistor (C945)	1	10	00
10.	BC 108	2	40	00
11.	Zenker Diode 12V	1	15	00
12.	Variable Resistor 25K	2	60	00
13.	Thermistor (NTC)	1	120	00
14.	12V Relay	3	270	00
15.	IC LM 324	1	50	00
16.	IC 555 Timer	2	80	00
17.	IC Socket	3	120	00
18.	Speaker (0.5W/8)	1	100	00
19.	Jumper wire	10yd	100	00
20.	Soldering lead	10yd	150	00
21.	Vero-board	1	80	00
22.	Connecting cord	5yd	50	00
23.	Araldite	1	80	00
24.	Soldering Iron	1	120	00
25.	Miscelluneous	-	250	00
	TOTAL COST		₦2265	00