AUTOMATIC ELECTRONIC DISPLAY BOARD

BY

NWOBU, STANLEY IFEANYI

98/7098EE

DEPARTMENT OF ELECTRICAL/COMPUTER ENGINEERING

SCHOOL OF ENGINEERING AND ENGINEERING TECHNOLOGY

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

IN PARTIAL FULFILMENT OF A B.ENG DEGREE IN

ELECTRICAL/COMPUTER ENGINEERING

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

NOVEMBER 2004

DECLARATION

I NWOBU, STANLEY IFEANYI, of the department of Electrical and Computer Engineering, Federal University of Technology Minna, do hereby declare that this work "AUTOMATIC ELECTRONICS DISPLAY BOARD" , was wholly done by me under the supervision of Engr. Jonathan Kolo of the department of Electrical and Computer Engineering, Federal University of Technology, Minna.

NWOBU I. STANLEY	....	08/12/2004
STUDENT	SIGNATURE	DATE

APPROVAL

This is to certify that this work titled "AUTOMATIC ELECTRONICS DISPLAY BOARD" was carried out by Nwobu I. Stanley under the supervision of Engr. J. Kolo for the award of Bachelor in Electrical and Computer Engineering, Federal University of Technology, Minna.

ENGR. J. KOLO	....	8/12/04
PROJECT SUPERVISOR	SIGNATURE	DATE
ENGR M.D. ABDULLAHI	....	31/01/2005
HEAD OF DEPARTMENT	SIGNATURE	DATE
....	....	....
EXTERNAL SUPERVISOR	SIGNATURE	DATE

DEDICATION

This project is dedicated to the Almighty God, my sister Ifeoma and also to my parents.

ACKNOWLEDGEMENT

Foremost, I want to acknowledge and appreciate the grace and strength bestowed upon me by the almighty God to write this project and also throughout my academic pursuit.

My most sincere appreciation goes to my sister Mrs. Ifeoma G. Mogo, for her support morally, financially and otherwise, without which my academic carrier would have been near impossible. Also my parents, brothers and sisters; Charles, Mrs. N. Atuora, Chiugo, Chika and Amaka are not left out. My most profound gratitude goes to my supervisor, Engr. Kolo, for his support and guidiance throughout the process of the project work. He's always accommodating, ready to help and encouraging. I can't thank him enough.

Lastly, my profound and heart found appreciation goes to my cousine, Mr. Emma Igboko and his family, for their relenghtless encouraging gestures in terms of financial backing and other wise, I want to say thank you. I must not also forget my wonderful friends and colleagues; Chinedu Ezunu, Francis Pam, Darlington, Emma, Don to mention but a few. I want to say you are all the best. God bless you all.

ABSTRACT

The electronic display board (sign post) is to display "F.U.T MINNA, ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT, YOU ARE WELCOME" in sequential order. The mode of operation is to switch "ON" and "OFF", each word or letters, one after the other after which it will reset and start all over again. The operation is controlled by a continuous pulse signal or clocking signal of about 40Hz.

+TABLE OF CONTENTS

TITLE PAGE i

DECLARATION..ii

APPROVAL PAGE..iii

ACKNOWLEDGEMENT..iv

ABSRACT...v

CHAPTER ONE

1.1 INTRODUCTION...1

1.2 AIM AND OBJECTIVE...2

1.3 SIGNIFICANCE OF STUDY...2

1.4 SCOPE OF STUDY...3

CHAPTER TWO

2.1 LITERATURE REVIEW...4-5

2.2 TRANSFORMER...6

2.2.1 CHOSING AND SPECIFYING TRANSFORMERS.............6

2.3 DIODES...7-9

2.4 IC REGULATORS...9-10

2.5 CAPACITORS...10-11

2.6 TRANSISTORS...11-12

2.7 RESISTORS...12

2.7.1 TYPES OF RESISTORS...12

2.7.2 PHOTO RESISTORS 13

2.8 INTERGRATED CIRCUITS...13-19

2.8.1 TYPES OF IC...13-14

2.8.2 NE 555...14-16

2.8.3 COUNTERS...17

2.8.4 KIND OF COUNTERS...17

2.8.5 IC DECADE COUNTERS...17-19

2.9 RELAY...19

2.10 DISPLAY COMPONENTS...21-22

CHAPTER THREE

3.1 AUTOMATIC SWITCH DESIGN...23-24

3.2 POWER SUPPLY DESIGN CALCULATION 24-27

3.3 TIMING CIRCUIT CALCULATION AND DESIGN..........28-30

3.4 DESING AND CONTROL UNIT...30-32

3.5 SWITCHING CIRCUIT...33-34

3.6 DESIGN OF THE DISPLAY UNIT...34-38

3.6.1 CURRENT LIMITING RESISTORS FOR THE LOADS.....37-38

CHAPTER FOUR

4.1 CONSTRUCTION...39

4.2 TESTING OF THE OUTPUT AT EACH STAGE AND THEIR RESULTS...39

4.2.1 OUTPUT OF THE POWER SUPPLY UNIT...39-40

4.2.2 OUTPUT OF THE AUTOMATIC SWITCH...40

4,2.3 OUTPUT OF THE TIMER...40-41

4.2.4 OUTPUT OF THE COUNTER...41

4.2.5 OUTPUT OF THE RELAY CIRCUIT AND DRIVERS....42

4.2.6 OUTPUT OF THE DISPLAY UNIT.........................42-43

4.3 MOUNTING AND TESTING OF THE WHOLE CIRCUIT...43

CHAPTER FIVE

5.1 CONCLUSIONS...45

5.2 RECOMMENDATIONS..45

REFRENCES...46

APENDIX...47-49

CHAPTER ONE

1.1 INTRODUCTION

Information are sent to the general public through different means of which signpost is one of the means which creates a very simple way of spreading information to the people. In the advertising industry, signpost is very useful for the dissemination of information, massages and signals to the people around. Signpost has been in existence for long and are used by establishments/companies as marketing tools i.e. advertising products, services etc.

For these, establishments/companies find it very important to have a portable signpost which takes more massages on it and an attractive signpost which can easily attract the attention of people to read the massages on the board. It is to these that the electronic display board was invented which is preferable to non-electronic board.

The earlier constructed electronic signposts consumes very high power and to this a low power consumption electronic display board using 555timer, Decade counter, LED (light emitting diode), etc was invented with the qualities that make them easy to read and understand.

Thus, this project involves the design and construction of an electronic display board, which will contribute in solving the problems in the advertising industry. This project also involves the design and construction of Automatic switch which is a darkness sensitive switch used to put ON and put OFF the electronic display board.

1.2 **AIM AND OBJECTIVE**

AIM

The main aim of this project is to design and construct an Automatic Electronic Signpost to display "F.U.T MINNA, ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT" and also to display "YOU'RE WELCOME" all enclosed in a switching boarder lines.

OBJECTIVE

1. To display "F.U.T MINNA" word after word.
2. To display "F.U.T MINNA" at once.
3. To display "ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT" word after word.
4. To display "ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT" at once.
5. To display "F.U.T MINNA, ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT" at once.
6. To spell out "YOU'RE WELCOME"
7. To automatically come ON in the night and go OFF in the day.

1.3 **SIGINIFICANCE OF STUDY**

In various establishments, this project is found useful and applicable to display, the establishment's name, logo, time schedule, warning signals, etc.

The project operates mostly at night and in a very dark environment.

1.4 **SCOPE OF STUDY**

The design will have an automatic switch, to switch OFF at day time and switch ON at night using a darkness sensitive switch which senses the day and night and switch OFF and ON the circuit.

The display also will be using discrete LEDs as the display component and not a lamp or seven segments LED to aid the simplicity of the design. The IC components used are mostly used in the design to aid stability of performance and reliability.

CHAPTER TWO

LITERATURE REVIEW AND COMPONENT DISCRIPTIONS

2.1 LITERATURE REVIEW

75 years ago, in the year 1929, the use of electronic (display) newscaster was introduced by Raymond Hill. The display of news bulletins, weather reports and advertisements were done by a machine which it screen is made of filament lamps. The rows of filament lamps illuminate in sequence so that the display move along the screen from left to right. This is achieved by punching the massage to be displayed on a long strip of strengthened paper which is then joined to form a continuous loop. The continuous loop is then loaded to the machine which reads the information from the strip and controls the light on the screen. When the information is displayed on the screen, the newscaster reads out from the displayed information. The machines which display the information form the strip are of two types; one for news tapes and the other for the advertising tapes.

The electronic display boards or signposts are also used by companies for the promotion of their goods and services, showing signs, cautions, sending out signals etc, to their customers. In schools, hotels, restaurants etc, electronic display board is also used in dissemination of information to the public.

Nowadays, there have been a lot of improvement in the design and construction of electronic display board which have been very useful to establishment/companies in passing information and services to the general public. The advantages of the recent electronic display board over the earlier designed ones are:

- Reduction in size (portable)
- Easy to read and understand

- Low power consumption
- Low cost of production
- More visually attractive
- Flexible as they can display more information and in different modes over a period of time etc.

LED in variable massage sign have been widely used and accepted since the late 1980s'.This single color signage is visible in a myriad of applications including traffic management, commercial advertisement, shopping mails and public transportation to name a few. It was until the mid 1990's with the advert and cost reduction of high brightness InGaN blue LEDs that full color, RGB LED signs began their major entry into the video display market. Sign builders often face a variety of difficulties when integrating RGB technology into their video system. These include;

i. Patchiness due to variation in lamp brightness, forward voltage, color and or far field pattern.
ii. Heat dissipation issues due to ESD (Electrostatic Discharge).

With the recent white LEDs as well as advancement in ultra bright InGaAp and GaN technology, LEDs have begun to replace conventional type lighting in a variety of illumination applications. LEDs not only consumes far less electricity than traditional forms of illumination, resulting in reduced energy costs, but require less maintenance and repair. Studies have shown that the use of LEDs in illumination applications can offer; greater visual appeal, reduced energy cost, increased attention capture, savings in maintenance and lighting replacements.

2.2 **TRANSFORMER**

A transformer is essentially two inductors wound in such a way that energy from one coil is transferred to the other. It consist of two or more electrical circuit (Primary and secondary windings) interlinked by a common magnetic field for the purpose of transferring energy between the windings. The windings which is on a magnetic core, ensures that there is high magnetic flux linkage between the windings. When an alternating voltage is passed across primary winding of the transformer, it induces voltage to the secondary winding which depends on the number of the turns of the windings.

The transformer is step down transformer when the number of turns of the secondary winding is more than that of the primary winding. It is also a step up transformer when it is vice-versa.

Equation below (2.1) is the relationship between voltage, winding and current.

$V_p/V_s=N_p/N_s=I_s/I_p$ --2.1

Where Vp, Np and Ip are the primary voltage, number of turns in the primary winding and the primary current respectively.

Vs, Ns and Is are the secondary voltage, the number of turns in the secondary winding and the secondary current respectively.

There are two main types of transformer construction namely:

i. Core type

ii. Shell type

2.2.1 **CHOOSING AND SPECIFYING TRANSFORMERS**

Power rating is the product of voltage and current of the secondary winding which can be neglected once the voltage and current ratings have been specified. Transformers are specified according to the secondary winding and regulation.

Once the required voltage is known, it is only necessary to pick a transformer which gives the output at the required current rating.

The minimum voltage is given as

VTX Min.= VTX[1+ Reg.TX(1-I/ITX) – Reg. Mains] ----------------------------2.2

Also the maximum voltage is given as

VTX Max.= VTX[1+ Reg.TX(1-I/ITX) + Reg. Mains] ----------------------------2.3

VTX = Stated Transformer Voltage

ITX = Stated Transformer Current

I = Current drawn from the transformer

Reg.TX = Stated Transformer Regulating Factor = 13%

Reg. Mains = Stated Transformer Factor = 6%

The transformer minimum voltage evaluated at full load is used for selection of transformer; maximum voltage evaluated at zero loads is used to calculate the smoothing capacitor working voltage.

2.3 **DIODES**

Diodes are constructed by combining a P type and N type semiconductor materials. Diodes allow current to pass only in one direction within a specified limit. When the diode is reverse biased, it conducts a very little current until it reaches a certain voltage called the breakdown voltage when very large current flows at a constant voltage.

Diodes are used in;

i. Voltage rectification/current rectification
ii. Voltage doublers
iii. Over voltage and over current regulation circuit
iv. Clipping circuit

v. Clamper circuit etc.

RECTIFICATION

This process whereby an AC voltage or current is been changed to a DC voltage or current.

We have many types of rectification which are;

i. Half wave rectification

ii. Full wave rectification

A Bridge rectification and Centre tap rectification are two types of full wave rectification.

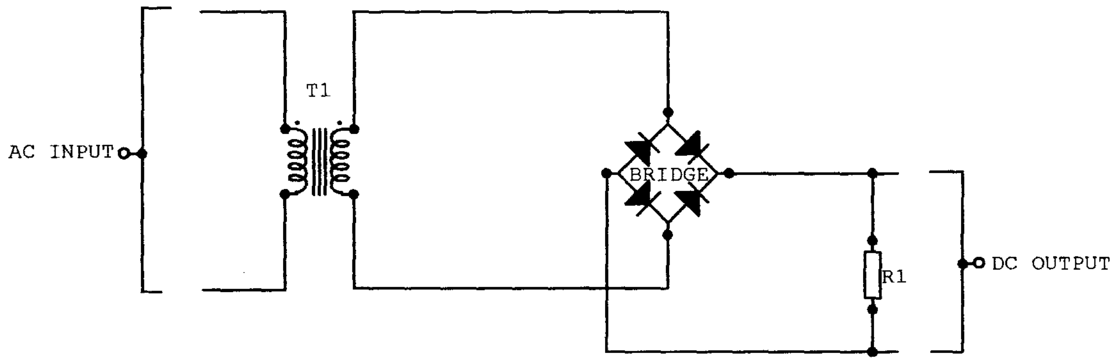


Fig 2.1 A diagram of a full wave rectifying circuit.

The output waveform of full wave rectifier in Fig 2.1 is drawn below.

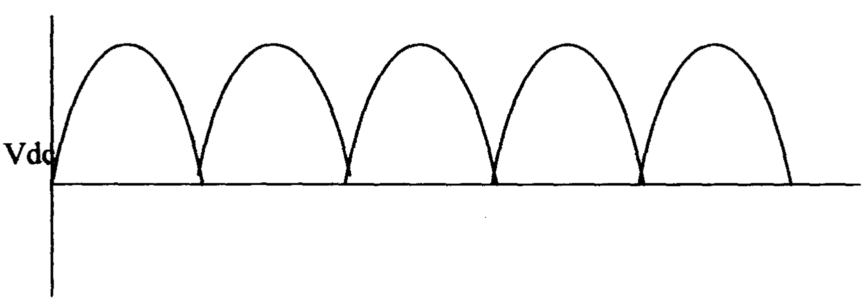


Fig 2.2. Full wave rectifier waveform.

The direct current voltage (Vdc) is given by

$V_{dc} = 1/2\Pi \int V_{id}(wt) = 2V_m/\Pi$ ---2.2

$I_{dc} = 1/2\ \Pi \int V_{id}(wt) = 2V_m/\ \Pi$ ---2.3

With a capacitive filter

$V_{dc} = 1.4V_{ac}$--2.4

$I_{dc} = 0.62\ I_{ac}$--2.5

Due to the diode voltage drop Vd

$V_{dc} = 1.42V_{ac} - 2V_d$ ---2.5

Peak inverse voltage (PIV)

This is the maximum voltage to which the diode can be subjected to and it is Vmax. for bridge rectifier or greater than Vmax.

2.4 **IC REGULATORS**

The principle of operation of IC regulator is still based on the zener diode mode of operation whereby the two basic element of a stabilizer circuit, Viz. voltage reference and voltage amplifier can easily be combined into IC. IC regulators are designed for specific fixed voltage and it offers the advantages of extremely good regulation, compact size and ease of use.

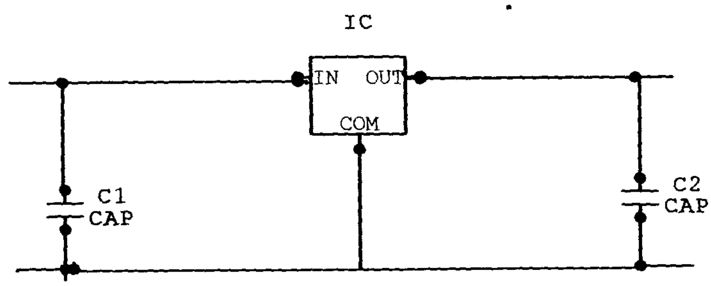


Fig 2.3 Regulator circuit configuration.

C1 and C2 are decoupling capacitors that maintain low output impendence at all frequencies. The output impedances of all regulators tend to rise at high frequencies. Typical IC regulators are 78L05, 7805, 78H05, 78L12 etc.

2.5 **CAPACITORS**

It is a passive component for storing electric charges and has a capacitive C which is the ability of a dielectric charge. The main function of capacitors in main electronic circuit is to decouple and smoothens the circuit.

In a circuit where both AC & DC is present, it is used to eliminate AC ripple, mostly in DC power supply i.e. smoothing the peaks through of the voltage by working on the reservoir principle it charges the capacitor during the peaks and discharge during the through to give an overall smoothed output.

The value of a smoothing capacitor is determined using equation 2.7 below

C=IV/(Vpeak-Vreg)--2.7

I = current draw

T = period

Vpeak = maximum voltage

Vreg = regulated voltage

But Vripple = Vpeak –Vreg --2.8

2.6 **TRANSISTORS**

There are different types of transistors namely:

i. BJT

ii. FET

In this project report, BJT will be discussed only.

The bipolar junction transistors BJT are active semi conductor devices which consist of two PN junctions. When P-type is between two N-type semiconductors, then an NPN transistor is formed but if it is an N-type semiconductor, a PNP transistor is formed.

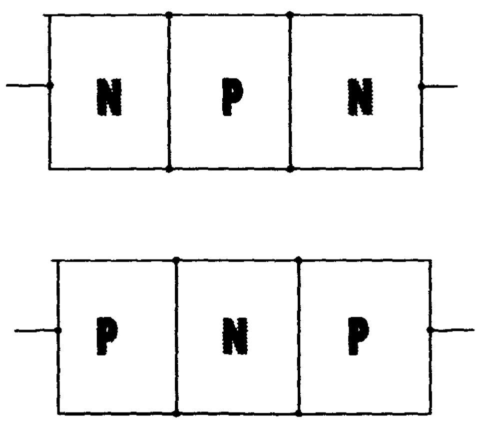


Fig 2.4 NPN type and PNP type transistor.

A typical BJT transistor has 3 terminals, can be configured in 3 different ways;

a common emitter,

b common base and

c common collector.

i. Amplification – it is the process whereby the power of a signal is increased in magnitude.

In transistor the input current is been amplified by a factor β, the amplification factor to give the output current Ic.

$Ic = \beta IB$---2.9

ii. Switch-Transistors also act as a switch in a circuit.

This occur when the transistor is acting in ct off and saturation region.

Cut off condition occurs when the two junctions of transistors are reversed biased.

Also when the junctions are forward biased, saturation occurs.

The transistor acts as a switch (ON at saturation and OFF at cut off) at these situations.

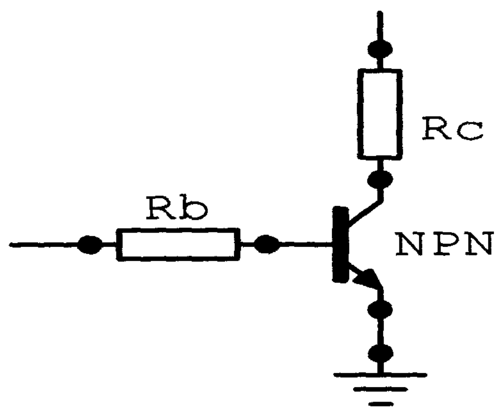


Fig 2.6 Transistor switching circuit.

The transistor is in the off state during cut off.

When voltage is applied to the base B, the collector is shorter to ground through the emitter thereby initiating the switching action.

2.7 RESISTORS

Resistors are used in electronic circuit to provide specific path for electric currents and to serve as circuit element that limits the current to some desirable value. Resistors limit the currents in a circuit by connecting the flow of electron into heat.

2.7.1 TYPES OF RESISTORS

I. Fixed resistors: it has a fixed i.e. constant resistance value which cannot be changed.

II. Variable Resistors: This type of resistor may be adjusted mechanically with a screw driver, or have a resistance which depend on light or pressure.

2.7.2 PHOTO RESISTORS

Photo resistors are light- controlled variable resistors. A photo resistor is usually very resistive (in mega ohms) when placed in the dark. When it is illuminated, it resistance decreases significantly; it may drop as a few hundreds ohms, depending on the light intensity. It is used in light and dark activated switching circuit and light sensitive detective circuits.

2.8 INTEGRATED CIRCUITS (ICs)

Integrated circuits are electronic circuit in which both active and passive components are fabricated on an extremely tiny single silicon chip. It consists of a large number of these components that are work dependently to give a fast and accurate response.

2.8.1 TYPES OF IC

ICs are classified base on the function they perform and how they are constructed.

a. Classification base on the function they perform:
    i. Linear ICs: - It contains several amplifier circuits for either audio or radio frequency signals.
    ii. Digital ICs: - It contains an array of pulse switching circuits to perform logic function.
b. Classification based on how they are constructed:
    i. Monolithic ICs
    ii. Thick film ICs

iii. Hybrid ICs

Bipolar and unipolar ICs

Bipolar ICs are the ICs made with bipolar junction transistors BJTs e.g. TTL ICs (transistor transistor logic ICs)

Unipolar ICs are those made using field effect transistors (FETs and MOSFETs) e.g. COMS ICs (complimentary metallic oxide semiconductor).

The ICs used in this project are NE555, CD4017B, 741, 7805, 7809and 7812.

2.8.2 **NE555 (555 TIMER)**

The 555 timer IC is an incredibly useful precession timer that can act as ether a timer or oscillator. In timer mode (monostable mode), the 555 simply acts as a 'one short' timer; when a trigger voltage is applied to its trigger lead, the chips output goes from low to high (0-1) for a duration set by an external RC circuit. In oscillator mode (astable mode) the 555 timer acts as a rectangular wave generator whose output waveform (Low duration '0', High duration '1', frequency, etc) can be adjusted by means of two external RC charge/ discharge circuit

555 timer IC can be used in amazing number of applications. For example, with the aid of 555, it is possible to create digital clock waveform generator circuit, frequency divider, bounce-free switches, triangular waveform generators, etc.

Configuration of 555 Timers

i. Monostable or 'one shot' multivibrator
ii. Astable or square wave clock multivibrator

In this project, a continuous pulse is required for clocking the counter so that it can change it output stage for each clock input, depending on whether a negative going or positive going transistor is required by the counter for it operation.

Astable Multivibrator

Figure 2.8 is a simplified block diagram showing what is inside a typical 555 timer IC. The overall circuit configuration shown here (with external components included) represents the astable 555 configuration.

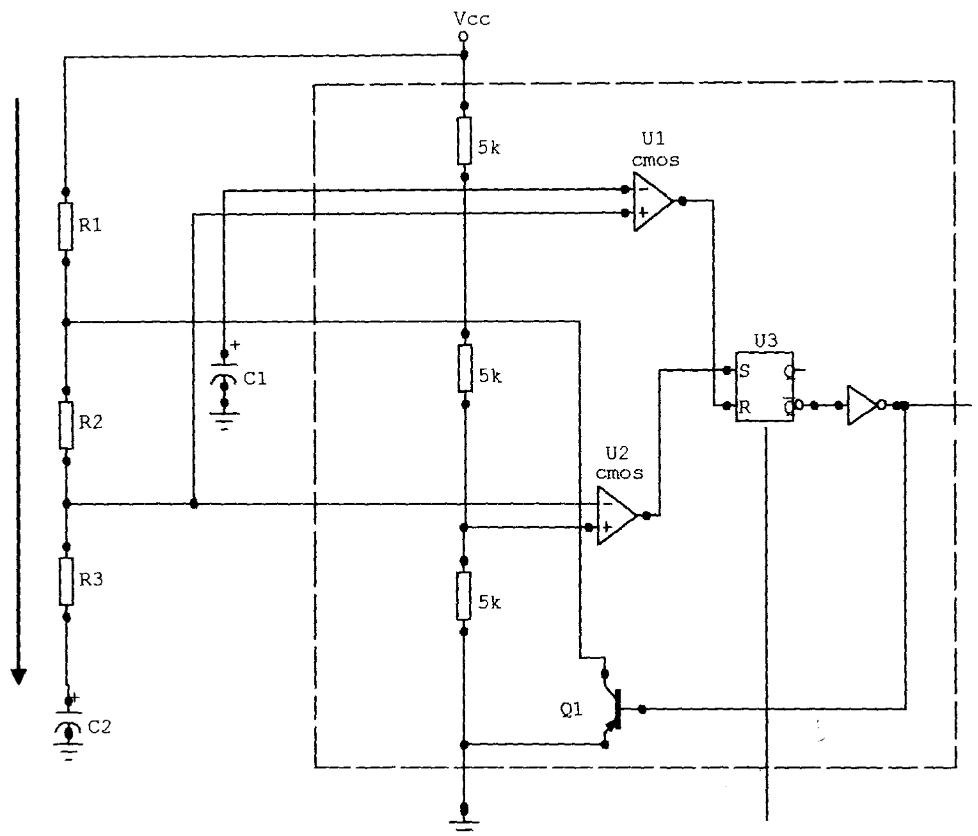


Fig. 2.8 Astable configuration of 555 timers with the block diagram showing what is inside the IC.

In astable configuration, when power is first applied to the system, the capacitor is discharged. This means that 0 volt is placed on pin 2, forcing comparator 2 high. This in turn set the flip- flop so that Q is high and the 555's output is low (a result of the inverting buffer). With Q high, the discharged transistor is turned ON, which allows the capacitor to charge toward Vcc through R, and R2. When the capacitor voltage exceeds 1/3Vcc, comparator 2 goes low, which has no effect on the SR flip- flop. However, when the capacitor voltage exceeds 2/3Vcc, comparator 1 goes high, resetting the flip- flop and forced Q high and the output low. At this point, the discharged transistor turns on and shorts pin 7 to ground, discharged the capacitor through R2. When the capacitor's voltage drops below 1/3 Vcc, comparator 2's output jumps back to a high level, setting the flip-flop and marking Q low and the output high. With Q low the transistor turns on, allowing the capacitor to start charging again.

The cycle repeats over and over again. The net result is a square wave output pattern whose voltage level is approximately Vcc – 1.5v and whose ON/OFF period are determined by the C, R1, and R2.

Charging time t1 = 0.693(Ra + Rb) C --2.11

Discharging time t2 = 0.693RbC --2.12

Period T = 0.693 (Ra + Rb)C --2.13

Frequency of operation f = 1/T = 1.443/(Ra + Rb)C ---------------------------------2.14

The duty cycle (the fraction of the time the output is high) is given by

Duty cycle = thigh/thigh – tlow --2.15

= t1/T =(Ra + Rb)/(Ra + 2Rb) ---2.16

When Ra is made very small as compared to Rb, then D = 1/2 * 100% = 50 % meaning that the 'ON' time t1 is equal to 'OFF' time t2 and hence a symmetrical square wave can be obtain.

If Ra is made so large, a duty cycle higher than 50% will be obtain i.e. 'ON' time is greater than 'OFF' time.

2.8.3 **COUNTERS**

A counter is a digital circuit that consists of n-flip-flop connected in cascade whose function is to count the number of pulses applied to its input terminals. The maximum number of possible 1 and 0 state is known as the modules of the counter and this cannot be greater than 2^n.

There are two types of counter namely;

i. Asynchronous or ripple counter – the output of flip- flop are not in exact synchronizes with the input pulse i.e. the clock will trigger the first flip-flop. The output of which will trigger the second flip-flop etc.

ii. Synchronous or parallel counters – the output of the flip-flops changes state immediately when the pulse or clock is received. The flip- flop changes state simultaneously in parallel thereby reducing the propagation delay to an appreciable value.

2.8.4 **KIND OF COUNTERS**

1. Pure binary counter: It follows the normal binary counting sequence till 2^n – 1 before it resets. N is the number of flip-flops.
2. Decade counter: Also known as BCD counters is a counter that has 10 distinct states no matter what the sequence is. It consist of four flip-flop connected asynchronously or synchronously to count in binary form 0-9.
3. Binary counter: It is a counter that follows the normal binary counting order till 2^n before it resets.

2.8.5 **IC DECADE COUNTER (CD4017B)**

There are series of IC chips that can be configured to work as a decade counter but for this project, CD4017B is used.

CD4017B is a monolithic circuit available in 16-lead dual inline plastic package. It consist of 5 stages Johnson counters having 10 decoded outputs respectively. The input include a clock, a Reset and a clock inhibit signals. Schmitt trigger action in the clock input circuit provides shaping that allows unlimited clock signal transition if the clock inhibit signal is low. Counter advance via the clock line is inhibited when the clock inhibit signal is high Reset signal clears the counter to its zero count. CD4017B permits high speed operation, 2 input decimal decoded gating and spike free decoded outputs. Each decoded output remains high for one full clock cycle. A carry out signal completes one cycle every 10 input cycles.

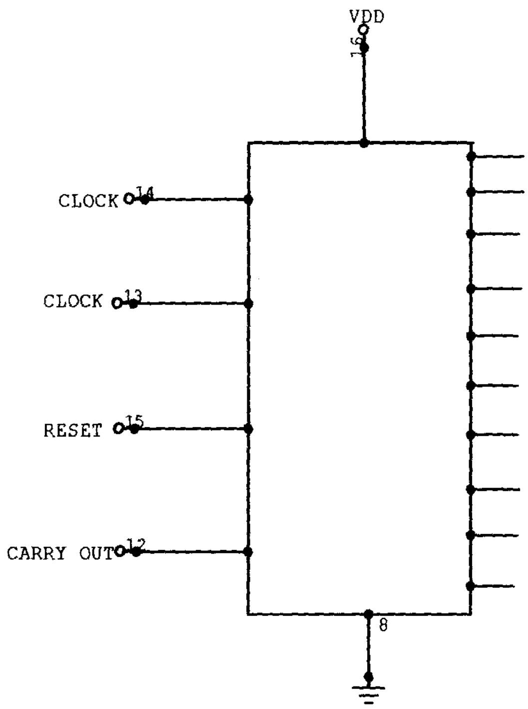
A summarized table showing the operation of CD4017B is given bellow.

INPUT				OUTPUT									
Clock	Reset	Clock	Carry	1	2	3	4	5	6	7	8	9	Carry out
↑	L	L	H	L	L	L	L	L	L	L	L	L	L
↑	L	L	L	H	L	L	L	L	L	L	L	L	L
↑	L	L	L	L	H	L	L	L	L	L	L	L	L
↑	L	L	L	L	L	H	L	L	L	L	L	L	L
↑	L	L	L	L	L	L	H	L	L	L	L	L	L
↑	L	L	L	L	L	L	L	H	L	L	L	L	H
↑	L	L	L	L	L	L	L	L	H	L	L	L	H
↑	L	L	L	L	L	L	L	L	L	H	L	L	H
↑	L	L	L	L	L	L	L	L	L	L	H	L	H
↑	L	L	L	L	L	L	L	L	L	L	L	H	H
↑	H	H	L	L	L	L	L	L	L	L	L	L	L

Table 2.1 Output sequence of a decade counter

L = Logic '0' and H = Logic '1'.

The configuration of CD4017B and the pin out is shown on the figure below.



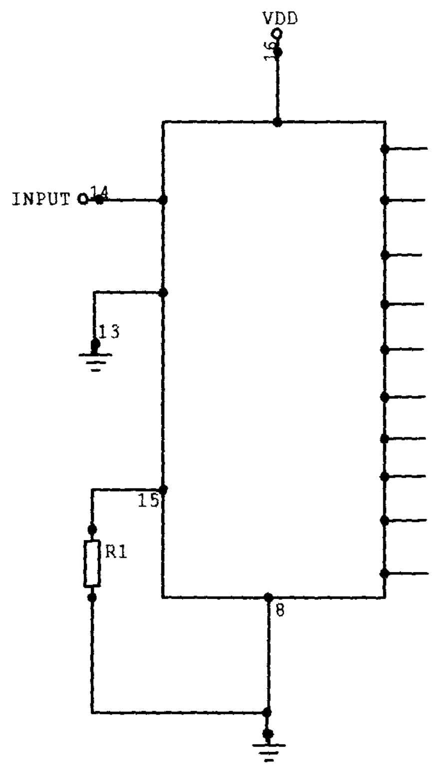


Fig 2.10 (a) 4017 pin out (b) Circuit configuration of 4017

2.9 **RERAY**

The conventional electromagnetic relay is really an electrically operated switch, and is a very useful power control device. It is an electrically controlled device that opens and closes electric contacts after other device in the same or another circuit

Three basic types of contact arrangement

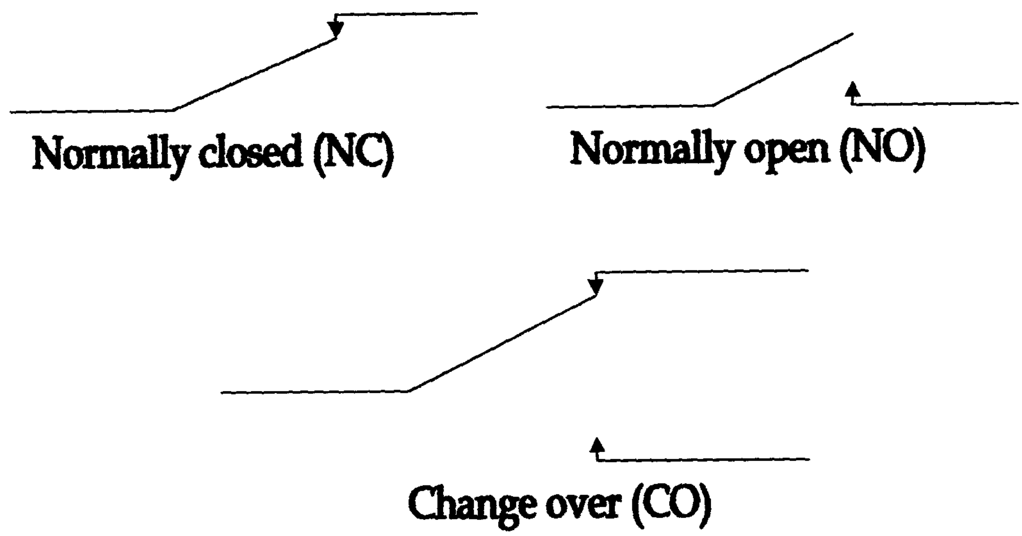


Fig. 2.11 Relay contact arrangement.

A single current flowing through the coil magnetizes, a bar of soft iron armature C which is drawn to the coil and opens and closes to drive large current by a small current. The opening and closing of contacts by a small current is made possible owing to the large number of turns on the force according to the equation below.

Magnetic field strength $H = IN/L = F/L$--2.17

I is the current flowing in the coil

N is the number of turns of the coil

F is the magnetizing force

L is the length of the coil

Hence,

$F=IN$--2.18

2.10 **DISPLAY COMPONENTS**

Light Emitting Diodes {LED}

Light emitting diodes are two lead devices that are similar to pin junction diodes, except that they are designed to emit visible or infrared light.

When a LED's anode lead is made more positive in voltage than its cathode lead (by at least 0.6 to 2.2v), current flows through the device and light is emitted.

LED's are used for various purpose because of their characteristic of being able to operate under a very harsh environment condition i.e. very high ambient temperature, high or low pressure, intermittent change in environment temperature etc. and also because of about 10mw and 2V respectively.

In limit the current drawn and the value of which is given by:

$$Rs = (V-VF)/IF \qquad (2.19)$$

V = Supply voltage

VF = Forward voltage

IF = Forward current

2.10.1 KINDS OF LED's

i. Visible light LED's
ii. Infrared LED's
iii. Blinking LED's
iv. Tricolor LED's
v. LED DISPLAYS (seven segment display)

CHOICE OF ELECTRONICS DISPLAY COMPONENT

The electronics display components chosen for this project depend on so many factors including;

i. The type and amount of information to be display

ii. Operating environment

iii. Power availability.

The consideration of these factors provides better way for us to achieve what we want to display and how much power needed to be supplied to the display.

2.10.2 CURRENT LIMITING RESISTOR AND REVERSE VOLTAGE PROTECTION

To protect a diode from excessive current, a resistor is placed in series as shown in the figure 2.12b below with the LED's. LED's also have reversed breakdown voltage VS that, if exceeded, may result in a zapped semiconductor. To provide reverse polarity protection to a LED, a diode can be placed in series and in the reverse direction with respect to the LED- the diode will conduct before the reversed voltage across the LED becomes dangerously large.

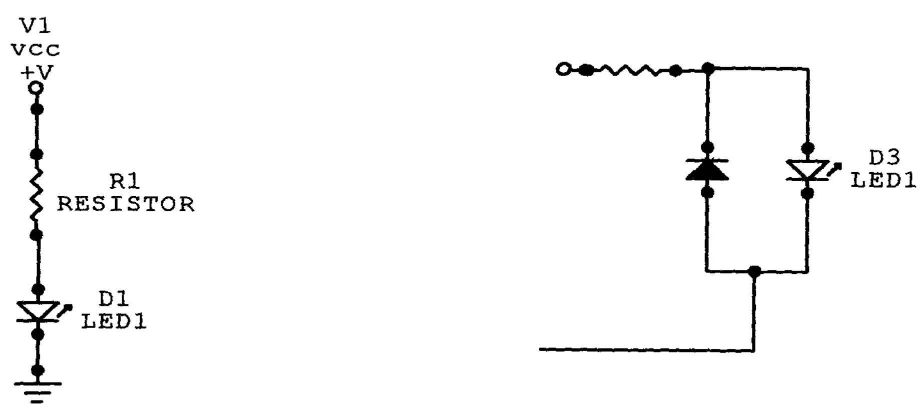


Fig 2.12 (a) Current limiting resistor connection. (b) Resistor voltage protection.

CHAPTER THREE

DESIGN ANALYSIS AND CALCULATIONS

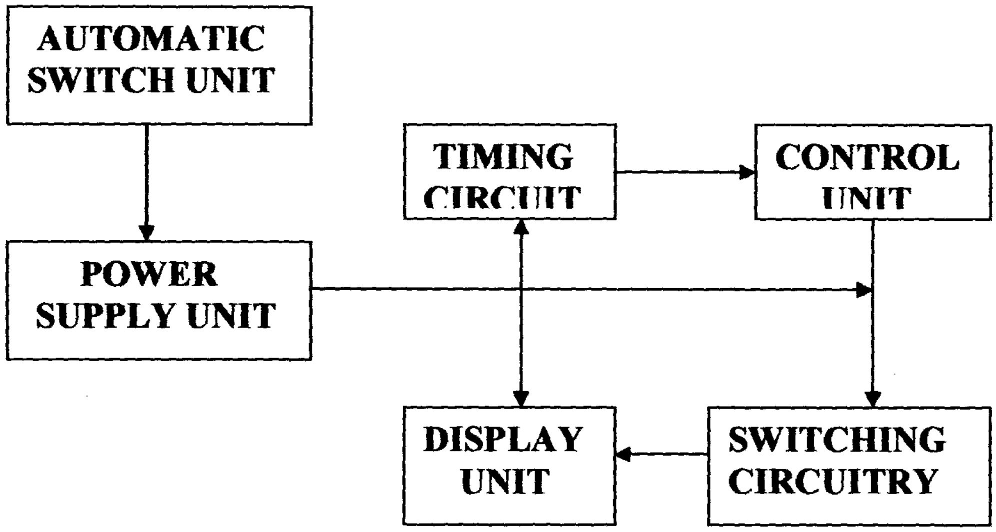


Fig 3.1 Block diagram of automatic electronic display board.

3.1 AUTOMATIC SWITCH DESIGN

The automatic switch is designed using bark activated switch circuit. This circuit will activate a relay when it is dark. The light sensor used is light dependent resistor (LDR). In bright light the resistance of the LDR can be as low as 80ohm and at 8'olux (darkness) the resistance increases to over 1M ohm. Op – amp is used to sense the voltage difference between pins 2 and 3. The variable resistor (VR) is used to adjust or provide a wide range for light intensities. In the day time the output of the op – amp is about 2 volts.

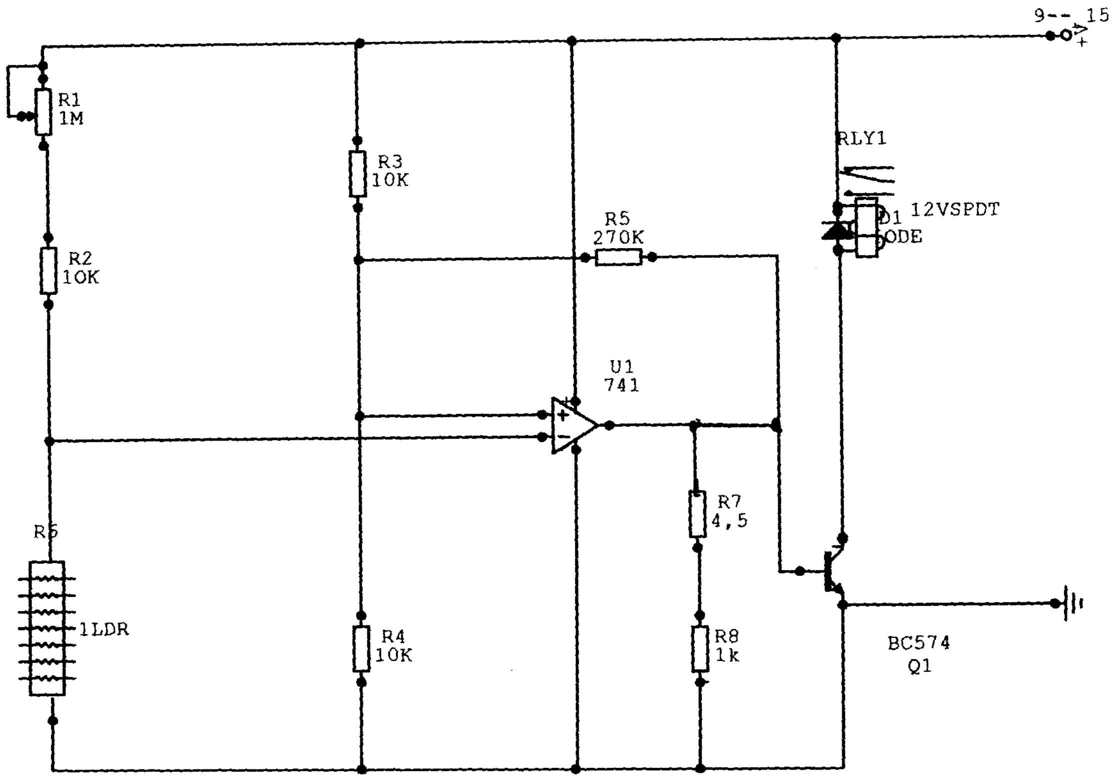


Fig 3.2 Automatic switch circuit diagram

When it is dark, the resistance of the LDR increases and the difference in input voltage is amplified by the op – amp, the output will swing towards full supply and drive the transistor which drives the relay. The 270k resistor provides a small amount of hysteresis, so that the circuit switches on and off with slightly different light levels. This eliminates relay chatter.

3.2 **POWER SUPPLY DESIGN CALCULATION**

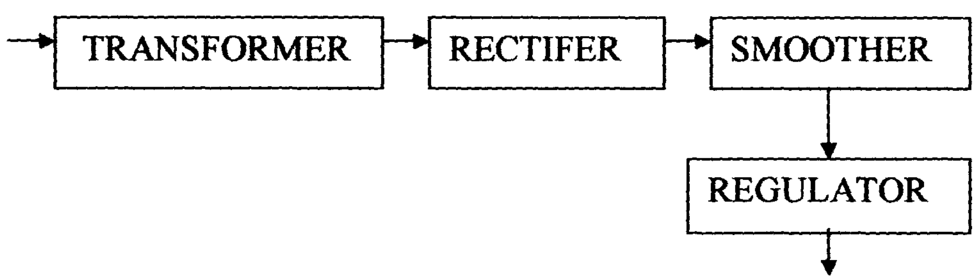


Fig 3.3 Block diagram of power supply

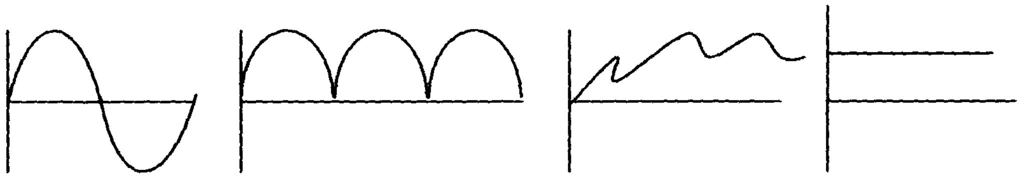


Fig 3.4 Output waveforms of the stages of power supply unit

A 5v and 9v power supply is to be designed choosing suitable transformers, rectifier and regulator is quite easy since specified values of this components are already available. Hence 15V, 2A transformer was chosen, also 5V and 9V regulator (7805 and 7809 respectively) were selected for regulation. The minimum regulators input voltage is +7v and +11v according to data book.

Minimum transformer output voltage and current are as given by equation 2.24 and 2.25 in chapter two respectively.

$$Vdc = 1.414\ Vac \quad \text{------------------------} \quad 2.4$$

I.e. $Vac = Vdc/1.414$

$$Idc = 0.62\ Iac \quad \text{------------------------} \quad 2.5$$

I.e. $Iac = Idc/0.62$

Due to the diode voltage drop Vd, the Vdc is given by the equation 2.6

$$Vdc = 1.414Vac - 2Vd \quad \text{------------------------} \quad 2.6$$

Therefore, $Vac = Vdc/1.414 + 2Vd$

Where $Vd = 0.7$

For 5V and 9V dc supply the minimum regulator input voltage (+7 and +11) is used for the calculation.

Then $Vac\ (5V) = [7+ 2\ (0.7)]/1.414 = 5.94V$

$Vac\ (9V) = [12 + 2\ (0.7)]/1.414 = 9.48V$

$Iac = 1/ 0.62 = 1.667A$

15volt transformer was chosen to provide not less than calculated minimum voltage of the regulators.

V_{TX} (min) = 15 [1 + 13% (1 – ½) – 6%]

The equation used is equation 2.2

V_{TX} min = V_{TX} [1 + Reg $_{TX}$ (1 – I/I_{TX}) – Reg mains] --------------------------------2.2

Using 15v secondary voltage, 2 Amps transformer

V_{TX} min = 15 [1 + 0.13 (1 – ½) – 0.06] = 15.1 volts

Vpeak = 1.414 V_{TX} min – 2Vd

= 1.414 (15.1) – 2 (0.7) = 19.81

Vpeak = 19.81

Smoothing capacitor value is calculated using equation 2.7

C = I T/(Vpeak – Vreg)

I = 1Amp

T = 0.01

Vpeak = 19.81

Vreg = 7v and 11v

The capacitor value

C = 1 x 0.01/(19.81 – 11)

= 1135 uf (for 9volt regulator)

Capacitor working voltage is

V_{TX} (max) = 15 [1 + 13% (1 – 0/1) + 6]

= 15 (1 – 013 (1) + 0.06) = 17.85v

Vpeak = 1.414 x 17.85 – 2(0.7) = 23.84V

The working voltage is rounded up to be 25V

The ripple factor δ is also considered, which should be kept minimum – say 0.04.

For δ to be 0.04

$F = 50Hz$

$V_{rms} = 15V$, $V_{max} = \sqrt{2}\, V_{rms} = 21.21V$

$I_{dc} = I_A$

Therefore, a suitable filter capacitor value can be calculated as:

$$0.04 = 1/(4 \times \sqrt{3} \times 50 \times C \times 21.21)$$

$$C = 1/(4 \times \sqrt{3} \times 50 \times C \times 21.21 \times 0.04) = 3403uf$$

Capacitor C2 and C3 were specified in the data sheet to be 220nf and 45nf respectively.

The circuit diagram of the power supply is shown below. In the circuit, 1uf, 16V capacitor was fitted at the output of the regulator to keep the output resistance of the circuit constant at high frequency.

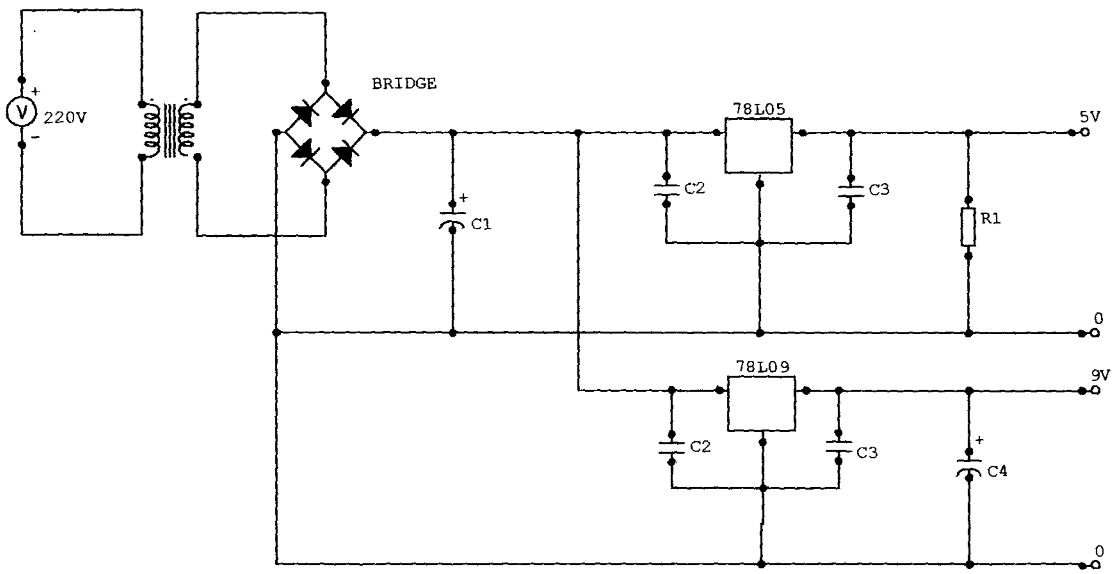


Fig 3.5 full diagrams of the power supply.

3.3 **TIMING CIRCUIT CALCULATION AND DESIGN**

The period of the output waveform is chosen to be three minute and lass than one second for the two timing circuit respectively.

Timing circuit A

10uf timing capacitor C was selected, resistor (timing resistor) R8 and R9 are choosing so as to achieve a duty cycle of about 50% that is R8 >> R9

$T = t1 + t2 = 3Sec$

Duty cycle $D = t1/T$

$t1 = 1.5Sec$

But $t1 = 0.693\,(R9 + R8)\,C$

$t2 = 0.693\,(R8)\,C$

Selecting $R9 = 10{,}000\Omega$

Since

$t1 = 1.5 = 0.693\,(R9 + R8)\,C$

$= (1.5/0.693C) - R9$

$= (1.5 / 0.693 \times 10 \times 10^{-6}) - 10{,}000$

$R8 = 206450\ \Omega$

Frequency $I/T = 1/3 = 0.33Hz$

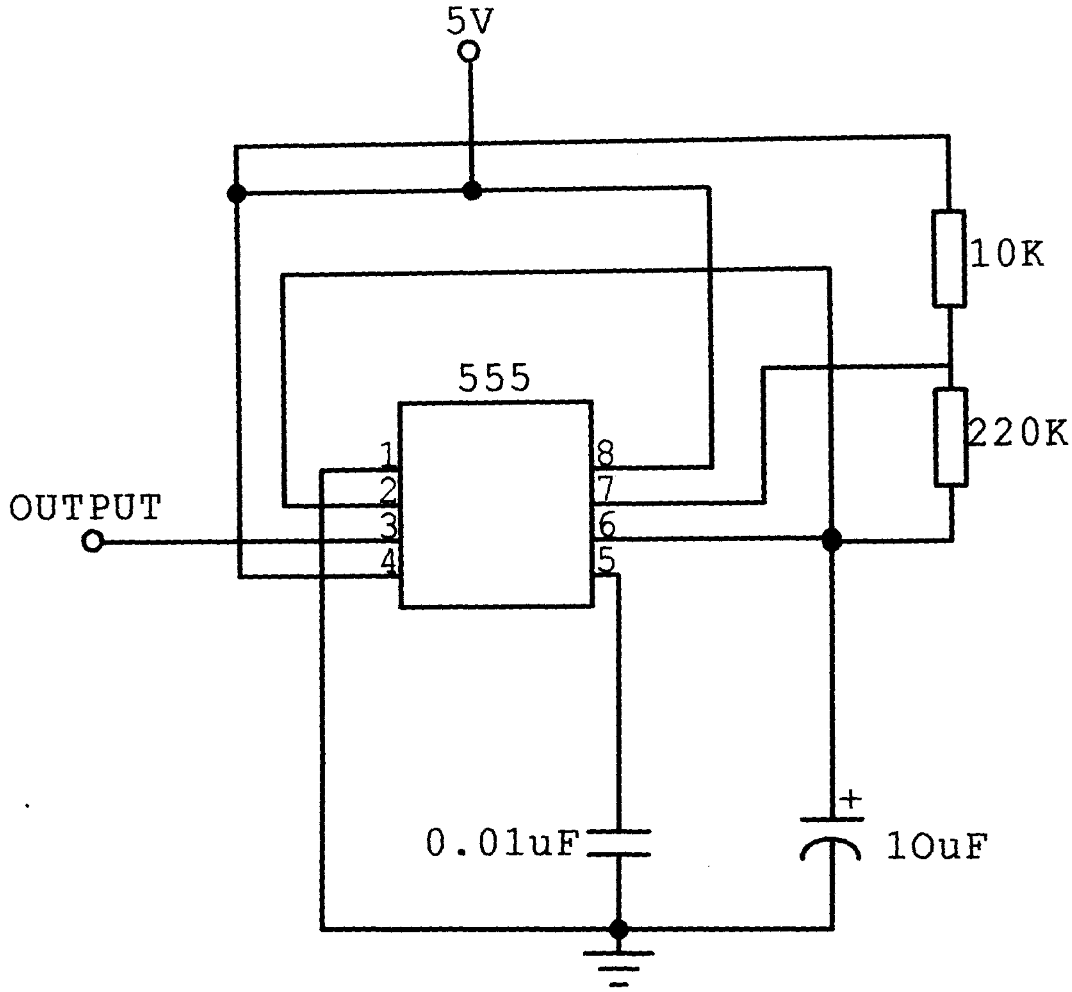


Fig.3.6 Timing circuit (A) diagram

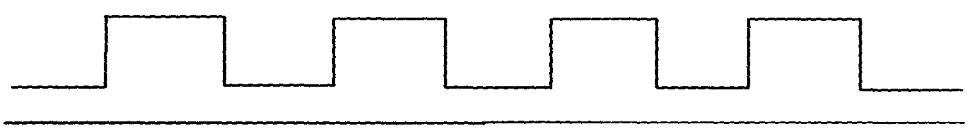


Fig 3.7 output wave of the timing circuit

Timing circuit B

470uf timing capacitor was selected. The timing resistor R7 and R6 are 1k Ω and 500 Ω

$t1 = 0.5 = 0.693\ (R7 + R6)\ C2$

$= (0.5/0.693 \times 470 \times 10^{-6}) - R7$

$R6 = (0.5/0.693 \times 470 \times 10^{-6}) - 1000\ \Omega = 535\ \Omega$

$R6 = 535\Omega$

But for a time less than a minute 400 Ω resistor was chosen and used i.e. the time T =

0.693 (R7 + 2R6) C

$T = 0.693 (1000 + 2 \times 400) \times 470 \times 10^{-6} = 0.58$ seconds

The period of the output waveform is 0.58seconds which is less than 1 minute

Frequency 1/T = 1/0.47 = 1.7Hz

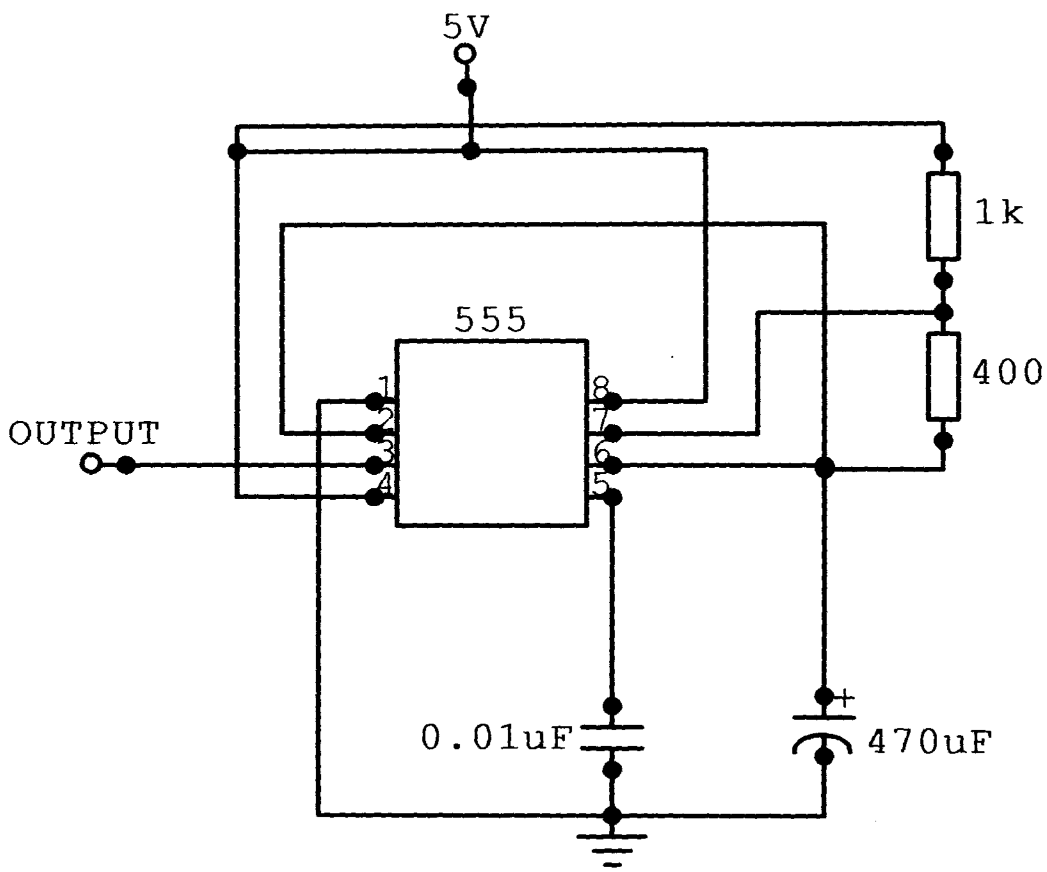


Fig. 3.8 Timing circuit (B) diagram

3.4 DESIGN OF CONTROL UNIT

From the data book, R11 and R10 which connect the pin 15 of the counters to the ground are to be selected between 10K Ω and 2n Ω.

Diode D2 – D46 are employed because of the characteristics that it allows the flow of current in only one direction. These diodes prevent the flow of current back to the counter.

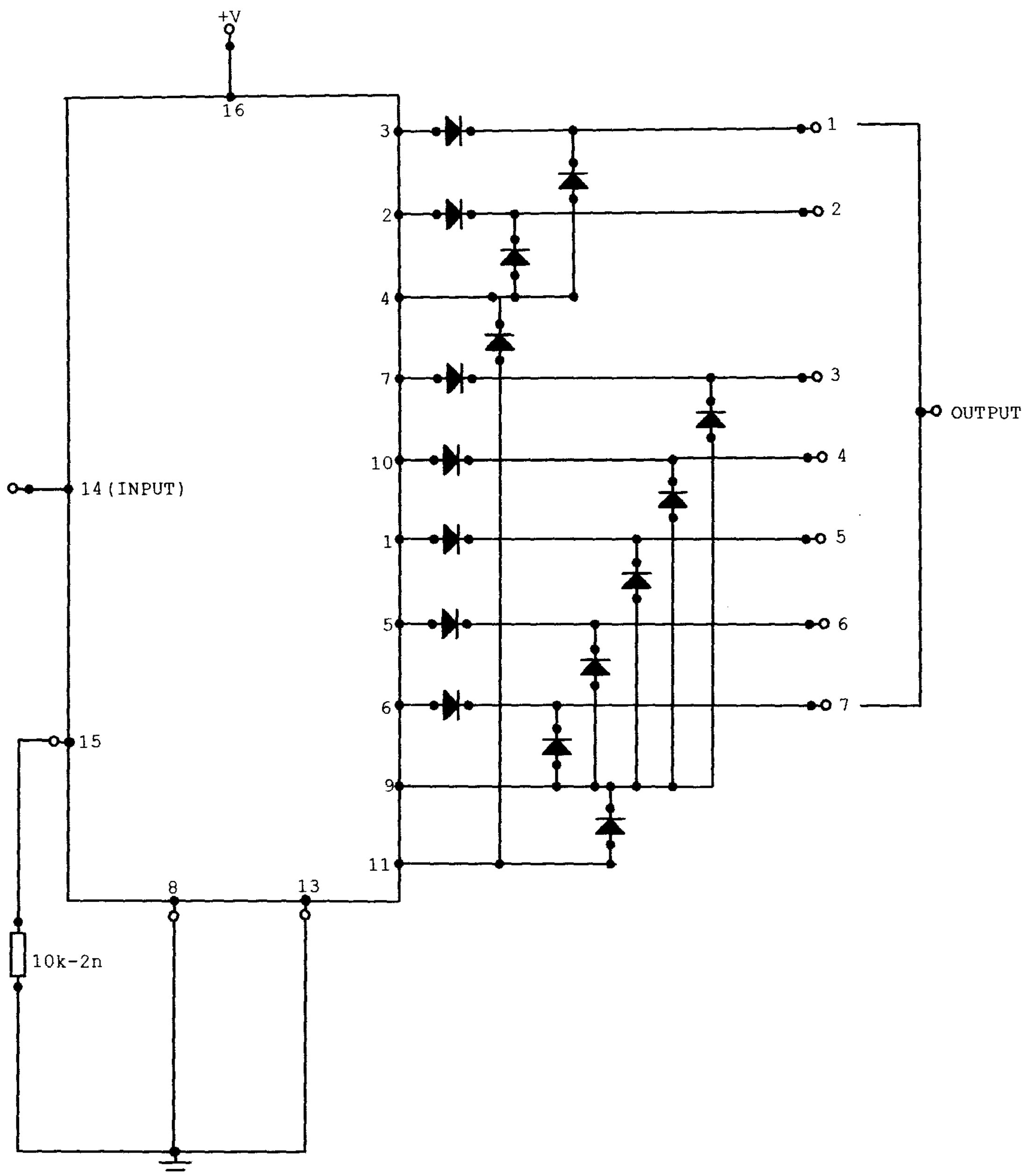


Fig 3.9 Control unit (A) circuit diagram

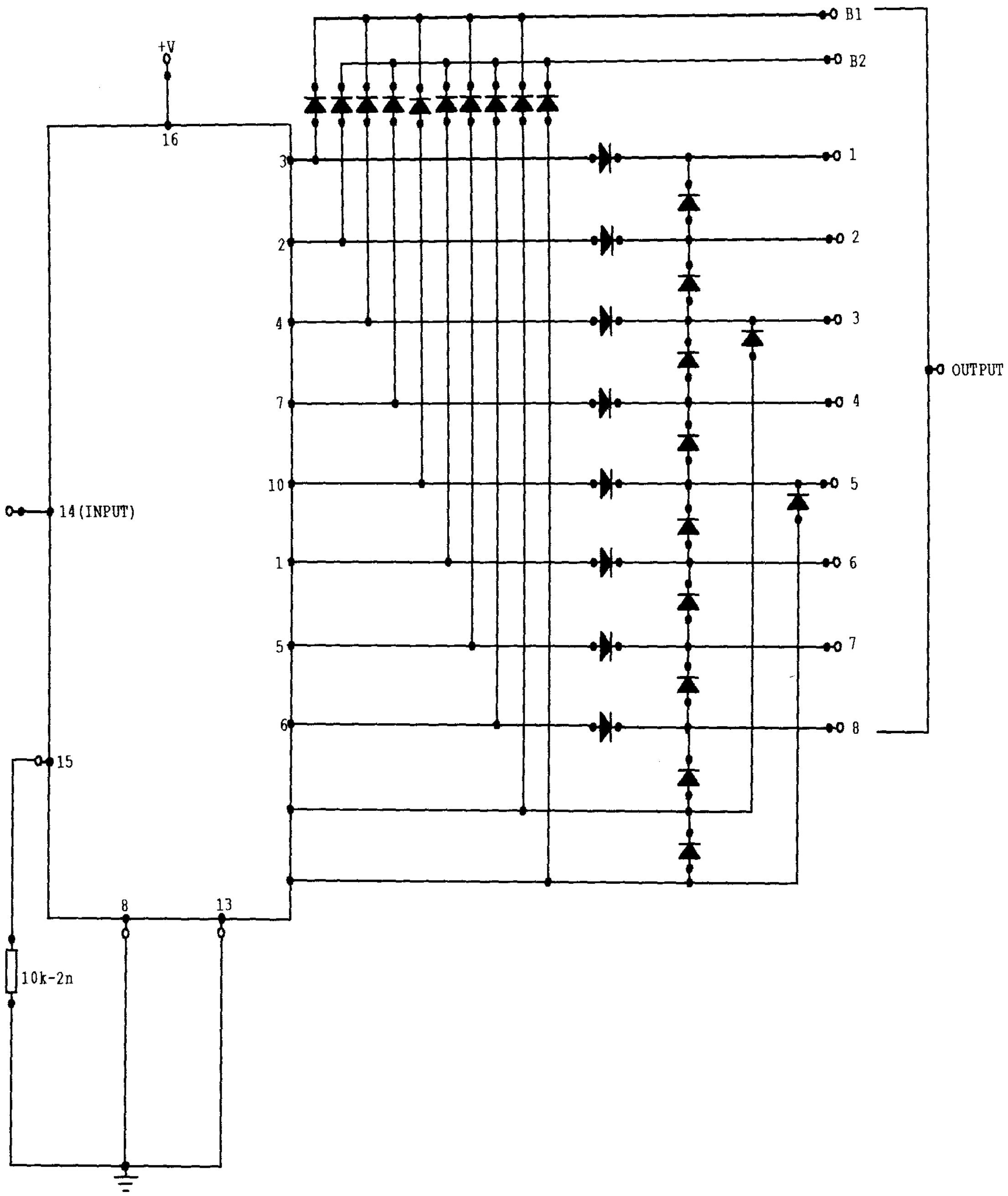


Fig. 3.13 Control unit (B) circuit diagram.

3.5 SWITCHING CIRCUIT

The transistor (a driver) which is required to boost the signal at the output in order to compensate for the drop as designed using 1k Ω resistor as the base resistor and the relay resistance of 100 Ω as the collector resistance.

Since R12-28 = hfc sat Rc

Where hfc sat = 10

R12-28 = 10 x100 = 1k Ω (the base resistor)

Hence R12-28 = 1k Ω

A general purpose transistor was selected for the switching.

6V relays were to control the supply to the display unit (load). The coil transient suppression which is a problem with relay relates to the collapsing magnetic field of the relay coil generating a transient or e.m.f voltage is protected using D47 – D63 which is connected in parallel with the coil.

This voltage if unsuppressed will destroy the transistor.

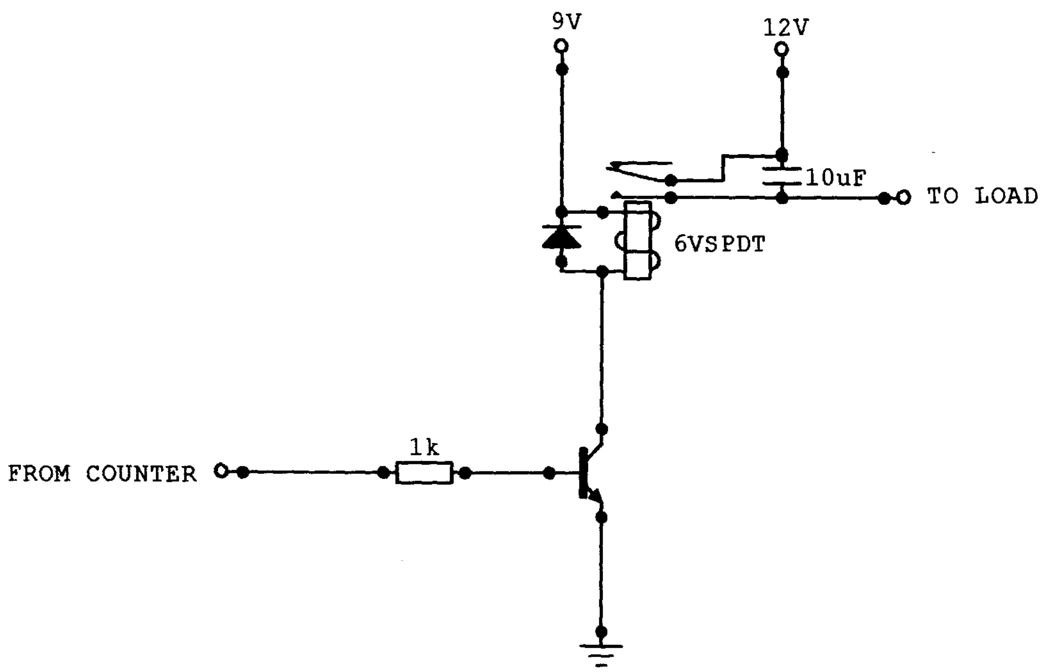


Fig 3.10 switching circuit diagram

The diode becomes forward biased as a result of the induced reversed voltage of the coil and the diode remains ON until the induced voltage drops to less than 0.6V.

Also 10uf, capacitor was used to suppress the arcing or spark discharge at the contacts. DC arcing or spark discharge causes metal to transfer from the negative contact to the positive contact.

Contact shunting or arc suppression is used to eliminate contact arcing when switching the load.

The capacitor value is given by $C = I^2/10$

Where

I = circuit current (A) = 10A

C = capacitance (uF)

$$C = 10^2/10 \times 10^{-6} = 10uF$$

The input of the switching circuits is connected to each of the control unit outputs (decade counter).

3.6 DESIGN OF THE DISPLAY UNIT

The design unit of this electronic display board is 5ft 7inches by 2ft 8inches. The casing is made of a metal pan with a reflective tinted glass at the front of the casing. The words are displayed with LEDs on a wooden board. This was realized using dot matrix format in writing the words.

On the 1st row `FUT MINNA` is displayed

The 2nd row displays `ELECTRICAL AND COMPUTER`

The 3rd row displays `ENGINEERING DEPARTMENT`

The 4th row displays ` You're Welcome`

These words are displayed with Red colour LEDs with orange colour LEDs at the middle of every letter. Also a boarder line is displayed in two lines using Red colour LEDs and Green colour LEDs the display circuit layout is shown below.

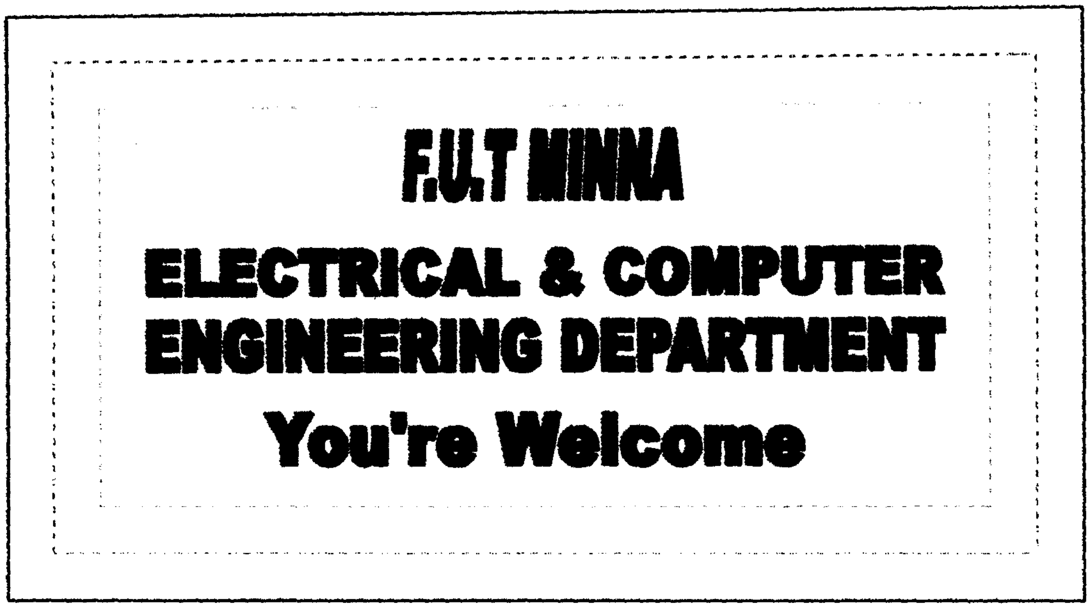


Fig 3.11 display circuit layout

The number of LEDs use for each load (letter or word)

Are as follows-

F.U.T	112 LEDs
MINNA	202 LEDs
ELECTRICAL	252 LEDs
& (AND)	28 LEDs
COMPUTER	243 LEDs
ENGINEERING	325 LEDs
DEPARTMENT	304 LEDs
YOU	31 LEDs
`re	20 LEDs

W	21 LEDs
E	10 LEDs
L	7 LEDs
C	7 LEDs
O	8 LEDs
ME	24 LEDs
Border line	484 LEDs

The LEDs are connected in parallel to form a letter or word. This is done by connecting the anodes of the LEDs together and the cathode together and soldered. About 2100 LEDs was used in this project for the displaying of the letters and the border line. Each letter was generated using dot matrix format as shown in fig below.

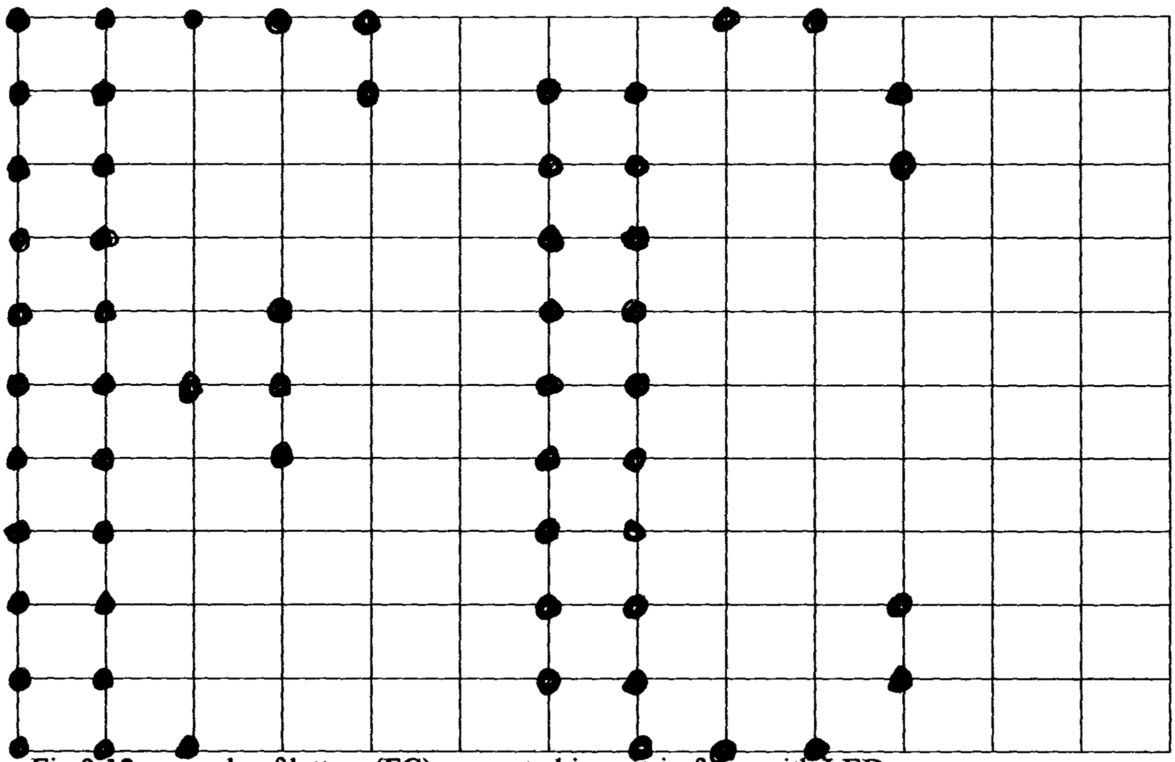


Fig 3.12 example of letters (FC) generated in matrix form with LEDs.

3.6.1 CURRENT LIMITING RESISTOR FOR THE LOADS

To protect the load from excessive current a resistor is placed in series with the loads (LEDs). The value of the resistor depends on the forward voltage Vf of the LEDs, the supply voltage V and the desired forward current If. This is given by equation below.

$$Rs = (V - Vf)/ If$$

The desired forward current to each LED = 20mA.

Supply voltage = 12V.

Forward voltage Vf = 3V

For each load the series resistor was calculated as shown below.

$$Rs = (V - Vf)/ N\ If$$

Where N = number of LEDs in a load.

In FUT we have Rs = (12 – 13)/ 112 x (20mA) = 4.016 = 4 Ω

MINNA: Rs = (12 – 13)/ 202 (20mA) = 2.227 = 2.2 Ω

ELECTRICAL: Rs = (12 – 3) / 252 (20mA) = 1.786 = 2.2 Ω

AND: Rs = (12 – 3)/ 28(20mA) = 16.071 Ω = 16 Ω

COMPUTER: Rs = (12 – 3)/ 243(20mA) = 1.852 Ω = 2.2 Ω

ENGINEERING: Rs = (12 – 3)/ 325(20mA) = 1.385Ω = 2.0Ω

DEPARTMENT: Rs = (12 – 3) / 304(20mA) = 1.480Ω = 2.0Ω

BORDER LINE 1 = Rs = (12 – 3)/ 228(20mA) = 1.991Ω = 2.2Ω

BORDER LINE 2: = Rs = (12 – 3)/ 228(20mA) = 1.991Ω = 2.2Ω

You: Rs = (12 – 3)/ 31(20mA) = 14.516Ω = 15Ω

Are: Rs = (12 – 3)/ 20(20mA) = 22.5Ω = 23Ω

W: Rs = (12 – 3)/ 21(20mA) = 21.4Ω = 22Ω

E: Rs = (12 – 3) 10(20mA) = 45Ω

L: Rs = (12 – 3) 7(20mA) = 64.3Ω =64Ω

C: Rs = (12 – 3) / 7(20mA) = 64.3Ω = 64Ω

O: Rs = (12 – 3)/ 8(20mA) = 56.25Ω = 56Ω

Me: Rs = (12 – 3)/ 24(20mA) = 18.75Ω = 19Ω

CHAPTER FOUR

TESTING AND CONSTRUCTION

4.1 CONSTRUCTION

The implementation of this project was first modified on the breadboard and then transferred to the vero board.

The construction was done in two stages: the soldering of the circuits and the coupling of the entire project to the casing. After soldering the components on the vero board the modules of the design were securely held to a flat board.

4.2 TESTING OF THE OUTPUT OF EACH STAGE AND THEIR RESULTS.

After construction, various stages were initially tested for continuity and correct output using a multimeter to ensure that there was no short circuit or open circuit.

The different modules were tested one after the other:

i. Output of the power supply unit
ii. Output of the automatic switch
iii. Output of the timing circuit
iv. Output of the relay circuit and driver
v. The display unit
vi. The whole circuit

4.2.1 OUTPUT OF THE POWER SUPPLY UNIT

The output of the 5v, 9v and 12v power supply unit was tested using multimeter. The transformers used are 12v and 15v. Their output (transformers) were tested when connected to 220volts AC supply and were confirm to be +12v and +15v respectively.

The rectifying stage was also tested and the output noted.

Next, the output of the power supply after the smoothing capacitors was observed using a 15v bulb, which gave a steady supply. The regulators were connected and tested using a multimeter. The output of 7805, 7809, and 7812 were 5v, 9v and 12v respectively. The test was done by placing the probe of the multimeter on the output terminal and the negative probe to the ground.

4.2.2 OUTPUT OF THE AUTOMATIC SWITCH

The automatic switch which was powered with 12v was tested in the dark and light (brightness) to determine the efficiency of the switch. The switch was taken into a dark room at this time the relay was triggered (switched to the normally open). When the light in the room was put ON, the circuit automatically switched off the relay (switched to the normally close). The sensitivity of the switch was at this time adjusted.

4.2.3 OUTPUT OF THE TIMING CIRCUIT

After configuring the 555 timers in this circuit the output was tested using an LED and multimeter. This was done by connecting the LED at the output terminal and ground of the configured 555 timer. For the timer 1, the output which was calculated to be 3 (three) seconds (i.e. the period) was confirmed using the timer ON and OFF of the LED with stop watch. The time ON of the LED used for testing was 1.5 seconds and the time OFF was also 1.5 seconds, therefore the period is 3 seconds.

For the timer 2, the output is also measured using the same method. The time ON of the LED was less than ½ a second and the time OFF also less than ½ a second. The period was calculated as 0.58 second; therefore the period is less than 1 second. This timer 2 supply pulse to the switching border lines and **"you're welcome".**

The frequently (f) of oscillation of the two timer was also measured using frequency meter.

4.2.4 OUTPUT OF THE COUNTER

After testing the 555 timers they were used to clock the decade counters. The output of the two decade counters. Were tested using multimeter and LEDs. The LEDs where connected at each ten output pins of the counters. The flashing of the LEDs (display time was observed and noted).

For the timer 1 and 2, the LEDs flashes at the interval of 3 seconds and approximately 1 second respectively for the two timers and switches to another output pin (LED) which light for the same time intervals.

After these testing, multimeter was used to measure the output voltage of the counter which was less than 5v.

4.2.4 OUTPUT OF THE RELAY CIRCUIT AND DRIVER

The output of the driver was measured using multimeter which confirmed that there was an increase in current after the driver. The outputs of the drivers were connected to the relays. When the circuit was powered, it was observed that each relay switched from normally close to normally open as designed and desired. LEDs were connected to the normally open and the ground was observed. The displays of the LEDs were as designed.-This gives the final testing of the first four stages of the project.

4.2.5 **THE DISPLAY UNIT**

On the completion of the display unit, various loads were initially tested for continuity, short circuit and open circuit using multimeter. Also the circuit was tested for proper connection of the LEDS i.e. that the LEDs which are connected in parallel do not have their poles interchanged.

During testing, some LEDs were found to be bad and were replaced. The other circuits were connected to the display unit after the test for continuity; short circuit and open circuit, etc were carried out.

The whole circuits were powered, after which the regulator (9v) and the transformer used was observed to be very hot. Also, the relays where not derived very well because of the low voltage supply from the NEPA through 9v regulator.

Hence another power supply was designed and constructed for the display unit only. This (power supply) supplies 12v to the display unit. The designed and construction was done using 12volts transformer 1 amp bridge rectifier, 33300uf – 25v smoothing capacitor etc

$$V = 12[(1+ 13 (1- 1/1) – 6)/100] = 11.28V$$

$V_{peak} = 1.414V_{Tmin} – 2V_d$

$= 1.414 (11.28) – 2 (0.7) = 14.55V$

$C = 1T/ (V_{peak} – V_{reg}\} = 1 \times 0.01/ 14.55 – 7 = 1325 \times 10^{-6}$

$C = 1325uf.$

Smoothing capacitor working voltage is

$V_{TXMAX} \quad = 12 [1+13(1 – 0/1) + 6/100] = 14.28V$

Vpeak equals 18.78V

Ie

$1.414 \times 14.28 - 2(0.7) = 18.79$

The circuit diagram is included in the general circuit of the project. Also the 9v regulator was replaced with 12v regulator for the relayed to be derived well even when there is very low voltage and current supply from the NEPA.

4.3 MOUNTING AND TESTING OF THE WHOLE CIRCUIT (SYSTEM)

The whole circuit was mounted on a metallic casing after testing each unit of the system. Final wiring, soldering, packing etc were done carefully so that the system would not be subjected (their leads) to unnecessary strain like twisting and bending. The front and back of the casing were covered with tinted glass (5mm) and metallic pan respectively. In mounting the circuits and components, repairing, servicing and maintenance were taken into consideration, hence, the transformers and the heating components/circuits were mounted on the metallic casing of the system very close to the vent. The packing of the system was done in a way that it can be easily open for repair and maintenance.

When all these were done, the system was plugged to the electricity (220v AC) in the day time and was observed. It was observed. In the afternoon when the system was powered the system remain OFF until in the evening at about 6.45pm (in the dark), the system came ON automatically and worked until in the morning when it was put OFF again automatically when light falls on it. This test was satisfactorily for the whole system (i.e. the project work.).

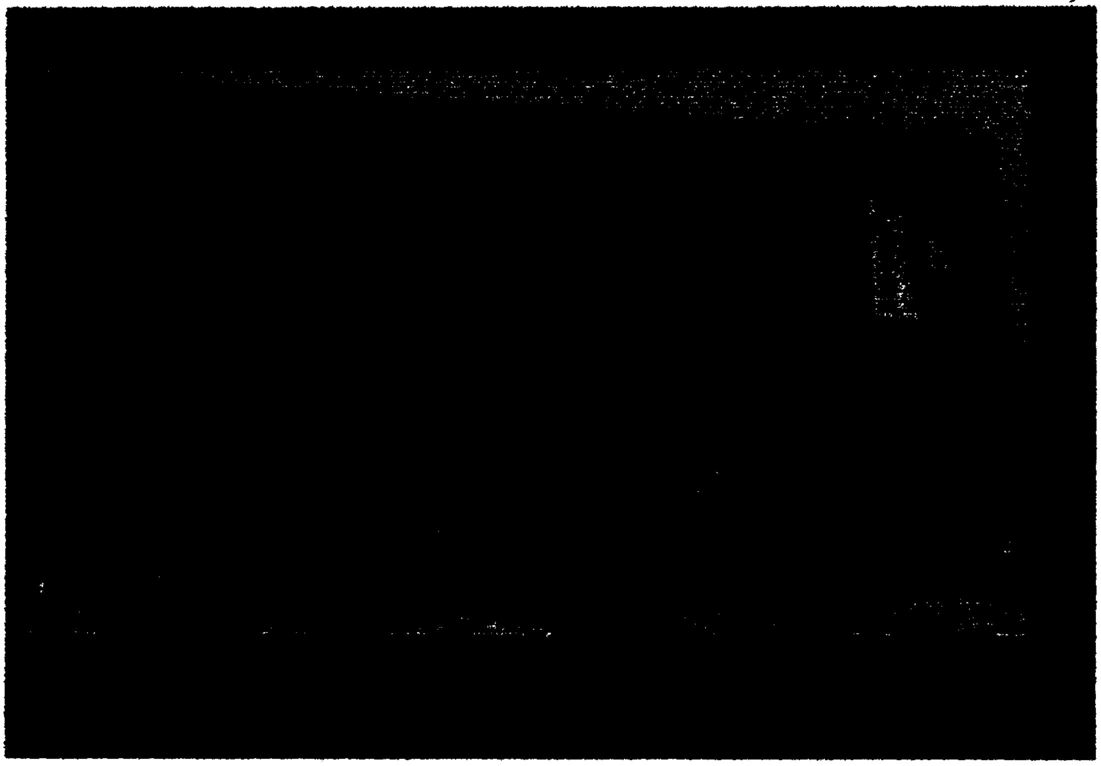


Fig. 4.1 the system circuit.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSIONS

Electronic Display (sign post) plays important role in advertisement, monitoring of digital signals and frequency measurement of such digital signals. It is accepted universally and environmentally friendly because of the fact that it has a relatively low production cost, easy to design and construct, portable, easy to read and understand, more visually attractive, flexible as they can display different modes over a short period of time, low power consumption, etc.

This project has given me a broad knowledge of simplicity of using digital components to design and construct any digital or analogue based systems.

This report will also serve as a guide to prospective students who care to work on similar project.

5.2 RECOMMENDATIONS

Although, this project has been designed to specification, there are still other things that need to be incorporated into the design.

These are:-

1. The electronic display should be improved upon to be a moving digital display system.
2. The design should be improved by using traics instead of relays for the switching circuit.
3. Group of students should be allowed to improve this project to a computerized scrolling display system.

REFRENCES

1. R.M.MARSTON Power Control Circuit Manual
2. HOWARD M. BERIN The 555 Timer Application source book with Experiments
3. RONALD J. TOCCI and NEAL S WIDMER (1990) Digital Systems Principles and Application (International Education) 7th edition.
4. K.J BOHLMAN (1987) Electronics Servicing. 2nd Edition Volume 1, Great Britain.
5. EL ROBERT BOYESTAD AND LOUIS NASHELSKY (1990) Electronics Devises and Circuit Theory, USA Edition
6. ECG DATA BOOK, 1999 edition.
7. EVERYDAY ELECTRONICS JOURNAL, May (1998) edition.
8. B.L THERAJA AND A.K THERAJA . A textbook of Electrical Technology. 2001 edition
9. TOM DONCAN SUCCESS ELECTRONICS LONGMAN (1983)

APENDIX 2: ENGINEERING PART LIST

ITEM NO	DESCRIPTION	QUANTITY
1	4.7KΩ (1/4)WATT RESISTORS	1
2	1KΩ (1/2) WATT „	23
3	2.2Ω (10) „ „	5
4	4Ω (10) „ „	1
5	20Ω (2) „ „	2
6	16Ω „ „ „	1
7	15Ω „ „ „	1
8	23Ω „ „ „	1
9	22Ω „ „ „	1
10	45Ω „ „ „	1
11	64Ω „ „ „	2
12	56Ω „ „ „	1
13	19Ω „ „ „	1
14	270KΩ (1/2) WATT RESISTOR	1
15	4KΩ „ „ „	1
16	220Ω „ „ „	1
17	10KΩ „ „ „	4
18	400Ω „ „ „	1
19	1MΩ VARIABLE RESISTOR	1
20	LDR LIGHT DEPENDANT RESISTOR	1
21	3300uf /35V ELECTROLYTIC CAPACITOR	1
22	2200uf /35V „ „	1
23	1uf /16V „ „	2
24	470uf /16 „ „	1
25	10uf / 16V „ „	18
26	0.01uf CERAMIC DISC CAPACITOR	2
27	220nf TANTALIUM CAPACITOR	2
28	470nf „ „	2
29	IN4001 DIODE	64
30	7805 IC REGULATOR	1
31	7809 „ „	1
32	7812 „ „	1
33	CD4017B DECADE COUNTER	2
34	NE555 TIMER	2
35	741 0P-AMP.	1
36	SPST 6V RELAY	17
37	SPDT 12V RELAY	1
38	BC574 TRANSISTOR	18
39	15V TRANSFORMER	1
40	12V „	1
41	LIGHT EMITTING DIODE 3V 20mA	2200
42	1A FUSE	2
43	13A „	1