DESIGN AND CONSTRUCTION OF A TOUCH ACTIVATED ELECTRONIC SWITCH

BY

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DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY

MINNA.

NOVEMBER, 2008

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A THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA. IN PARTIAL FUFILLMENT OF THE REQUIREMENT OF AWARD OF BACHELOR OF ENGINEERING (B.ENG) IN THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING.

NOVEMBER, 2008

DEDICATION

This project work is dedicated to God Almighty, for his infinite mercy and guidance throughout my stay in school and also throughout the project work.

Also to my wonderful and lovely parents and siblings, for their care, support, inspiration, support, prayers and most of all being there for me throughout my stay in school.

DECLARATION

I IYOGUN PAUL MINEZE hereby declare that this project work is done by me and has never to my knowledge been submitted elsewhere for the award of a degree. I also hereby relinquish the copyright to the Federal University of Technology, Minna

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ACKNOWLEDGEMENT

Life has taught me that the future hands you over what you have given it in the past. It is with deep sense of appreciation that I acknowledge those who have in one way or the other contributed to the success of this project and made my stay in school worth it.

My gratitude goes to my parents, Barr & Mrs. G.O.Iyogun my wonderful brothers Ikoghene, Ainogie, Onose and my aunts.

Special thanks go to my project supervisors, Engr. Adamu Murtala Zungeru for their timeless assistance during the project work, special thanks also goes to my lecturers in the department, for all the knowledge impacted on me during my years in the department.

Finally, I will say a big thank you to all my wonderful friends who have made my stay in the department both memorable and interesting. I'm saying thank you to friends like Femi, Uche, Bright, Gozie, Kaffy, Azeez, Bola, I'll be forever grateful for your sincere friendship. I'll really miss u all.

ABSTRACT

Creating a device capable of switching other devices with the simplest of ease, multiplicity in switching functions, preserving aesthetics and most importantly very reliable. A **TOUCH ACTIVATED ELECTRONIC SWITCH** offers these qualities based on the knowledge of induced AC and resistance in humans.

When the device feels a touch it responds by switching ON any appliance attached to it based on induced AC at the input pad.

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CHAPTER ONE

INTRODUCTION

1.0 GENERAL INTRODUCTION

Electronic devices are being used in almost all the industries for quality control automation and they are fast replacing the present vast army of workers engaged in processing and assembling in the factories. Great strides taken in the industrial applications of electronics during the recent years have demonstrated that this versatile tool can be of great importance in increasing production, efficiency and control [1].

When electricity was discovered a new revolution of devices to aid humans became the new order. This principles of electricity propounded by faraday [2] " the quantity of electricity discharged in a conductor is directly proportional to the quantity of electron flowing through it" led to wide study in conductors semiconductors leading to the unearthing of diodes transistors etc., a new era of electronics was born.

Though many invention in electronics came into being, before then was the danger posed by electricity, it became imperative that control measures needed to be implored to avoid danger of electrocution or damage to devices.

When a quantity becomes unrestricted it becomes difficult to use and also poses a great threat any discontinuity purposely imposed on a circuit serves as a control measure and mostly this devices are known as switches.

A switch [3] is simply used to make or interrupt an electric circuit, at will. From the users point of view the electricity in any device consists of light switches or power points(switched socket outlets), these fittings are known as accessories to them, the way outlets are served is quite secondary but it is quite secondary to the user who is only concerned with the appearance and function of the outlet.

In electronic or electrical appliance, switches are the most common consumer interface this is why the style, appearance, and multiple use of the TOUCH ACTIVATED ELECTRONIC SWITCH became the main focus of my project.

This title could also come as a TOUCH ACTIVATED ELECTROMECHANICL SWITCH. Electromechanical because it possesses mechanical part in the relay device.

1.1 OBJECTIVE

The aims of this project are as follow

- To develop an electronic switch that is power efficient reliable and has the ability to use on independent power source
- To develop a device that isolates the control circuit from the main circuit as can be done in high voltage and distribution substations[4]
- To develop a portable device that has multiple applications

1.2 METHODOLOGY

With the advancement in study of switches having different advantages over one another(mechanical and electromechanical switches) the idea of a TOUCH ACTIVATED ELECTRONIC SWITCH came about. The construction started with the idea of BODY CAPACITANCE [5] a biological property of the human body that makes it a good capacitor and able to store charges, with a body resistance of about 2mega ohms [8] the low induced AC' in human body needed to be amplified to a reasonable amount (about 0.6 or above) to turn on a transistor. The transistor is then coupled to a relay for fast switching. If the transistor is turned on, the voltage at the collector is pulled down at saturation under this condition the transistor is said to be cut-off [2] making the difference across the coil of the relay to be high enough to magnetize it this then turns ON the room or house light.

1.3 SCOPE OF PROJECT

The main scope of this project is the utilization of a comparator to interpret the intelligence of the input signal and produce an output to trigger the transistor-switch when contact is made on the touch pad. It in turn produces an output.

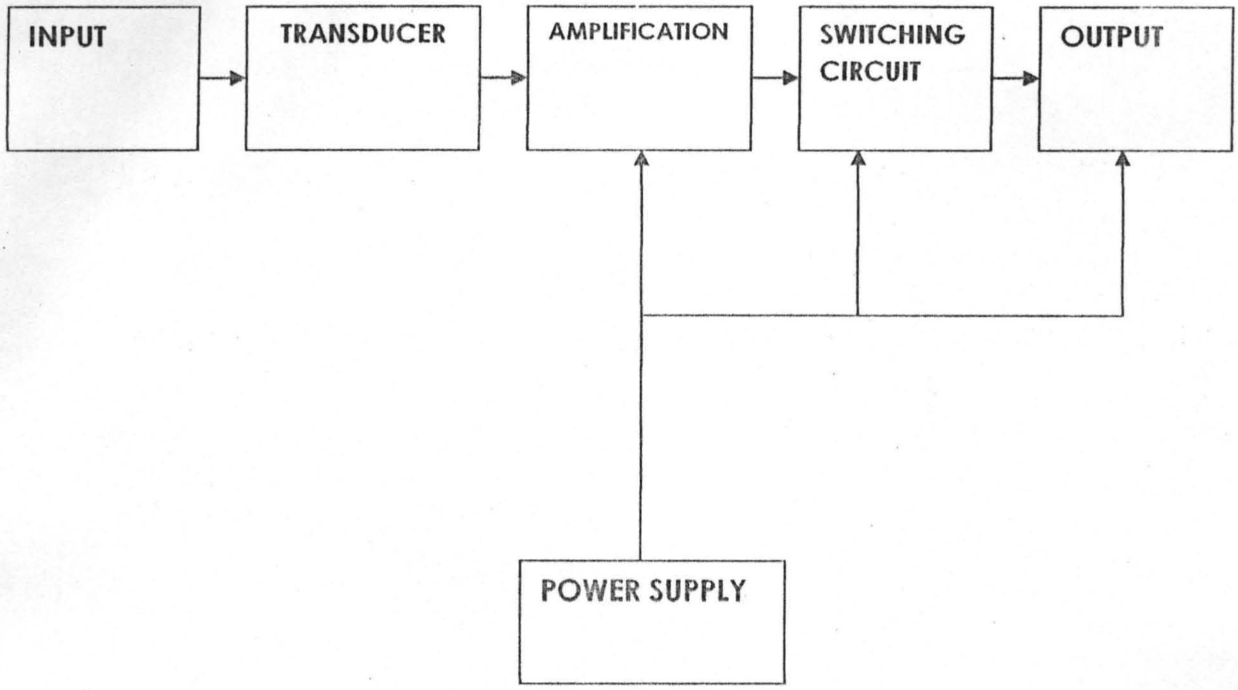
1.4 LIMITATION

At the design stage precise values of components calculated were not readily available so convenient estimates were used, this was advantageous in some aspects such as providing tolerance, that is, gives more protection from burning and was disadvantageous by reducing the overall preciseness of design thus also increasing budget.

1.5 SOURCE OF MATERIAL

Information that aided the design and construction of this security system, were sourced from the internet, Analog lecture notes, text books, consultation with higher authorities and colleagues.

1.5 Block Diagram



CHAPTER TWO

2.0 LITERATURE REVIEW

The discovery of transistor action in 1947[6] was the beginning of technological revolution still continuing in the twenty first century. Most devices are an outgrowth of early developments in semiconductor transistors and the TOUCH ACTIVATED ELECTRONIC SWITCH is not an exception. Technological advancement in the electronic and electromechanical industries has led to rapid development in the field of electrical engineering of concern is the electronic switch.

According to New Standard Encyclopedia (volume 1) [7] "Man power is an important part of an electronic system". Invariably TOUCH ACTIVATED ELECTRONIC SWITCH is designed to provide reliable switching for attached devices

A **touch switch [8]** is a type of switch that only has to be touched by an object of greater capacitance to operate. It is used in many lamps and wall switches that have a metal exterior as well as on public computer terminals.

Touch screens includes an array of touch switches on a display

Switches that is sensitive to human touch -- as opposed to switches that must be flipped or pushed to make and break a mechanical connection -- have been around for many years. They certainly have advantages, and the most important is the fact that dirt and moisture cannot get into the switch to gum it up or damage it. Over the years, many different properties of the human body have been used to flip touch-sensitive switches:

Temperature - The human body is generally warmer than the surrounding air. Many elevators therefore use buttons that are sensitive to the warmth of the human finger.

These buttons, of course, don't work if you have cold hands. The motion-sensitive lamps you see on people's patios also sense the heat of the human body.

Resistance - The human body, being made mostly of water, conducts electricity fairly well. By placing two contacts very close together, your finger can close the circuit when you touch it.

Radio reception - You may have noticed that, when you touch an antenna, the reception gets better on a TV or Radio. That's because the human body makes a pretty good antenna. There are even small LCD TVs that have a conductive neck strap so that the user acts as the antenna! Some touch-sensitive switch designs simply look for a change in radio-wave reception that occurs when the switch is touched.

Touch-sensitive lamps almost always use a fourth property of the human body -- its **capacitance**. The word "capacitance" has as its root the word "capacity" -- capacitance is the capacity an object has to hold electrons. The lamp, when standing by itself on a table, has a certain capacitance. This means that if a circuit tried to charge the lamp with electrons, it would take a certain number to "fill it." When you touch the lamp, your body adds to its capacity. It takes more electrons to fill you and the lamp, and the circuit detects that difference. It is even possible to buy little plug-in boxes that can turn any lamp into a touch-sensitive lamp. They work on the same principle.

Many touch-sensitive lamps have **three brightness settings** even though they do not use three way bulb. The circuit is changing the brightness of the lamp by changing the "duty cycle" of the power reaching the bulb. A bulb with a normal light switch gets "full power." Imagine, however, that you were you were to rapidly turn the power to the bulb on and off (say 100 times per second) -- then the bulb would only burn half as brightly because its duty cycle is 50 percent (half on, half off). "Rapidly switching the bulb on and off" is the basic idea used to change the brightness of the lamp -- the circuit uses zero percent (off), 33 percent, 66 percent and 100 percent duty cycles to control the lamp's brightness.

In applications where multiple switching options are required (e.g., a telephone service), mechanical switches have long been replaced by electronic switching devices which can be automated and intelligently controlled.

The switch is referred to as a gate when abstracted to mathematical form. In the philosophy of logic, operational arguments are represented as logic gate. The use of electronic *gates* to function as a system of logical gates is the fundamental basis for the computer—i.e. a computer is a system of electronic switches which function as logical gates.

TOUCH ACTIVATED ELECTRONIC SWITCH has become a standard equipment and is beginning to gain prominence as a more intelligent way of switching appliances and also due to the multiplicity of its uses.

2.1 THEORETICAL BACKGROUND

2.1.1 TOGLE SWITCH

[4]In the simplest case, a switch has two pieces of metal called *contacts* that touch to make a circuit, and separate to break the circuit. The contact material is chosen for its resistance to corrosion, because most metals form insulating oxides that would prevent the switch from working. Contact materials are also chosen on the basis of electrical conductivity, hardness resistance to abrasive wear), mechanical strength low cost and low toxicity.

Sometimes the contacts are plated with noble metal. They may be designed to wipe against each other to clean off any contamination. Nonmetallic conductors, such as conductive plastic, are sometimes used.

Actuator

The moving part that applies the operating force to the contacts is called the actuator, and may be a **toggle** or dolly, a **rocker**, a **push-button** or any type of mechanical linkage

2.1.2 Make-before-break, break-before-make switch

In a multi-throw switch, there are two possible transient behaviors as you move from one position to another. In some switch designs, the new contact is made *before* the old contact is broken. This is known as **make-before-break**, and ensures that the moving contact never sees an open circuit (also referred to as a **shorting switch**). The alternative is **break-before-make**, where the old contact is broken *before* the new one is made. This ensures that the two fixed contacts are never shorted to each other. Both types of design are in common use, for different applications.

2.1.3 Biased switches

A biased switch is one containing a spring that returns the actuator to a certain position. The "on-off" notation can be modified by placing parentheses around all positions other than the resting position. For example, an (on)-off-(on) switch can be switched on by moving the actuator in either direction away from the centre, but returns to the central off position when the actuator is released.

The momentary push-button switch is a type of biased switch. The most common type is a **push-to-make switch**, which makes contact when the button is pressed and breaks when the button is released. A **push-to-break switch**, on the other hand, breaks contact when the button is pressed and makes contact when it is released. An example of a push-to-break switch is a button used to release a door held open by an electromagnet. Changeover push button switches do exist but are even less common.

2.1.4 Special type switches

Switches can be designed to respond to any type of mechanical stimulus: for example, vibration (the *trembler switch*), tilt, air pressure, fluid level (the *float switch*), the turning of a key (*key switch*), linear or rotary movement (the *limit switch* or **microswitch**), or presence of a magnetic field (the *reed switch*).

2.1.4.1 Mercury tilt switch

The mercury switch consists of a drop of mercury inside a glass bulb with 2 contacts. The two contacts pass through the glass, and are connected by the mercury when the bulb is tilted to make the mercury roll on to them.

This type of switch performs much better than the ball tilt switch, as the liquid metal connection is unaffected by dirt, debris and oxidation, it wets the contacts ensuring a very low resistance bounce free connection, and movement and vibration do not produce a poor contact.

2.1.5 Knife switch

Knife switches are unique, because rather than employing an enclosed circuit connection area with a rubber- or plastic-insulated section for the user, the contacts and bridge are fully exposed.

The "knife", a flat metal swinging arm, is moved by the user between two or more contact areas. The knife and contacts are typically formed of copper, steel, or brass, depending on the application.

The primary advantage of a knife switch is the extremely high current capability inherent to the design. The amount of surface area on the "knife" that shorts the contacts is also extremely high, allowing a wide range of high voltage or high amperage applications with no circuit degradation, choke, or arcing during the switch throw. Thicker components need only be accompanied by wider contacts to conduct higher currents, which allow the design to scale extremely well with size.

Although knife switches are inferior to traditional switches in applications where user safety is paramount, knife switches are still commonly employed in everyday high-voltage applications such as building transformers, large power relays, and air-conditioning units.

2.2 Component Theory

2.2.1 Transistors

Transistors are active components used basically as amplifiers and switches. The two main types of transistors are. The bipolar transistors whose operation depends on the flow of both minority and majority carriers, and the unipolar of field effect transistors (called FETs) in which current is due to majority carriers only (either electrons or holes). The transistor as a switch operates in a class A mode. In this mode of bias the circuit is designed such that current flows without any signal present. The value of bias current either increased or decreased about its mean value by input signals (if operated as an amplifier), or ON and OFF by the input signal if operated as a switch fig.2.0 shows the transistor as a switch.

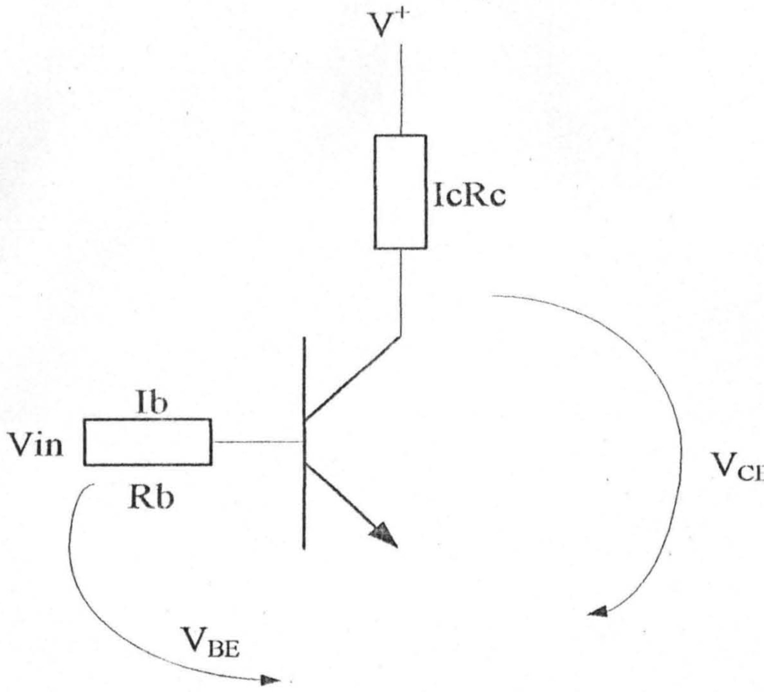


Fig. 2.0 transistor as a switch

For the transistor configuration, since the transistor is biased to saturation

$V_{CE} = 0$, when the transistor is ON,

This implies that,

$V_{+} = I_C R_C + V_{CE}$ ....(2.5)

$V_{in} = I_B R_B + V_{BE}$ ....(2.6)

$\frac{I_c}{I_b} = h_{fe}$ ....(2.7)

$R_b = \frac{V_{in} - V_{BE}}{I_b}$ ....(2.8)

Where

I_c = collector current

I_b = base current

Vin = input voltage

V^+ = Supply voltage

V_{CE} = collector emitter voltage

H_{fe} = current gain

V_{BE} = Base emitter voltage.

2.2.2 Comparator (LM741)

General Description

The LM741 series consists of two independent precision voltage comparators with an offset voltage specification as low as 2.0 mV max for two comparators that were designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage. These comparators also have a unique characteristic in that the input common-mode voltage range includes ground, even though operated from a single power supply voltage.

Features

Wide supply (Voltage range: 2.0V to 36V, Single or dual supplies: ±1.0V to ±18V), Very low supply current drain (0.4 mA) independent of supply voltage, Input common-mode voltage range includes ground, Differential input voltage range equal to the power supply voltage

Applications

Application areas include limit comparators, simple analog to digital converters; pulse, square wave and time delay generators; wide range V_{CO}; MOS clock timers; multivibrators and high voltage digital logic gates

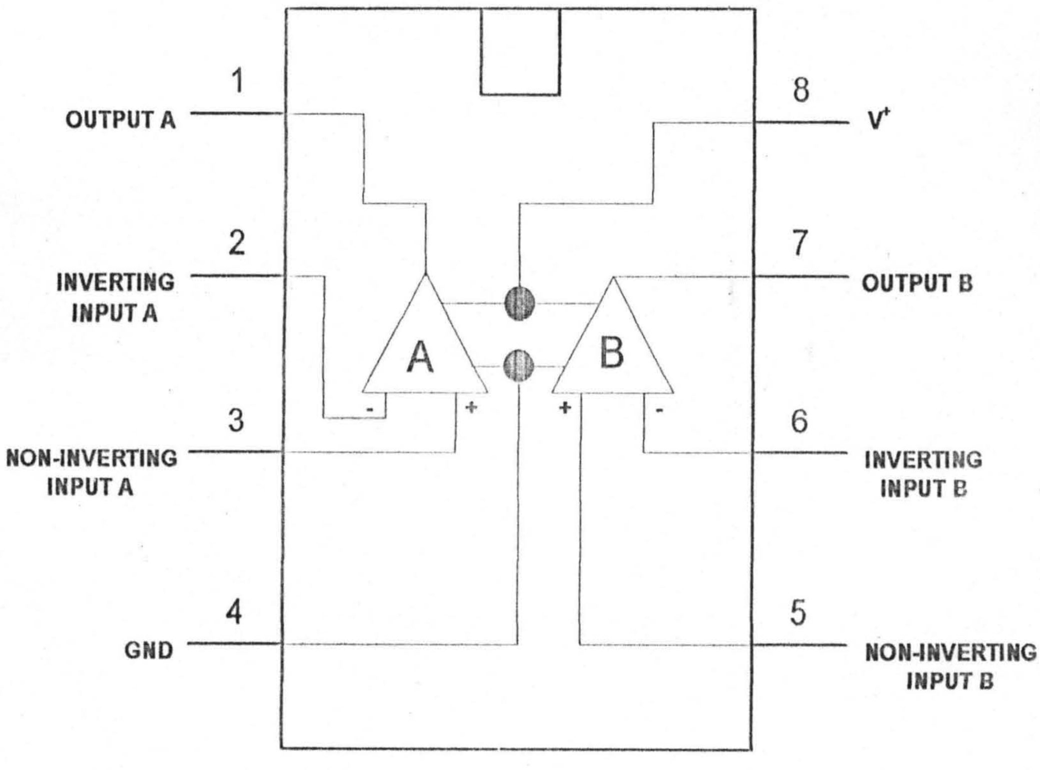


Fig.2.1 top view of LM741

2.2.3 Relay

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field, which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

Relays allow one circuit to switch a second circuit, which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

The coil of a relay passes a relatively large current; typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timers IC is 200mA so these devices can supply relay coils directly without amplification.

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay.

The supplier's catalogue should show you the relay's connections. The coil will be obvious and it may be connected either way round. Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and ICs in the circuit. To prevent damage you must connect a protective diode across the relay coil.

The animated picture shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT.

The relay's switch connections are usually labeled COM, NC and NO:

- COM = Common, always connect to this; it is the moving part of the switch.
- NC = Normally Closed, COM is connected to this when the relay coil is off.
- NO = Normally Open, COM is connected to this when the relay coil is on.
- Connect to COM and NO if you want the switched circuit to be on when the relay coil is on.
- Connect to COM and NC if you want the switched circuit to be on when the relay coil is off.

A relay is a switch operated by an electromagnet; it is useful if we want a small current in one circuit to control another circuit containing a device such as lamp or electric motor which requires a large current, or if we wish several different switch contacts to be operated simultaneously. In this project, a relay was used t control the switching effect of the bulbs used. Fig shows the symbol of a relay. The current needed to operate a relay is called the pull-in current and the dropout current is the current in the coil when relay just stops working

If the coil resistance of a relay R and its operating voltage is V, then the pull-in current $I = V/R$

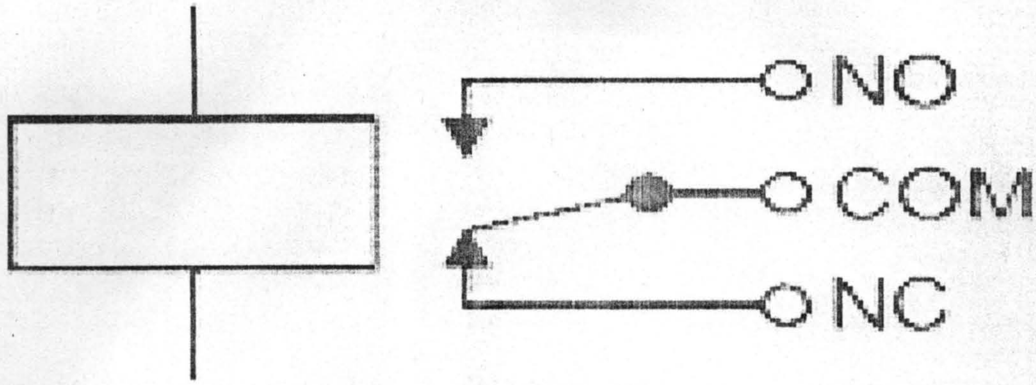


Fig 2.2a circuit symbol of a relay

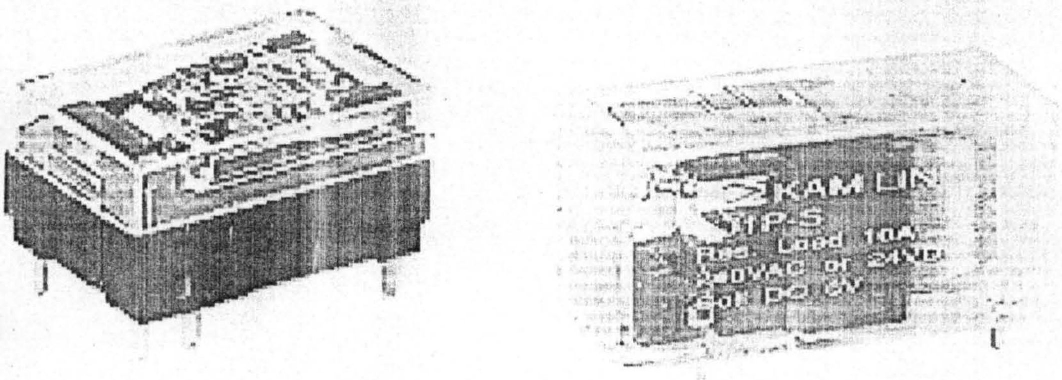


Fig 2.2a and b showing Relays pictures

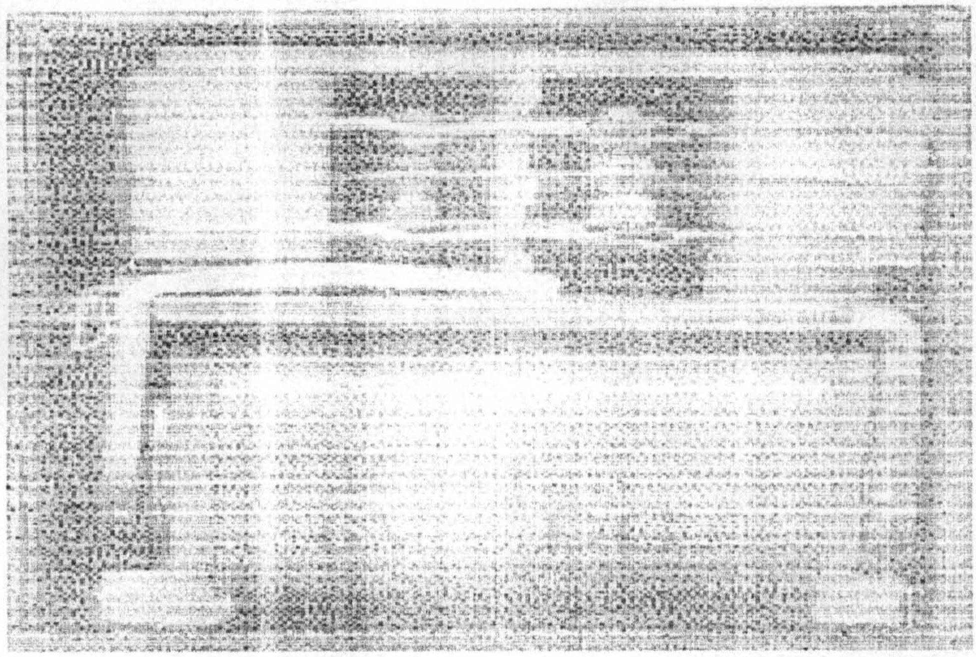
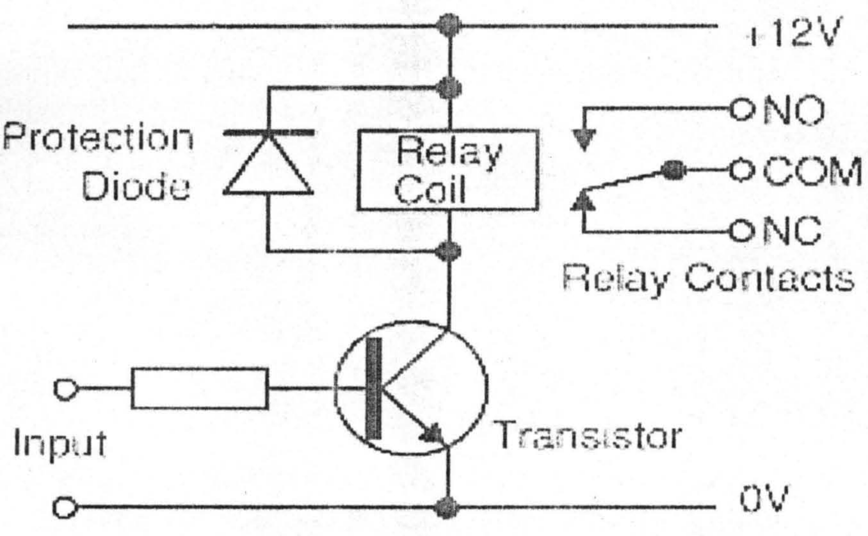


Fig 2.2d Relay showing coil and switch contacts

2.2.4 Protection diodes for relays



Transistors and ICs (chips) must be protected from the brief high voltage 'spike' produced when the relay coil is switched off. The diagram shows how a signal diode (e.g. 1N4148) is connected across the relay coil to provide this protection. Note that the diode is connected 'backwards' so that it will normally not conduct. Conduction only occurs when the relay coil is switched off, at this moment current tries to continue flowing through the coil and it is harmlessly diverted through the diode. Without the diode no current could flow and the coil would produce a damaging high voltage 'spike' in its attempt to keep the current flowing.

CHAPTER THREE

DESIGN AND CONSTRUCTION

The objective of this project (TOUCH ACTIVATED ELECTRONIC SWITCH) is to turn on appliances using human resistance.

This project comprises of five modules, namely:

(1) A High-gain linear amplifier

(2) A Small-signal AC-to-DC rectifier.

(3) A transistor Switch.

(4) A Comparator.

(5) The power supply

The High-gain linear amplifier: this circuit amplifies the induced ac in human body to a reasonable amount (above 0.6V) to turn the transistor on.

The Small-signal AC-to-DC rectifier converts the AC from the output of the amplifier to DC to turn the transistor on.

The power supply unit provides the whole system with suitable voltage for operation.

THE PROJECT IN MODULES

3.1 Design of High-gain Linear Amplifier

This circuit is built on a LM324 operational amplifier configured as a non-inverting amplifier. The circuit is wired as shown below.

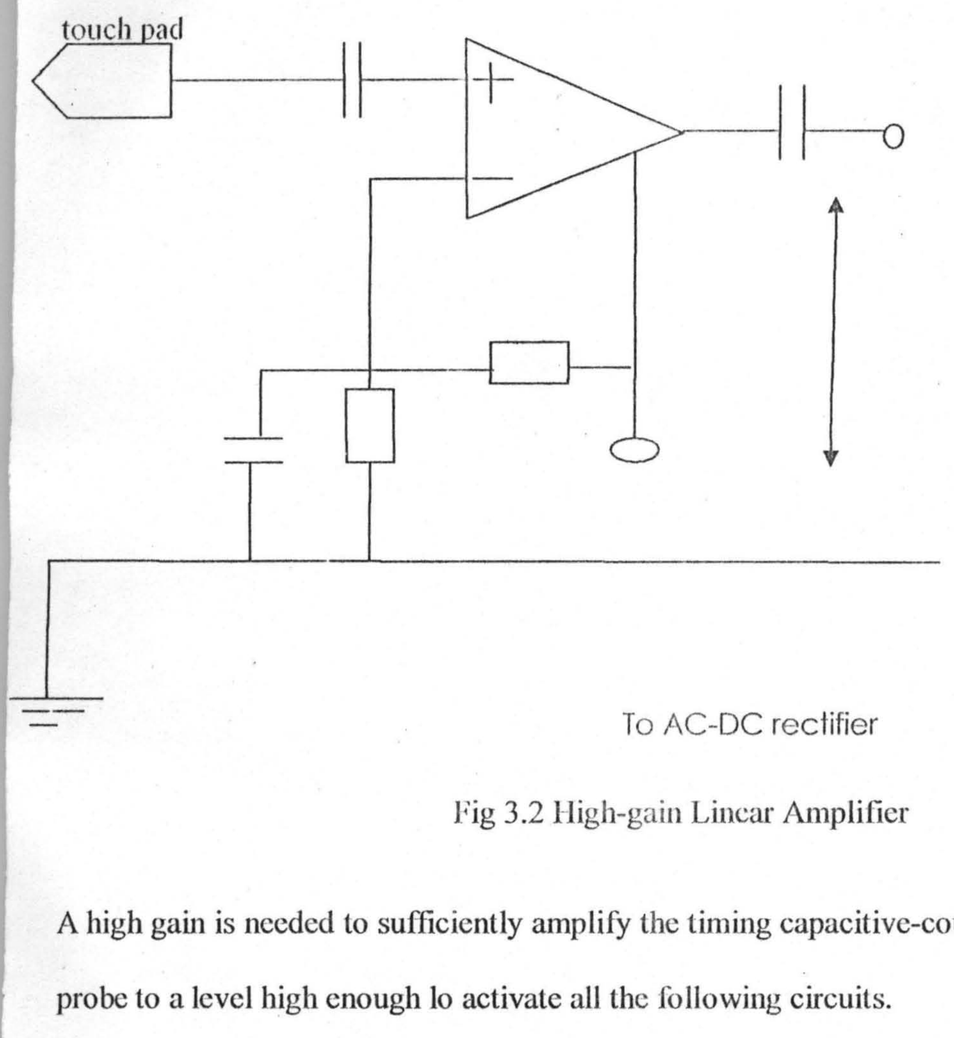


Fig 3.2 High-gain Linear Amplifier

A high gain is needed to sufficiently amplify the timing capacitive-coupled signal from the touch probe to a level high enough lo activate all the following circuits.

The amplifier is wired in the non inverting mode; hence the input-output waveforms are 180^0 out of phase. The capacitors are configured as DC blocking capacitors.

3.2 Design of AC-to-DC Rectifier

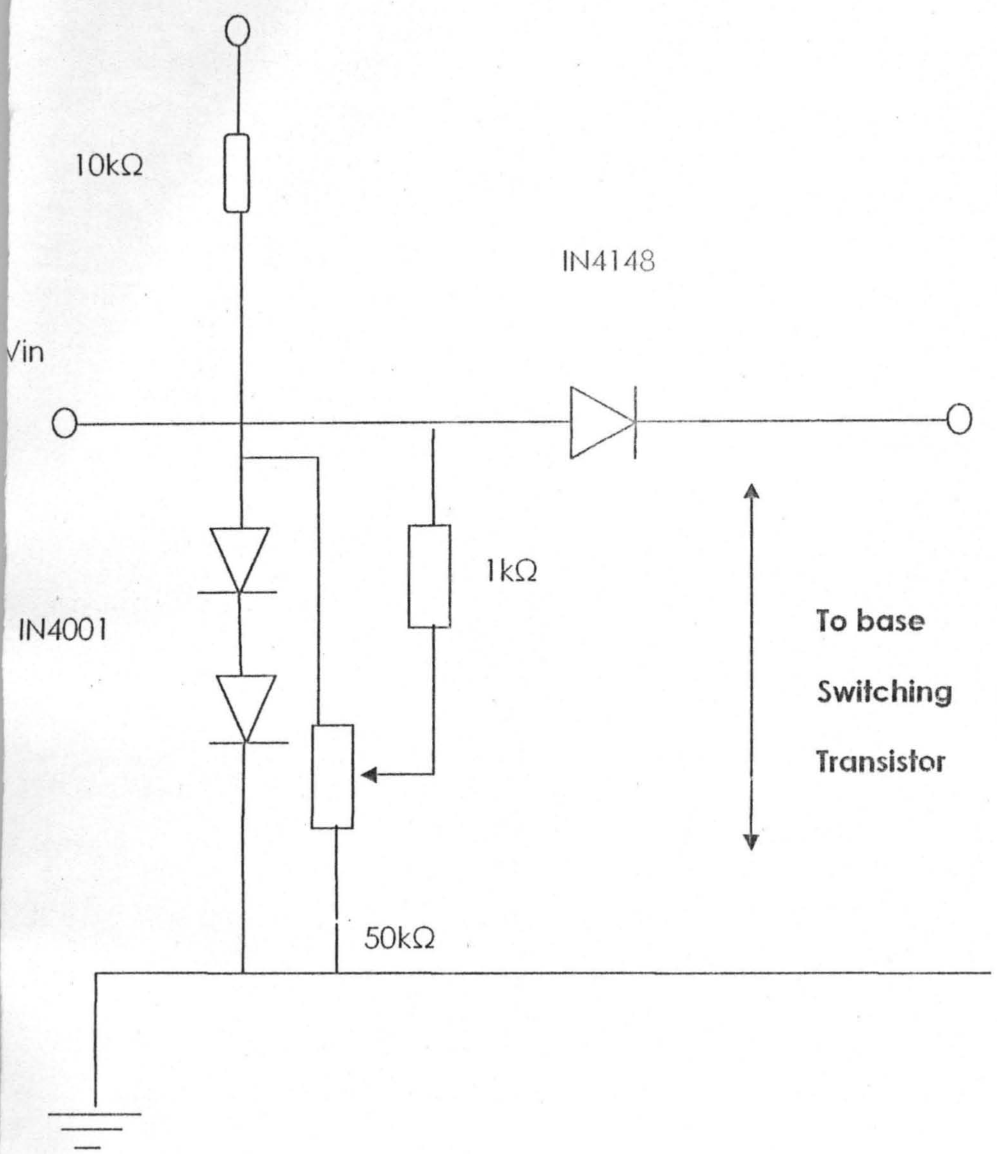


Fig 3.3Ac –to- Dc Rectifier

The dc output is applied to the base of an NPN transistor whose collector is lied to the trigger input of a 555 timer configured as shown below. The rectifying diode is biased to get equal output voltage with respect to the input voltage.

3.3 The Transistor Switch

The heater's ON/OFF switching is performed through a relay's switch. The relay responds to the control signal from the comparator through the transistor.

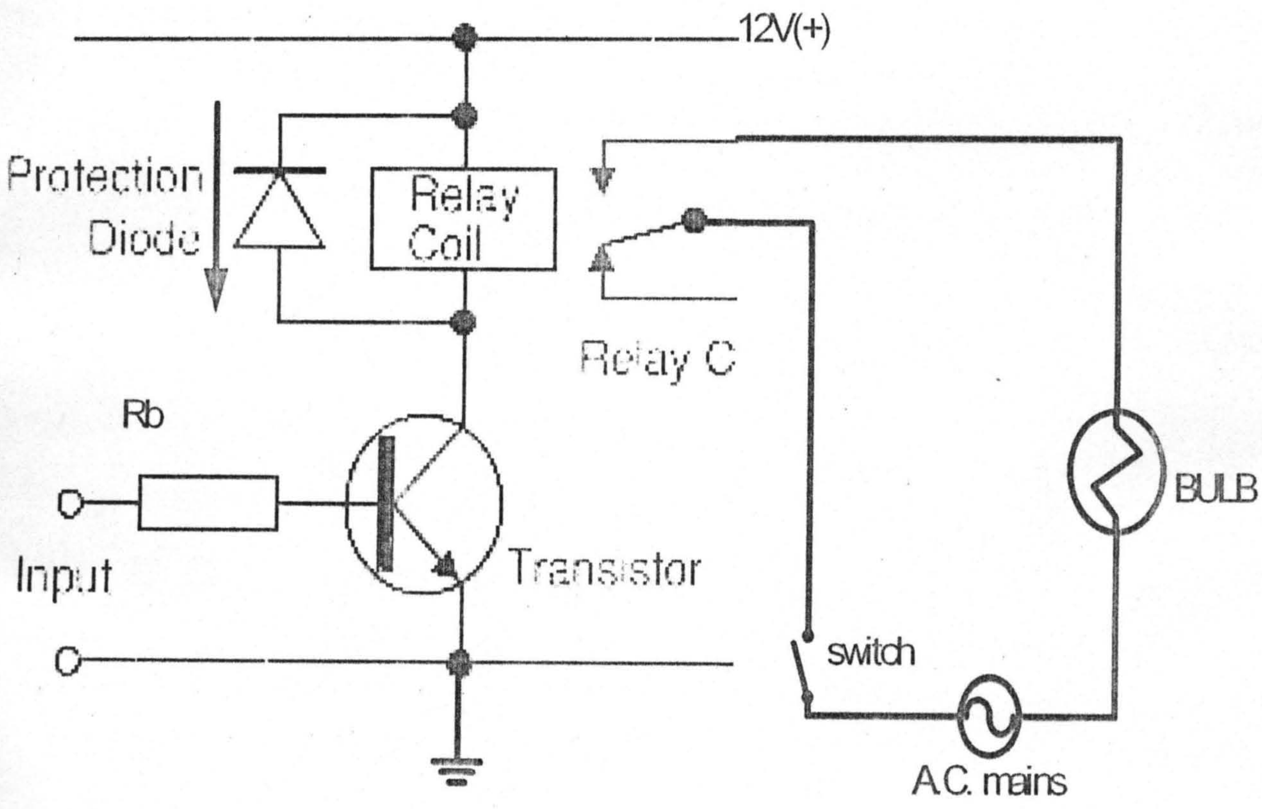


Figure 3.4 the Output Switching Unit

An NPN transistor operating in the common-emitter configuration is involved in the switching of the 10A/12V relay. The power supply (I2V) is from a 12V regulator (7812). The collector of the transistor is loaded with both D1 and R_L. R_L is the resistance in the relay's coil. The relay possesses three switching terminals A, B and C. Normally. Terminal C is connected to A, that is, when the relay is not operated, it is normally in contact. Whenever a 12V power supply is set across the inductive part of the relay, contact C leaves A for B. The initial output state of the relay is restored back when power is cut from the inductive part.

The switching is done through the magnetic effect of the coil, when electricity is supplied to relay a magnetic field is created around the coil. This field is always proportional to the amount of electricity applied. The action of the inductor or coil is attributed to back e.m.f. It is based on Lenz's law[10] of electromagnetic induction it states that " the direction of an induced e.m.f is always such that it tends to set up a current opposing the motion or the change of flux responsible for inducing that e.m.f" . The switching on and off change in the relay's coil sends this back e.m.f, which is potentially strong enough to damage a related switching transistor[11]. To prevent this damage, a reverse biased or freewheeling diode is usually placed across the collector of the transistor involved and the $V_{CC.}$ This diode protects the transistor from back e.m.f that might be generated since the relay coil presents an inductive load. In this case Rc[2], which is the collector resistance, and also resistance of the relay coil, which is 400Ω for the relay type used in this project[12].

R_L is 400Ω, in the saturation mode of the transistor a voltage of 12V is expected across it. Therefore, collector current

$$Ic = \frac{12}{400} = 0.03A$$

$Ic = 0.03$ A

The transistor has a typical current gain of 100

[13]Therefore, base current

$$Ib = \frac{Ic}{100}$$

$$Ib = \frac{0.03}{100} = 0.0003A$$

$$Ib = 0.3mA$$

5V is expected to switch the transistor through the base.

Therefore,

Rb = $\underline{12 - 0.7}$ = 37666.67

.0003

Rb ≈ 40kΩ

A value of 4.7kΩ is used in the circuit owing to the expected voltage drop at the base of the transistor. This value is more practical.

The output state initially involves the contact of terminal A with C. This results into the flow of AC mains through the heating load whenever the primary switch is close. The comparator's output is logical 0 for this particular condition. That is, the transistor is cut-off.

But in a situation whereby the comparator produces a logical 1 output or relatively high voltage, the transistor is saturated and the relay is energized resulting to the movement of contact C from A to B.

A TIP4IC NPN transistor is used as a saturated switch to ride and relay close or open. The T1P41 was chosen because of its high 1C capability (4Ω).

3.4 Design of the Power Supply Unit

3.4.1 The power supply unit

For the circuit we would require a 7812-voltage regulator as shown in the figure below, which gives a required output of +12V. The voltage regulator regulates input voltages above its required output voltage. If the input voltage is below its required output voltage, it would be passed out without been regulated. For example for a 7812, if the unregulated input voltage is greater than 12V, it will be regulated to 12V, but if its less than 12V, for example 9V, the 9V unregulated will be outputted. To achieve this, the following steps were undergone.

- Stepping down the A C supply with a transformer
- Full wave rectification
- Removal of ripple from the rectified waveform

- Voltage regulation to desired value

- Power display LED

The power unit involves the transformer-bridge rectifier circuit. A 24V transformer is used to provide power to 7812 regulators, which produce, regulated 12V.

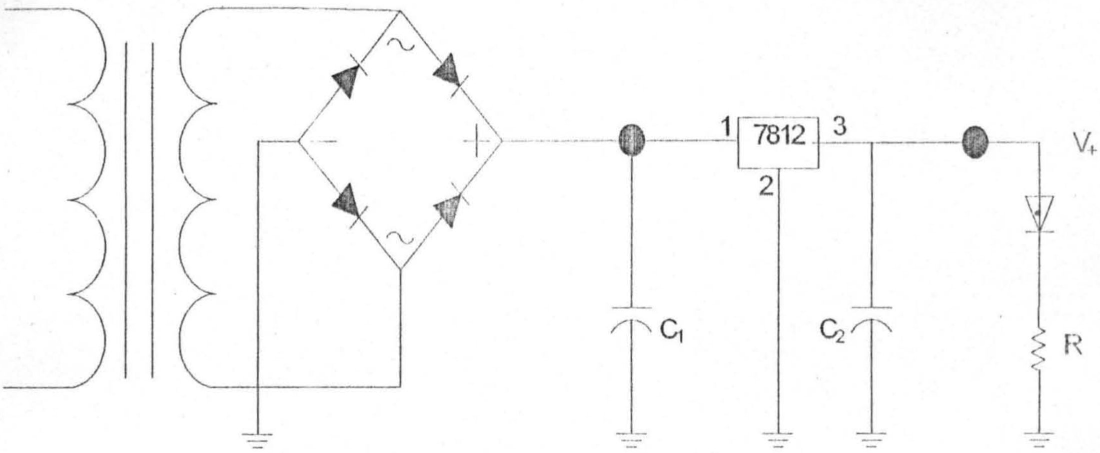


Fig.3.5 the Power Supply Unit

The common bridge rectifier, comprising four rectifying diodes, is used for converting the 24V ac power supply into corresponding roughly 24V dc voltage. The involved ripple at the output of the bridge rectifier is filtered through *a* 2200μF,-35V capacitor. The voltage rating of the capacitor is about twice the expected output voltage of the rectifier, to protect the device from the effect of high voltage supply.

A power switch was used to open and close the complete circuit when required. The 7812-voltage regulator is connected in parallel across the rectified voltage output. The devices are aimed for stability of the complete circuit. The 12V power supply from the 7812 is connected to the main circuit.

3.4.2 Analysis of Power Supply

If the unregulated input of the 7812 is greater than the required output by a factor of 4, that is 12+4=16, the voltage regulator IC, starts getting hot and will be damaged. Hence we will need an input into the 7812 to be approximately 16V.

Since, the diode drops 0.6V and we have 4 rectifying diodes forming the full wave bridge, the voltage drop will then be $0.6 \times 4 = 2.4V$

For a peak voltage of 16+2.4=18.4V peak.

For the r.m.s voltage $= \frac{18.4}{\sqrt{2}} = \frac{18.4}{1.4} = 13.143V$

Hence a transformer of a preferred value of 15V was employed. i.e. 220V/15V transformer

Assuming a ripple voltage of 15%

$$dv = \frac{15}{100} \times 18.4V$$

$$= 2.76$$

$$dt = \frac{1}{2f} = \frac{1}{100} = 0.01$$

$$C_1 = \frac{1 \times 0.01}{2.76} = 3.623 \times 10^{-3}F$$

$$C_1 = 3300\mu F$$

A preferred value of 3300μF was however employed.

To reduce the ripple left, a compensating capacitor C_2 was used and a 4065μF was employed.

3.4.3 Power indicator

A power indicator circuit comprising of a resistor and Light Emitting Diode (LED) shows the presence of power in the circuit.

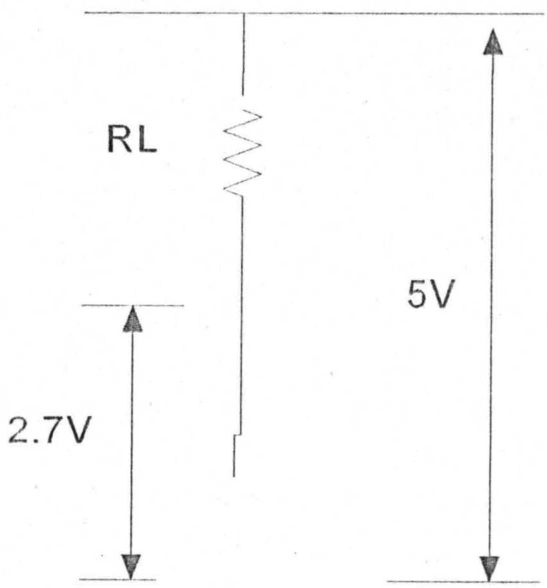
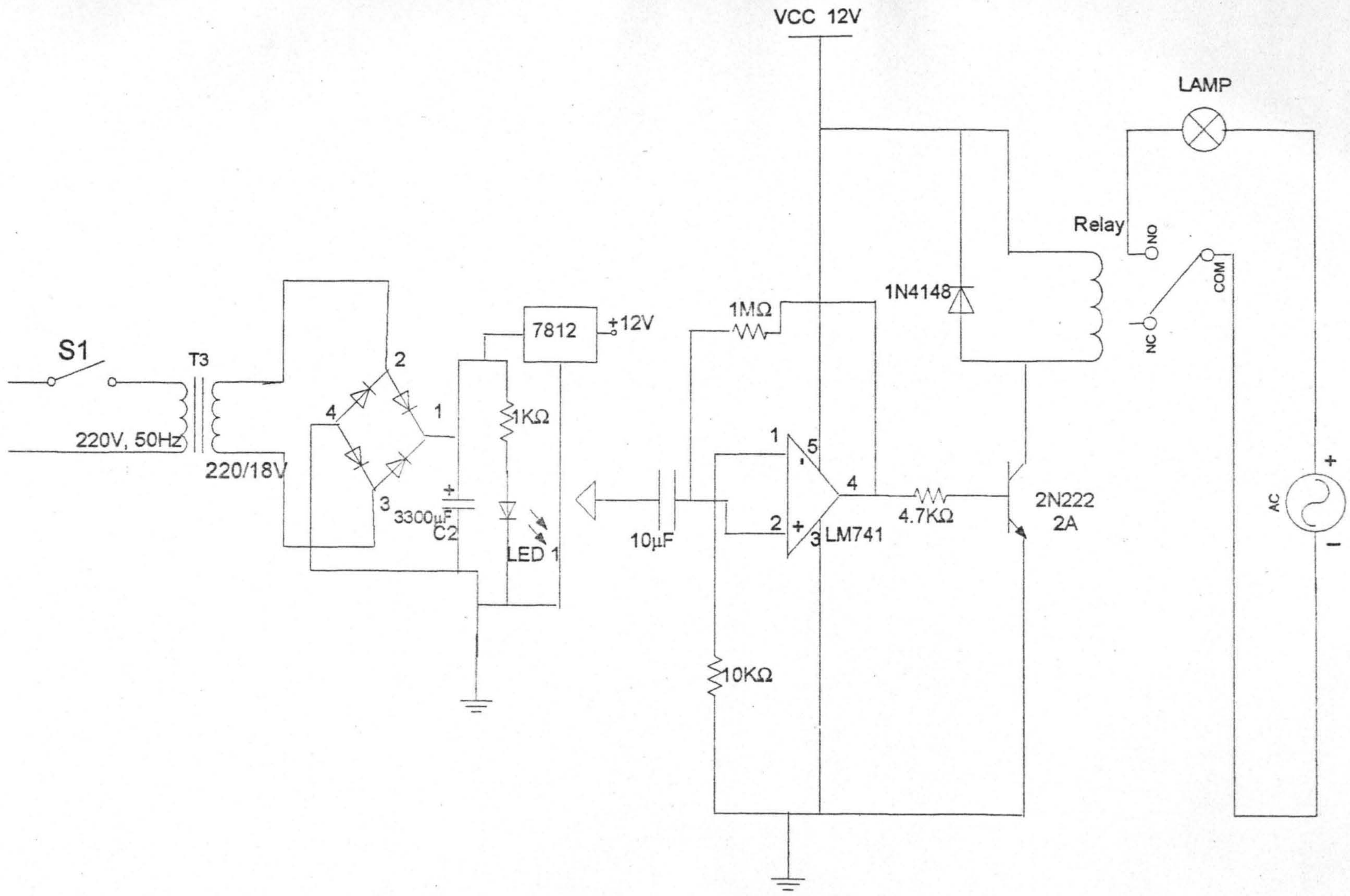


Figure 3.6 the Power Indicator Circuit

A voltage of around 2.7V is expected across the diode with a current of roughly 2mA.

$$RL = \frac{5-2.7}{2\times10\text{^}-3} = 1150\Omega = 1.15k\Omega$$

A resistor of 1kΩ is used instead for more practical importance and availability. It was also chosen to limit the power on the light emitting diode, LED. Power dissipated by the resistor is given by P = V^2/R. - 12^2/1000-0.144W



COMPLETE CIRCUIT DIAGRAM OF THE TOUCH ACTIVATED ELECTRONIC SWITCH

CHAPTER FOUR

TEST, RESULT AND DISCUSSION

4.0 Testing

Testing is an important procedure employed in the field of science and technology for her effective presentation of genuine results of any project when testing is correctly conducted, absolute standards on theory can be continued. Subsequently, designs, hypothesis and new data about this project are determined. It is an important parameter aiding us in executing this project,

Testing offers construction the last opportunity of identifying errors and finding solutions to such errors.

During the construction of this project, testing was conducted in to two main stages, testing of each stage and testing of the entire circuit.

4.1 Testing of each stage

In the complete construction of this project, TOUCH SENSITIVE SECURITY SYSTEM, each of the five stages discussed in the previous chapter was first constructed and tested one after the other for the required output. The sequential testing procedure is outlined below.

4.1.1 Testing of the High-Gain Amplifier Circuit

The components used in this circuit are op-amp 324, capacitors and resistors. The circuit was first built on a breadboard to ascertain its proper working condition, after which it was then constructed in a printed circuit board and thus coupled to the power supply unit. The output was measured by a multi-meter which is sufficient enough to turn the transistor on.

4.1.2 Testing of Small Signal AC – to –DC Rectifier

The circuit consists of resistors and diodes. The circuit was built on breadboard, crosschecked and confirmed to be correct. It was then coupled to the output of the amplifier circuit. The output was measured by a multi-meter. The output AC voltage was confirmed to be the same with the DC voltage output. The components were then transferred to the printed circuit board.

4.1.3 Testing of the Power Supply Unit

The circuit consists of diodes, resistor, capacitors and a regulator IC (LM 7812). The circuit was connected first on a breadboard. The output to the operational amplifier was measured with a multi-meter and confirmed to be 12V and also output to the other circuits were confirmed to be 12V. The circuit was then transferred to the printed circuit board.

4.1.6 Testing of the Entire Circuit

The entire circuit consists of all network and units that make up the system of the device, from the power supply unit, down to the lighting circuit. Having completed the construction and soldering on the printed circuit board, the whole system was tested by touching to the sensor (a touch pad) which immediately activates the entire circuit and the LIGHT comes ON.

4.2 Result and Discussion

Following the construction of this project, the desired result was achieved. Light was seen glowing at the output. Illumination of bulb automatically accompanied touch display, which is serving as an indicator to the display unit.

This is achieved when the trigger (touch) board is connected to circuit input; the output of the circuit triggers a bulb when the touch board at the input is touched using induced AC in human body, it is obvious that the touching part has to be clean and makes good contact with the trigger wire.

This resultant effect suggests the application of this project in areas of need (homes, offices, bank, and vehicles).

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.0 Conclusion

The construction of this project (TOUCH ACTIVATED ELECTRONIC SWITCH) is a step forward in preserving aesthetical value and providing easy switching method, which to a large extent encourages the continuous appreciation of technology and its importance to the existence of man.

Within the limited, permitted and available resources, this project has indeed been a success.

5.1 Recommendations

After implementing this project for a good period of time, the following are here by suggested;

(i) All residential buildings, factories, work; places, and offices should be fitted with a touch activated electronic switch in other to curb excessive cost bourn on purchasing inferior Chinese dolly or rocker switches .

(ii) Also, during installation, design should permit control of more devices by very few switches.

(iii) The obvious low cost of this project should be encouraged to go commercial.

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