AUTOMATIC ELECTRONIC DISPLAY BOARD

BY

NWAEKPE DARLINGTON OKEZIE

93 / 7094 EE

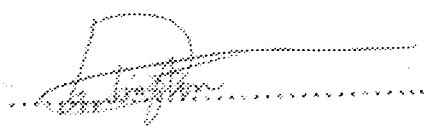
IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR OF ENGINEER (B. ENG) IN ELECTICAL / COMPUTER ENGINEERING

SUBMITTED TO THE DEPARTMENT OF ELECTRICAL / COMPUTER ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

NOVEMBER 2004.

DECLARATION

I declare that this work has not been presented in whole or in part for the award of bachelor of engineering degree anywhere. All literature cited has been duly acknowledged in the reference.



Nwaekpe Darlington Okezie

08/12/2024

Date

DEDICATION

This project is dedicated to the Almighty God and my loving parents Mr and Mrs S.E Nwaekpe.

CERTIFICATION

This is to certify that **NWAEKPE DARLINGTON OKEZIE** of Electrical and Computer Engineering Department, School of Engineering & Engineering Technology, Federal University of Technology, Minna carried out this work on " **Automatic Electronic display board**" in partial fulfillment of the requirement in Electrical and Computer Engineering.

Approved by;

.....
Engr. J. Kolo
Project Supervisor

8/12/24
.....
Date

.....
Engr. M.D. Abdullahi
Head of Department

3/01/2025
.....
Date

.....
External Examiner

.....
Date

ACKNOWLEDGEMENT

To the almighty God (omnipresent), who has been there all the years. Your grace Lord has been sufficient for me.

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I would not fail to mention the wonderful contributions of all Nifesians. Thank you very much. The Lord will reward your labour of love.

ABSTRACT

The electronic display board is carefully designed for use in the department to create an eye-catching display. It gives an outline explanation of how the circuit work, together with all the electronic components needed. The electronic display board illuminate LEDs in pattern, which chases from left to right and back again. Outputs from the circuit board are used to control and add spectacular effect to the letter board. This project gives a broad knowledge of using digital and discrete components in the design and construction of any digital or analogue based system.

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CHAPTER ONE

1.1 INTRODUCTION

Outdoor advertising is one of the oldest media. It is usually colourful and strong on illustration and it has short selling messages. Billboards are placed in locations where surveys have shown that they will be seen by large numbers of people. They range from lithographical papers sheet pasted together to the more permanent and expensive painted building and the very closely spectacular, which uses the flashing lights to attract attention. By flashing lights in proper sequence the spectacular are sometimes controlled by program in the microcomputer.

The sole aim of the display board is to capture the attention of general public, in other to meet this objective, hence the introduction of the LEDs (Light Emitting Diode). As light Emitting Diode (LED) is essentially a PN junction semiconductor diode that emits a monochromatic light when operated in a forward biased direction.

The first commercially usable LEDs were developed in the 60's by combining three elements: Gallium, Arsenic and Phosphorous to produce the Red LED, which was found to exhibit very high quantum efficiency.

The output of the light chaser is connected to the letter board, where the LEDs are soldered to make letters, symbols or Logos. When the appropriate light chaser output goes "HIGH", all the LEDs on the Letter board lights up simultaneously. In this way a message that illuminates following the same pattern as the individual LEDs on the Light chaser printed Circuit Board (PCB) or Veru board.

1.2 AIMS AND OBJECTIVES.

The sole aim of this project is to design and construct an autonatic electronic display/ advert board with spectacular effects to display "F.U.T. MINNA, ELECTRICAL &COMPUTER ENGINEERING DEPARTMENT" and also to display "You Are Welcome" all enclosed in a switching boarder line.

OBJECTIVES.

To display "F.U.T. MINNA" word after word.

To display "F.U.T. MINNA" at once.

To display "ELECTRICAL & COMPUTER ENGINEERING DEPARTMENT" word after word.

To display 'F.U.T. MINNA, ELECTRICAL & ENGINEERING DEPARTMENT '' at once.

To spell out '' YOU ARE WELCOME''.

To automatically come 'ON' in the night and go 'OFF'' in the daytime.

1.3 SIGNIFICANCE OF STUDY

This project will be constructed using discrete LEDs as the output component (display) and not the filament lamp. The light chaser is the configuration of some digital integrated circuit (ICs) like the 4017-decade counter, 555 timer, transistor, diodes, and capacitors, relays e.t.c. Which aids in the design for the stability of performance.

The design control will be automatic i.e. it will automatically come 'ON' at the night and 'OFF' when it is daytime. Although the design should have been designed to be programmable, but this will not be considered because of the cost and also it is a prototype design.

1.4 METHODS OF DESIGN

These tools of carrying out this project comes in various forms at various stages of the design, consultation with my supervisor, a review of past experiments, related projects and script. At some other time library work was done to verify the appropriate components and devices required to carry out the design. A visit to electronics component dealers, browsing of the electronic components data books and the Internet. Group discussion was also arranged to share experience of people on the behaviour of the components used for the design.

CHAPTER TWO

2.1 LITERATURE REVIEW

The use of incandescent lightning in digital electronic display is no more as profitable as it used to be since the introduction of LEDs. LED lamps are more superior to the incandescent lighting. So why is it that some design engineers still make use of incandescent lamp for their display output? Well, it might be that they are just a few years behind what is really happening in the LEDs.

Although recent advancement in the world of LED technology have dramatically improved and still improving the effects on the electronics sign post (display board).

2.2 LIGHT EMITTING DIODE

A light emitting diode (LED) is essentially a PN-junction semi conductor diode that emits a monochromatic light when operated in a forward biased direction.

2.3. ADVANTAGES OF LED

I. Cheaper component to filament bulb

II. Very visible at day time as well as night

III It emits focused beam of a single wavelength (colour) in only one direction.

IV Easy to maintain

V Very reliable and durable

VI Low power consumption.

Solid-state design enables LEDs to withstand shock, vibration, frequent switching and environmental extremes without compromising their long life- typically 100,000 hours or more.

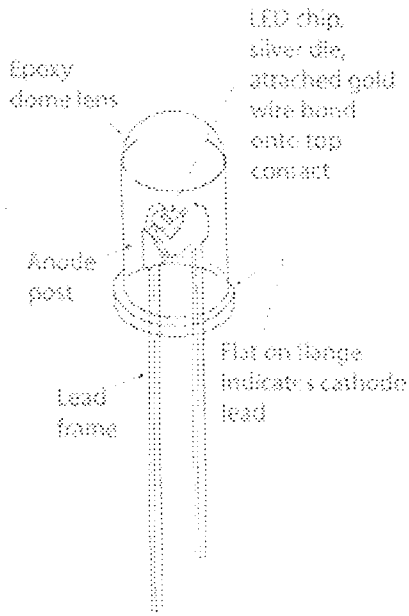


Fig. 2.0.0 LED

2.4. RELAYS

A relay is an electrically operated switch, however most relays are electromechanical switches that works on the effect produced by current flowing through a coil. The currents flowing through the coil of the relay creates a magnetic field, which attracts a lever and changes the switch con acts. Then coil current can be OFF or ON so relays have two switch positions and they are double throw (change over) switches. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

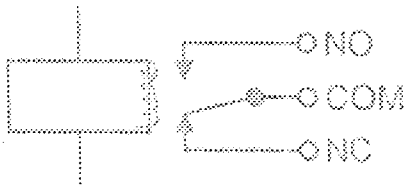


Fig.2.0.1 Circuit symbol for a relay

NO = Normally open

NC = Normally closed

COM = Common

The opening and closing of contacts by a small current is made possible owing to the large number of turns on the coil which creates a very large magneto motive force; according to the equation below;

Magnetic field strength H = IN / L = F /L

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 2.1

CHOOSING A RELAY

These are some of the features considered while choosing a relay for this project.

(I) COIL VOLTAGE

The relays coil voltage rating and resistance must suit the circuit powering the relay coil. However, some relays operate perfectly well with a supply voltage that is a little lower than thin rated value. In this case a 6V, 100 ohms relay is being used.

(ii) COIL RESISTANCE

The circuit must be able to supply he current required by the relay coil. Ohm's law can be used to calculate the coil resistance of the relay.

Relay coil current = supply voltage / coil resistance ----------2.2

(iii) SWITCH RATINGS (VOLTAGE& CURRENT)

The relay contact must be suitable for the circuit they are to control. You will need to check the voltage and current ratings.

ADVANTAGES OF RELAYS

- Relays can switch AC and DC
- Relays can switch high voltages
- Relays are good for switching large currents (>5A)
- Relays can switch many contacts at once.

DISADVANTAGES OF RELAYS

- Relays are bulkier
- Relays cannot switch rapidly
- Relays use more power due to current flowing through their coils
- Relays require more current than many chips can provide.

2.5 IC REGULATOR

The two basic elements of a stabilized circuit via, voltage reference and voltage amplifier, can easily be combined into IC (integrated circuit), offering the advantages of extremely good regulation, compact size and ease of use.

The principle of operation is still based on the zener diode mode of operation but with added improvements. IC regulators are designed for

Specific fixed Voltages.

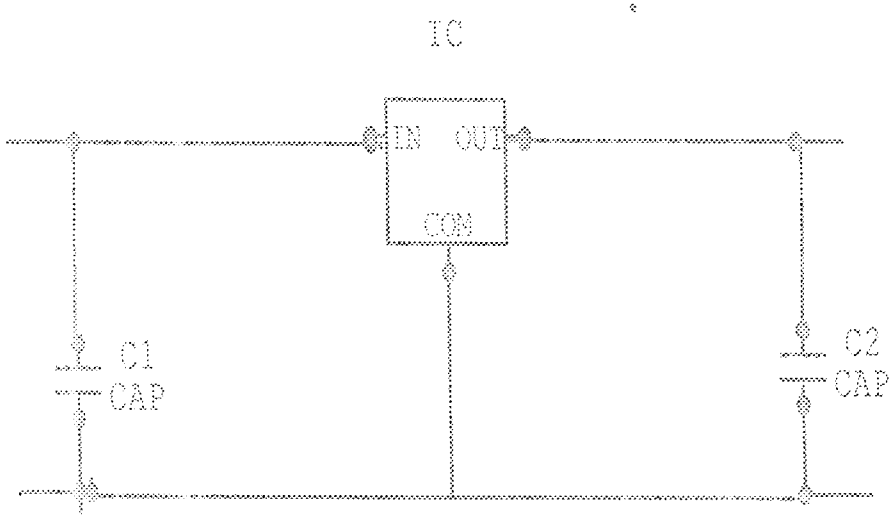


Fig 2.4 Typical IC regulator configuration

$C_1$and C_2 is decoupling capacitors that maintain a low output importance at all frequency. The output impedance of all regulators tends to rise at high frequencies, it should be noted that the minimum permissible input voltage of all regulators should be greater than their ratings for them to function properly. Typical IC regulators are 78L5, 7805,78105, 79L05, 7812,78L12, 317 etc.

2.6 DIODE

This is a two terminal device consisting of a P-N junction formed either in Ge or Si crystal. The P and N type region are referred to as anode and cathode.

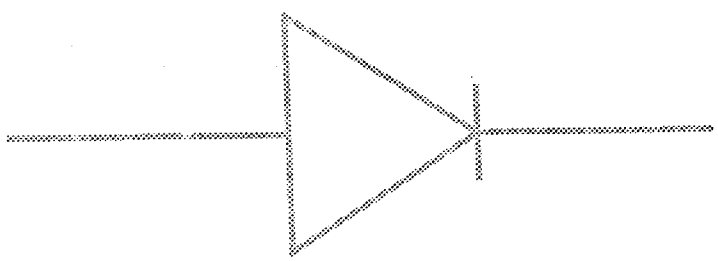


Fig 2.5 circuit symbol

The low current diode whose body is about 3mm long can carry a forward current of about 100mA, have saturation current of about 5μA at room temperature (25°) and can withstand a reverse voltage of 75volts without breaking down.

FORWARD VOLTAGE OF DIODE (FORWARD BIAS)

There is always a small voltage across a conducting diode, it is called the forward voltage drop and is about 0.7volt for all normal diode, which are made from silicon. The forward voltage drop of a diode is almost constant whatever the current passing through the diode, so they have a very steep characteristic.

REVERSE VOLTAGE (REVERSE BIAS)

When a reverse voltage is applied a perfect diode does not conduct, but all real diode leak a very tiny current of a few μA or less. However all diodes have a maximum reverse voltage (usually 5volt or more) and if this is exceeded the diode will fail and pass a large current in the reverse direction, this is called breakdown.

TYPES OF DIODES

- Rectifier diodes: These are used in power supplies to convert alternate voltage to direct voltage i.e. from AC to DC.

  Rectifier diodes pass large currents.

- Signal diodes: (small current) this are used to process information (electrical signals) in circuits, so they are only required to pass small currents of up to 100mA

- Zener diodes: Zener diodes are used to maintain a fixed voltage.

They are designed to 'breakdown' in a reliable and non

-Destructive way so that they can be used in reverse to maintain

A fixed voltage across their terminals.

Zener diodes can be distinguished from ordinary diodes by their code and breakdown voltage, which are printed on them. Zener diode codes begin BZX... or BZY... Their breakdown voltage is printed with V in place of a decimal point, so 4V7 means 4.7V for example.

Zener diodes are rated by their breakdown voltage and maximum power:

- The minimum voltage available is 2.7V.
- Power ratings of 400mW and 1.3W are common.

- LED (Light Emitting Diode)
- Tunnel diode
- Schottky diode. Etc.

The table below shows maximum current and maximum reverse voltage for some popular rectifier diodes.

Diode	Maximum current	Maximum Reverse voltage
1N4001	1A	50V
1N4002	1A	100V
1N4007	1A	1000V
1N5401	3A	100V
1N5408	3A	1000V

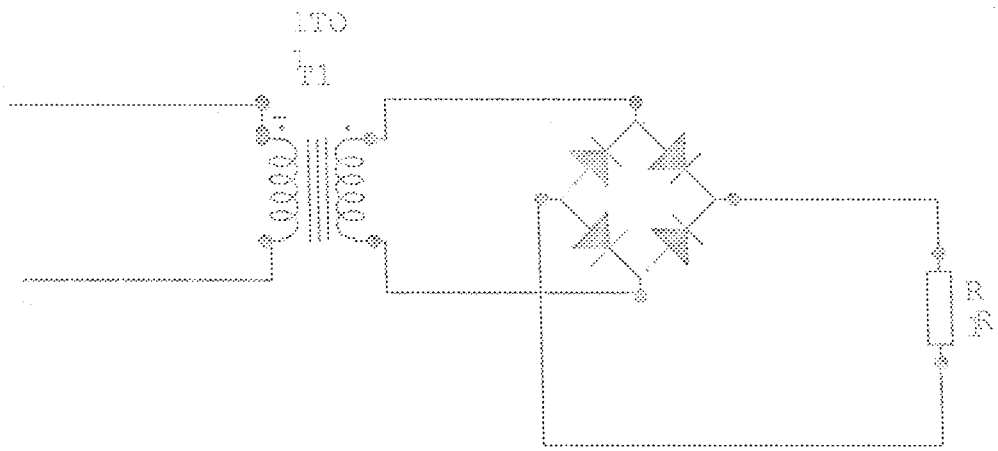


Fig. 2.50 Rectification circuit

2.7 CAPACITORS

These are energy storing device. They store electric charge. They are used with resistors in timing circuits because it takes time for a capacitor to fill with charge. Capacitors are also used in filter circuits by smoothing varying DC supplies by acting as a reservoir of charge. capacitors can easily pass AC (charging) signals but they block DC (constant) signals.

CAPACITANCE

This is a measure of capacitors ability to store charge. A large capacitance means that more charge can be stored. Capacitance is measured in farads, F. However 1F is very large, so prefixes are used to show the smaller values. E.g. μ means 10-6, so 1000000 μF=1F

TYPES OF CAPACITOR

a) Electrolytic capacitors-: These are polarized capacitor and they must be connected the correct way round, at least one of their leads will be marked + or –

b) Tantalum Bead capacitors-: These are polarized and have low voltage ratings like electrolytic capacitors; they are used when a very capacitance is required.

2.8 TRANSFORMERS

A transformer is a piece of electrical apparatus, which consist of two or more electrical circuits (primary and secondary windings) interlinked by a common magnetic field for the purpose of transforming energy between the windings. The windings are usually on a magnetic core, which ensure that there is high magnetic fluxes linkage between the windings. An alternative voltage across one winding will induce an alternative voltage in the coil and the induced voltage depends on the number of turns on the windings.

The relationship between voltages, windings and current is given in the equation below

$$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p}$$

Where V_p, N_p, I_p are the primary voltage, numbers of turns and primary currents in the windings respectively, while V_s, N_s, Is on the secondary voltage, numbers of turns and current in the windings respectively.

TRANSFORMER CONSTRUCTION

There are two general types of construction of transformers namely;

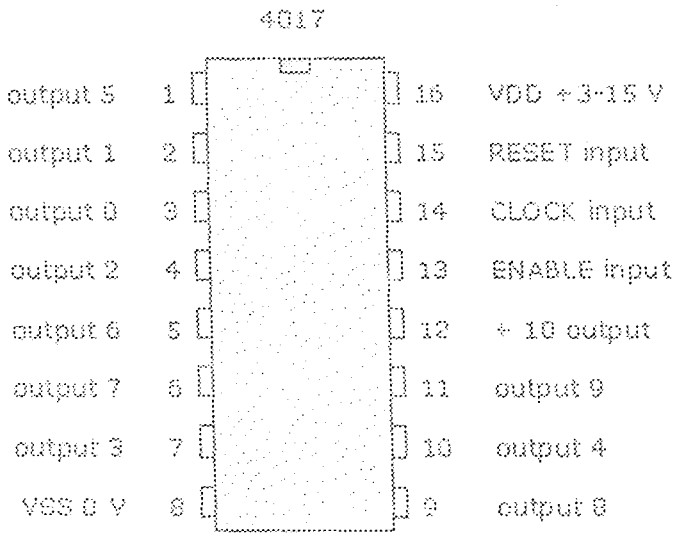
i) Core types and, (ii) shell type

2.9 DIGITAL INTEGRATED CIRCUIT (IC)

Integrated circuit is a circuit whose components and connecting wire or pins are made by processing distinct areas of a chip of semi-conductor materials, such as silicon. ICs pack a lot more circuit in a small package so that the overall size of digital system is induced. ICs have made digital system more reliable by reducing the number of external interconnection from one device to another. Digital ICs cannot handle very large currents or voltages because of the heat so generated in such a very small space.

This particular project will bring out one of the application of digital ics such as the 555 timers and decade counter chip as example of digital IC.

Pin connections



The 4017 decade counter has ten outputs

Fig.2.8 Decade counter

2.1 COUNTERS

A counter is an electronic switching device/ circuit such as a flip flop or stepping circuits which respond to sequential inputs pulses applied to it, giving one output pulse after receiving a certain number of input pulses.

TYPES OF COUNTER

There are basically two types of counter:

Asynchronous counter: this can be defined, as the mode of counter operation in which the completion of an operation starts another i.e. the counting is sequential.

Synchronous or parallel counter: this is a counter whose operations are timed by single frequency clock signal. The output of the flip-flop changes states immediately the pulse or clock is received. The advantage of the decade counter (synchronous counter) over asynchronous one is that all the flip-flops change states simultaneously in parallel thereby reducing the propagation delay to an appreciable value.

KINDS OF COUNTER

Binary counter: This kind of counter follows the normal binary counting order till 2^n before it resets, where n is the number of flip-flops.

Decade counter: This is also known as BCD counter. it counts in sequence from 0000 to 1001, it has 10 distinct states no matter what the sequence is.

WHAT IS A DECADE COUNTER?

The 4017 decade counter has 10 separate outputs, which go HIGH in sequence, as shown below.

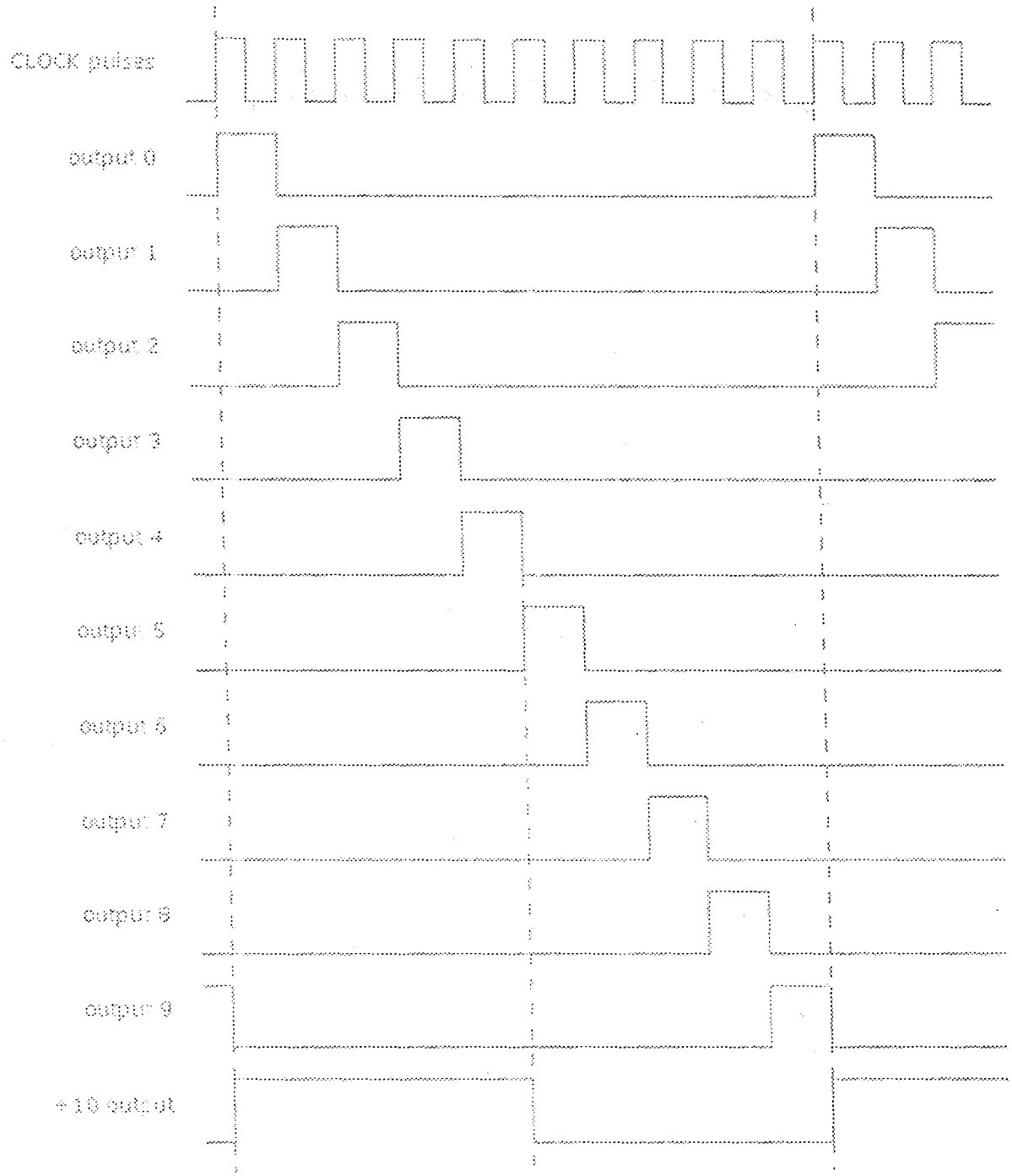


Fig.2.5 waveform of a decade counter.

INPUTS OUTPUTS

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

FIG 2.81 Truth table for 4017-decade counter IC.

L =LOGIC "0"

H =LOGIC "1"

↑= CLOCK (SIGNAL)

2.2 PHOTO RESISTOR

This is a light sensitive semiconductor component specially designed for light detecting devices. The light dependent resistor (LDR), also known as photo resistor. The LDR operates on the principle that cadmium sulphide is particularly sensitive to light in the

visible part of the spectrum. In the dark, the LDR has a dark resistance of 10MΩ, this resistance drop as low as 150Ω or less.

Photo resistors are light controlled variable resistor. It may drop as low as few hundred ohms, depending on the light activated switching circuit.

2.3 TRANSISTOR

The transistor is a three-layer semiconductor device consisting of either two n- or one p-type layers of material or two p- and one n-type layers of material. The former is called an NPN transistor, while the latter is called a PnP transistor.

Transistors amplify current, for example they can be used to amplify the small output current from a logic chip so that it can operate a lamp, relay or other high current device. In many circuits a resistor is used to convert the changing current to a changing voltage, so the transistor is being used to amplify voltage.

A transistor may be used as a switch (either fully on with maximum current, or fully off with no current) and as an amplifier (always partly on).

The amount of current amplification is called the current gain, symbol h_{FE}.

Types of transistor

There are two types of standard transistors, NPN and PNP, with different circuit symbols. The letters refer to the layers of semiconductor material used to make the transistor. Most transistors used today are NPN because this is the easiest type to make from silicon.

The leads are labeled base (B), collector (C) and emitter (E).

Transistors have three leads, which must be connected the correct way round.

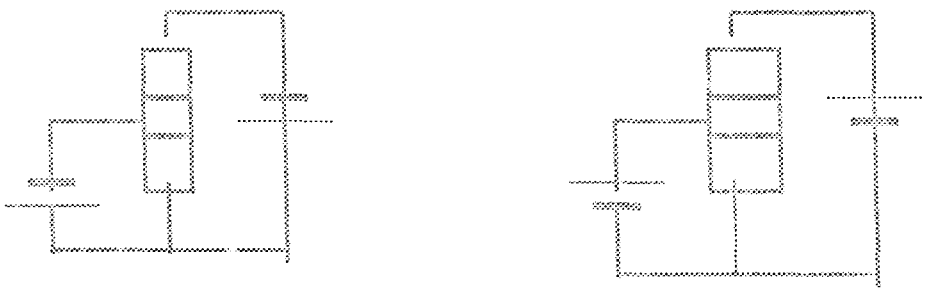


Fig 2.1 Transistor biasing

TRANSISTOR AMPLIFYING ACTION

The basic voltage –amplifying action of the common – base configuration can be described using the circuit below. For the common – base configuration, the input resistance between emitter and base of a transistor will typically vary from 20 to 200Ω the output resistance may vary from 100k to 1M. The difference in resistance is due to forward –biased junction at the output (base to collector).

2.4 RESISTORS

A resistor is a passive component that is used in electrical or electronic circuit to create opposition to the flow of current. The unit of resistance is the ohm (Ω): it is the amount of resistance that is required to pass a current of one ampere in response to an applied emf of one volt.

Resistors can be connected in series and in parallel.

TYPES OF RESISTOR

The most usual type of resistor is the solid carbon resistor. It consists of a small cylinder of carbon, which is mixed with a non- conductor. Resistors are always marked with colour code to indicate the value.

2.5 THE 555 TIMER

The 555 timers is an integrated circuit, it consists of two voltage comparators, a bi-stable flip-flop, a discharge transistor, and a resistor divider networks.

The resistive divider network is used to set the comparator levels. Since the entire three resistors are of equal value, the threshold comparator is referenced at 2/3 of supply voltage level and trigger comparators referenced at 1/3 of supply voltage. The outputs of the comparators are tied to the bistable flip- flop. When the trigger voltage is movedbelow1/3 of the supply, the comparator changes states and sets the flip- flop driving the output to a high states

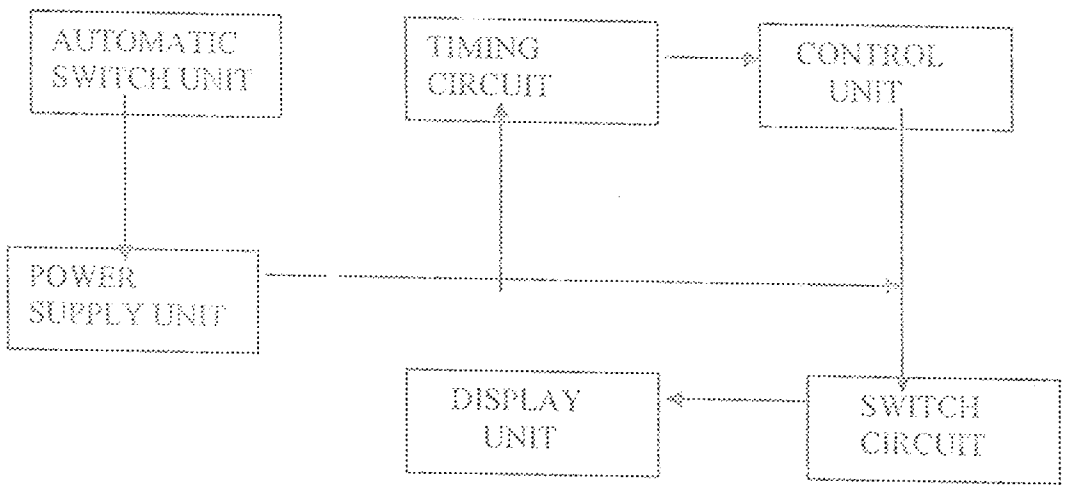
The threshold pin normally monitors the capacitor voltage of the RC timing network. When the capacitor voltage exceeds 2/3 of the supply, the threshold comparator reset the flip-flop, which in turn drives the output to a low state. When the output is in low state, the discharge transistor is "on", thereby discharging the external timing capacitor. Once the capacitor is discharged, the timer will await another trigger pulse, the timing cycle having being completed.

CHAPTER THREE

3.1 INTRODUCTION

The light chaser using 4017-decade counter illuminates LEDs sequentially in a pattern, which chases from left to right and back again. The timing depends on the configuration of the 555 timer, which sends signals to the input of the 4017-decade counter at determined and constant interval. Outputs from the main chaser circuit board are to control the letter board. The letters and symbols are printed or designed on a letter board in matrix form to create eye-catching display. Digital lighting system produces a very broad spectrum of innovative and simple lightning flashers, sequential for signs

DESIGN CALCULATIONS AND ANALYSIS



In its simplest form, an electronic display board consists of four subsystems linked together.

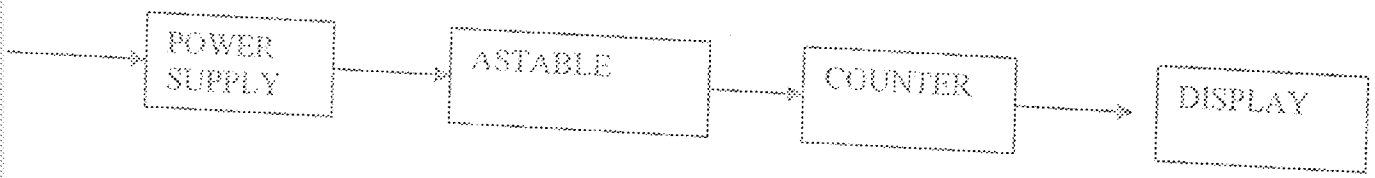


Fig 3.1 Block Diagram Of Subsystem Of Electronic Display board

3.2 AUTOMATIC SWITCH DESIGN.

The automatic switch designed works on the principle of operation of the LDR. In the dark, the photo resisto. has a high resistance,while the resistance is as low as 150Ω or even less in bright sunlight. The op-amp serves as a voltage comparator. The op-amp compares the voltage difference between pin 2 and pin 3.The variable resistor provides a range for light intensities.During daytime the op-amp outputs 2volt, however when it's dark the output swings towards full supply to switch on the relay.The 270K resistor provides a small amount of hysteresis, so that the circuit switches on and off with slightly difference in light intensity level.

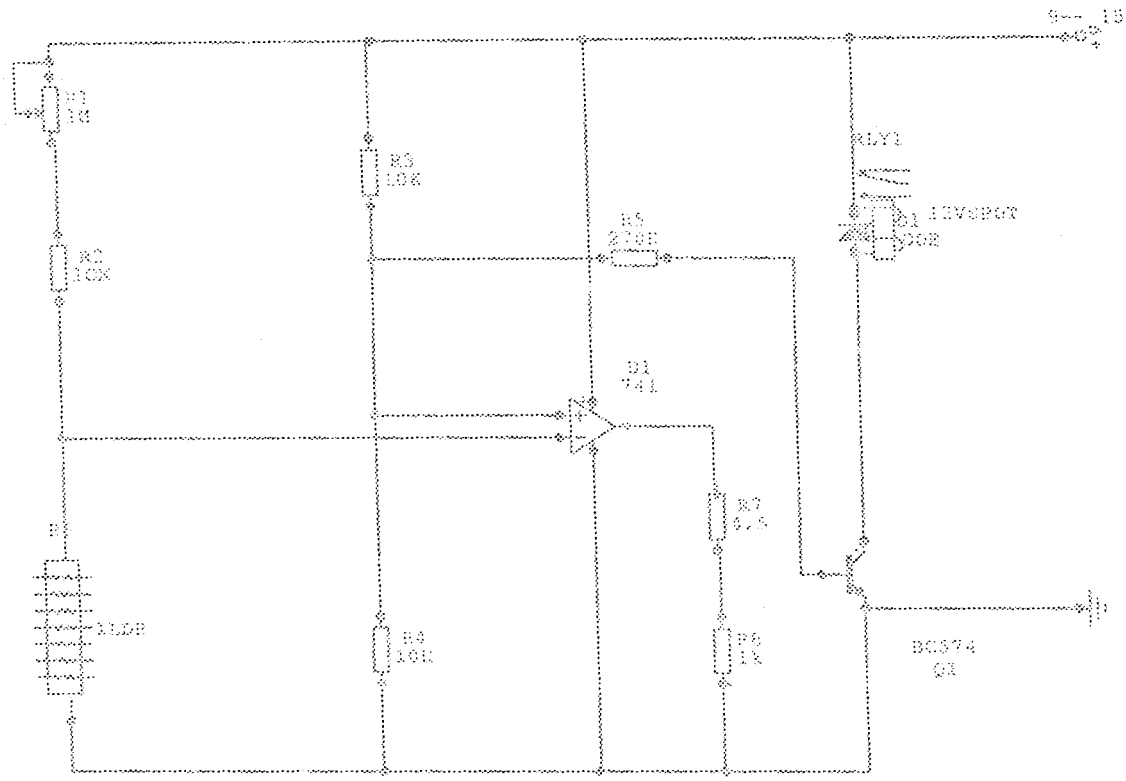


Fig 3.2 Automatic Switch Circuit

POWER SUPPLY DESIGN CALCULATION

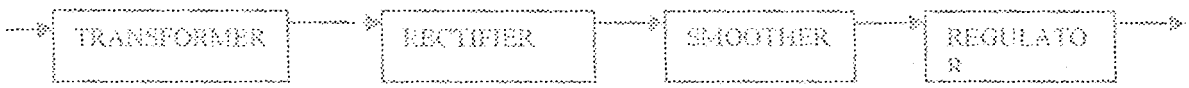


Fig 3.3 Block Diagram Of The Power Supply

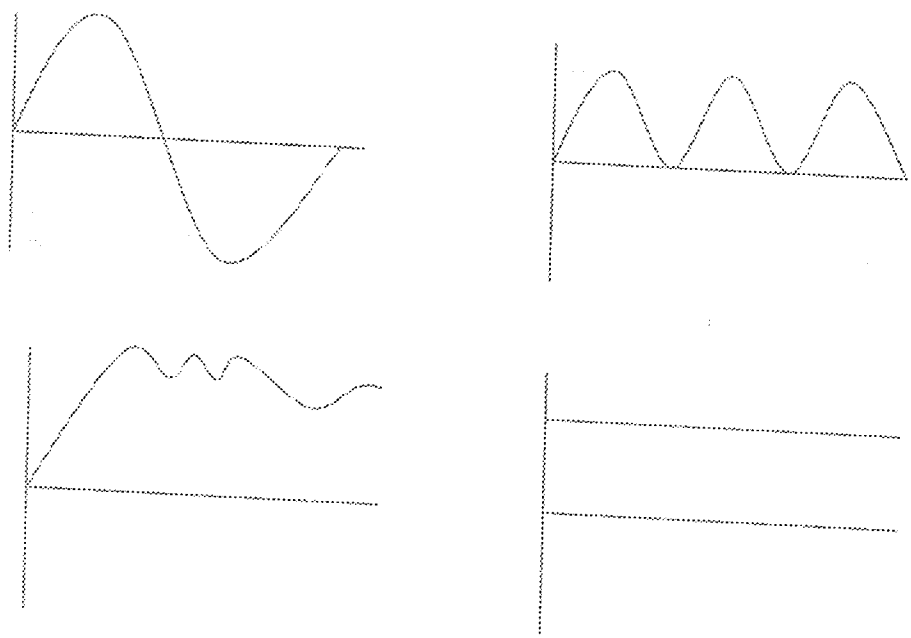


Fig 3.4 Output Waveforms Of The Power Supply Unit

3.3 THE POWER SUPPLY CIRCUIT

This consist of the transformer, rectifier circuit, filter circuit, voltage and current regulation circuit.The transformer,transforms the voltage from the mains to a required voltage value, in this case a 15volt,2A transformer was chosen. The selection of transformer was characterised by the input of the drivers i.e the astable circuit (555 timer) and the counter (4017).

A 2A, diode IC (Bridge rectifier) was used to convert the 15volts Ac to Dc voltage.The DC voltage was filtered to reduce the ripple voltage, this was done using a calculated value of the filter capacitor.

5v and 9v regulator, (7805 and 7809 respectively) were selected for regulation. The minimum regulations input voltage is +7v and +11v according to data book.

Minimum transformer output voltage current are as given by equation 2.4 and 2.5 respectively.

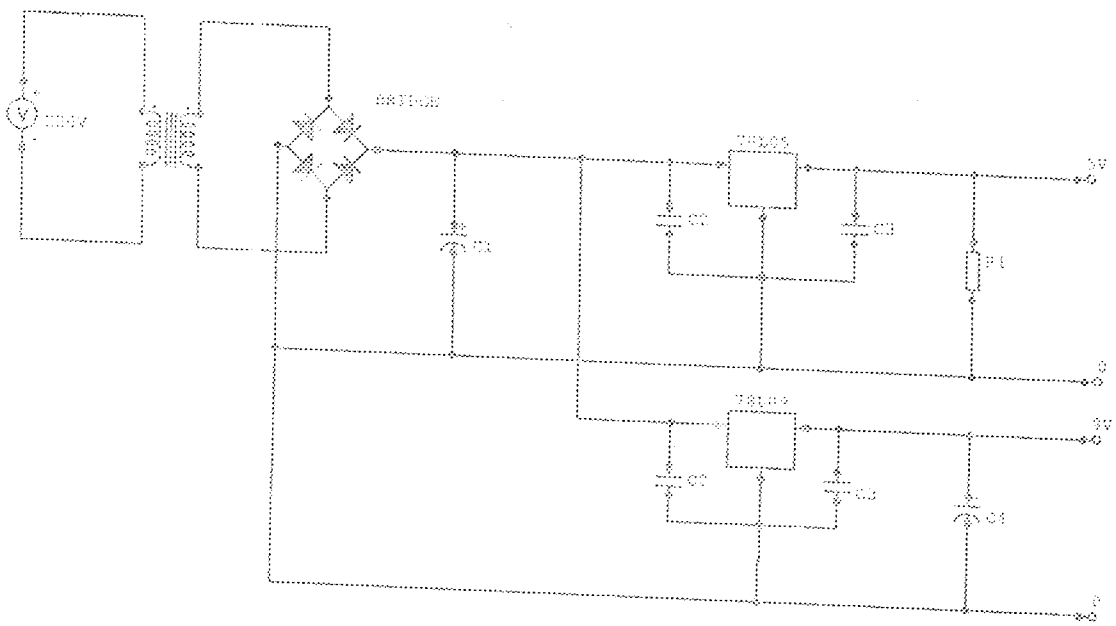


Fig 3.5 Power supply circuit.

3.4 TIMING CIRCUIT

The astable produces pulses.The frequency of the pulse is varied by adjusting a variable resistor.An astable circuit using the "555 timer" integrated circuit was designed to send pulses to the counter in this design. The astable configuration of the 555 timer oscillates

back and forth between RESET and SET states.The circuit provides a CLOCK signal for use as a timing train of pulses to operate the digital circuit (4017).For an equal values of resistors and capacitors the frequency of the CLOCK is

$f=1/2T = 0.7/RC$.....3.0

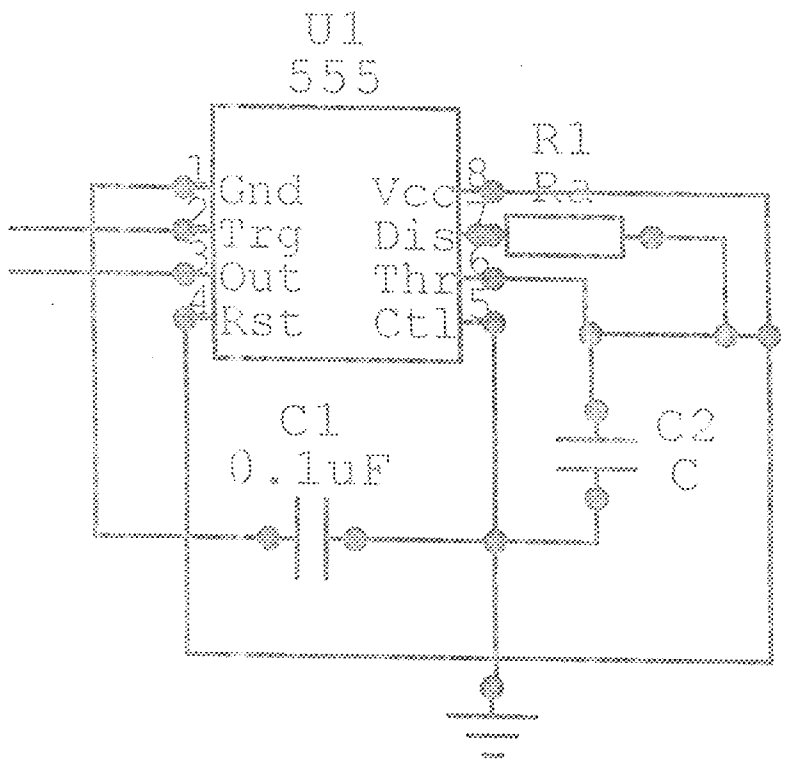


Fig. 3.6 Astable multivibrator circuit.

3.5 THE DECADE COUNTER

A decade counter can be defined as any counter that has 10 distinct states,irrespective of the sequence. A decade counter such as the 4017 counts from 0000 through 1001.The decade counter Vcc input is between 3-15volt (dc).It receives CLOCK signals from the

astable circuit using the 555 timer.This SETs and RESETs the timing interval at a specified and constant frequency.

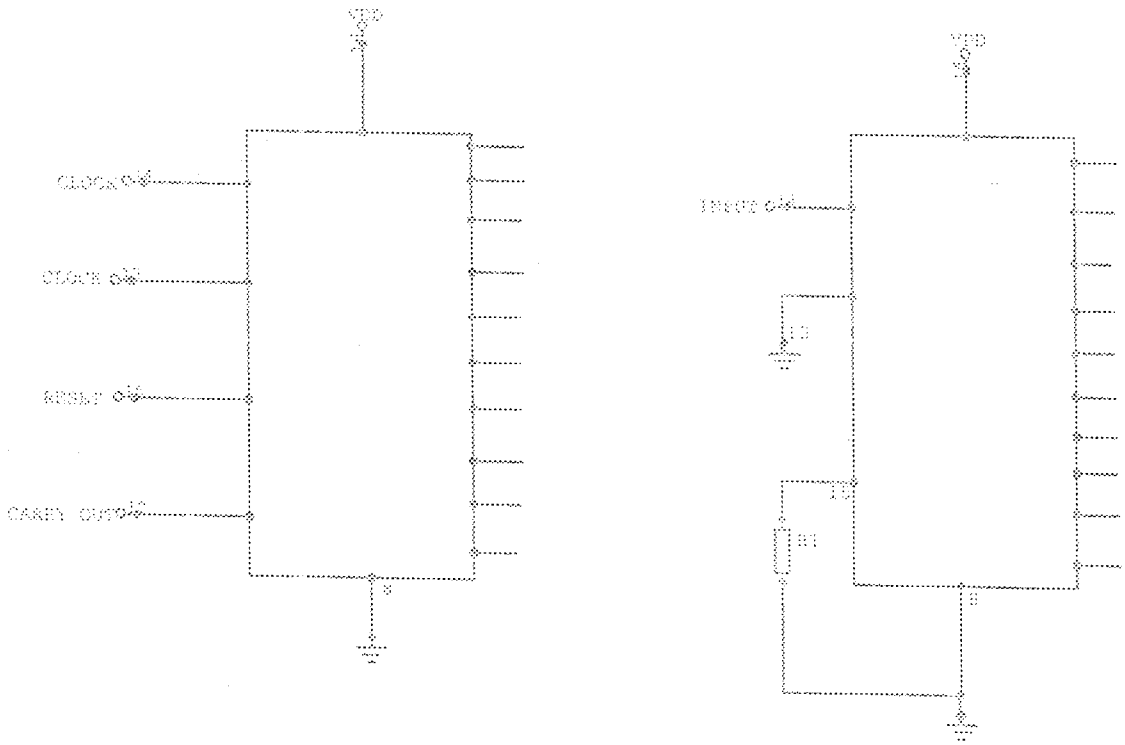


Fig.3.7 Decade counter(4017) & Pin connections

$V\,dc = 1.414 V_{ac}$ ----------2.4

Ie $V_{ac} = V\,dc / 1.414$

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

Ie $I_{ac} = I\,dc / 0.62$

Due to the diode voltage drop V the V is given by the equation 2.6

$V_{dc} = 1.414V - 2V_d$ 2.6

Therefore $V_{ac} = V_{dc} / 1.414 + 2V_d$

Where $V_d = 0.7$

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

Then V_{ac} (5v) = 7 + 2(0.7)/ 1.414 = 5.94v

V_{ac} (9v)= 11+ 2(0.7) / 1.414 =

I_{ac} = 1/ 0.62 + 1.667A

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

$V_{TX(min)}$=15(1+13%(1-1/2)-6%)

The eqution used is equation 2-2

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

Using 15 V secondary voltage, 2 Amps transformer

$V_{TX(min)}$= 15 [1=0.13 (1 – ½) – 0.06] = 15volt

$V_{peak} = 1.414VTX\ min - 2VD$

= 1.414 (15.1) – 2(0.7) =19.81

V_{PEAK} = 19.81

Smoothing Capacitor Value is calculated using equation 2.7

C = IT/ V peak – V reg 2.7

I = 1 Amp

T =0.01

V_{peak} = 19.81

V_{reg} =7V and 11V

the capacitor value = C = 1x 0.01/19.81 – 11

= 1135μF (for a volt regulator)

the capacitor value for 5 Volt regulator

C = 1 – 0.01/ 19.81 – 7

= 780μF

capacitor working voltage is

Vdc (max) = 15 [1+ 13 % (1 –0/1) + 6]

= 15 [1 – 0.13 (1) + 0.06]

= 17.85 volt

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

The working voltage is rounded up to be 25 volt

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

For δ to be 0.04

F= 50Hz

Vrms=15 V. Vmax=√Vrms = 21.21 Volt

Idc =1 A

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

0.04 = 1/4*√3 *50 C *21.21

15 Volt transformers were chosen to provide not less than calculated minimum voltage of the regulations.

C = 1/4*√3*50*21.21*0.04 =3403uF

Capacitor C_2 and C_3 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, 1μf, 160V capacitor was fitted to the output of the regulator to keep the output resistance of the circuit constant at high frequency.

3.6 TIMING CIRCUIT CALCULATION AND DESIGN

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

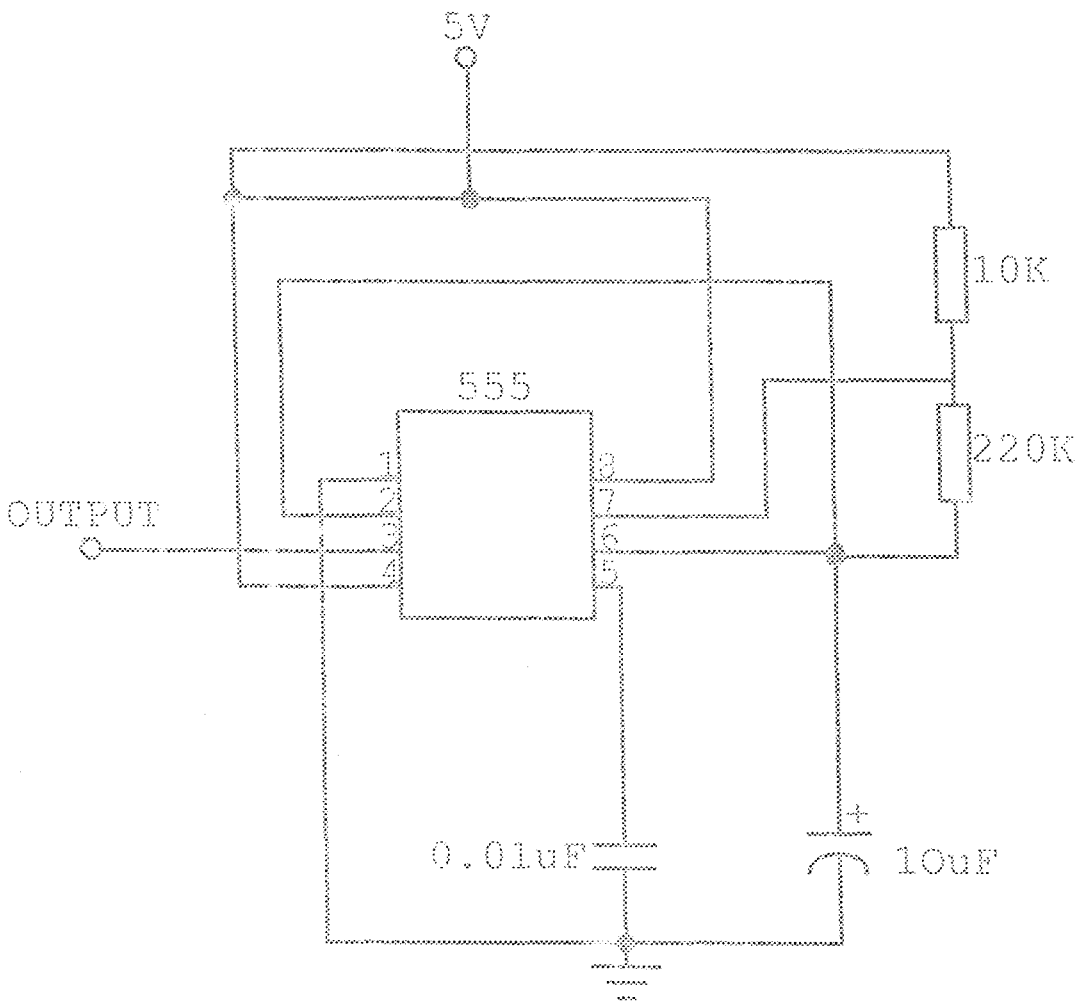


Fig 3.8 Timing circuit A

10 μF timing capacitor C was selected.

Resistor {timing resistors} R_2 and R_3 are chosen so as to achieve a duty cycle of about 50% i.e. $R_a >> R_b$

$T = t_1 + t_2 = 3S$

Duty cycle $D = t_1 / T$

$T_1 = 1.5S$

But $t_1 = 0.693 \{R_a + R_b\} C$

$t_2 = 0.693 \{Rb\} C$

Selecting $R_a = 10,000\Omega$

Since

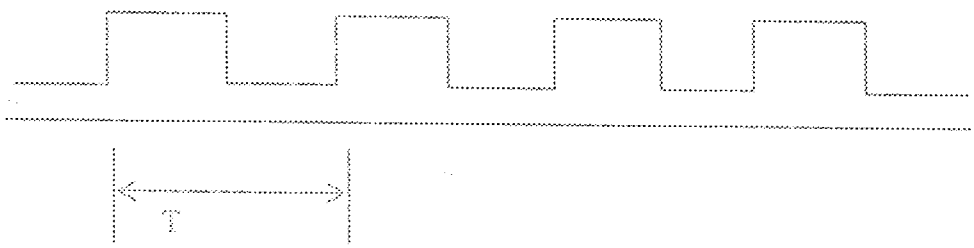
$t_1 = 1.5 = 0.693 \{R_a + R3\} C$

1.5 /0.693 C =12

1.5/0.693*10 * 10^6 10,000

R3 = 206450

Frequency 1/T = 1/3 = O.33H2



$f = 1/T$

FIG 3.9 Output Wave Of The Timing Circuit

TIMING CIRCUIT B

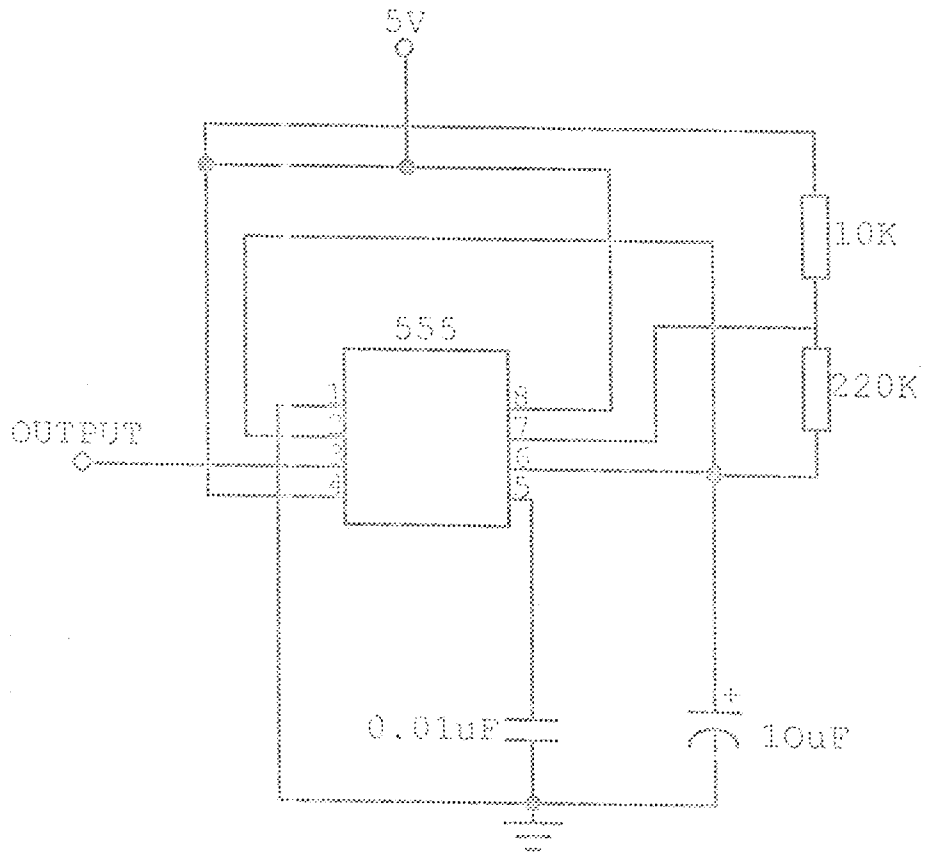


Fig3.10 Timing circuit b

470μF timing capacitor was selected. The timing resistor Ra2 and Rb2 are 1000 Ω and 500 Ω

t_1=0.5=0.693 {Ra2 + Rb2} C2

=0.5 / 0.693 * 470 *10^6 –Ra2

=0.5 / 0.693 * 470 * 10 ^ 6 - 1000Ω = 535 Ω

Rb2 = 535 Ω

But for a time less than a second, 500 Ω resistor was chose and used i.e. the

Time T = 0.693 {Ra + 2Rb} C

T= 0.693 {1000 + 2 * 500} * 470 *10^-6 =0.65 sec

The period of the output waveform is 0.65 sec which is lee than 1 sec

Frequency. 1/T= 1/0.65 = 1.5 H z.

COUNTER AND TRANSISTOR CONFIGURATION

Diode D_1 –D_{13} 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.

The transistor (driver circuit) which is required to boost the signal at the output in order to compensate for the drop is designed using 1kΩ resistor as the base resistor and the relay resistance of 100 Ω as the collector resistance. Since $R_b \approx h_{fe}$ sat R_c

Where h_{fe} sat = 10

Rb = 10* 100= 1kΩ (the base resistor)

Hence, R7 to R27 = 1 kΩ

A general-purpose transistor was selected for the switching.

3.7 THE SWITCHING CIRCUIT

This project was design using relays and transistors as the switching components: the switches keep the flow of current in the circuit in either "OFF" or "ON" condition. The mechanical switches are very slow and they have sparking problems, however they can switch both AC and DC currents unlike the bi-polar transistor, which only switches DC current.

6V relays were used to control the supply to the (display) load.

The coil transient suppression that is a problem with relay relates to the collapsing magnetic field of the relay coil generating a transient or emf in parallel with the coil. This voltage if unsuppressed will destroy the transistor driver shown in fig 3.6 below. The transistor was biased to switch on the signal from the counter by supplying 6volts to the relay.

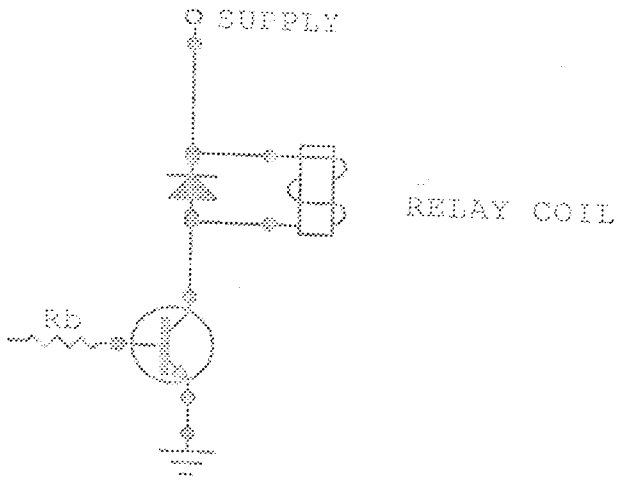


Fig. 3.11 switching circuit with coil transient suppression

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

Also 10μF, 16V Capacitor was used to suppress the arcing or spark discharge at the contact. DC arcing or spark discharge, which 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) =10 A

C= Capacitance

C = 10^2 / 10*10^-6 = 10μF.

3.8 THE CONTROL UNIT

The counter output cannot be connected directly. If one output is "HIGH" while the other is "LOW" large current will flow from one output to the other and the counter will be destroyed. Creating different sequence in the output of the design require proper control of the signals. Diodes were used to control the flow of signals to the display unit. The diodes block the flow of currents back into the counter and at the same time controls the outputs on the displayunit. The diode is basically an OR gate which goes high only when at least one of the input is high.

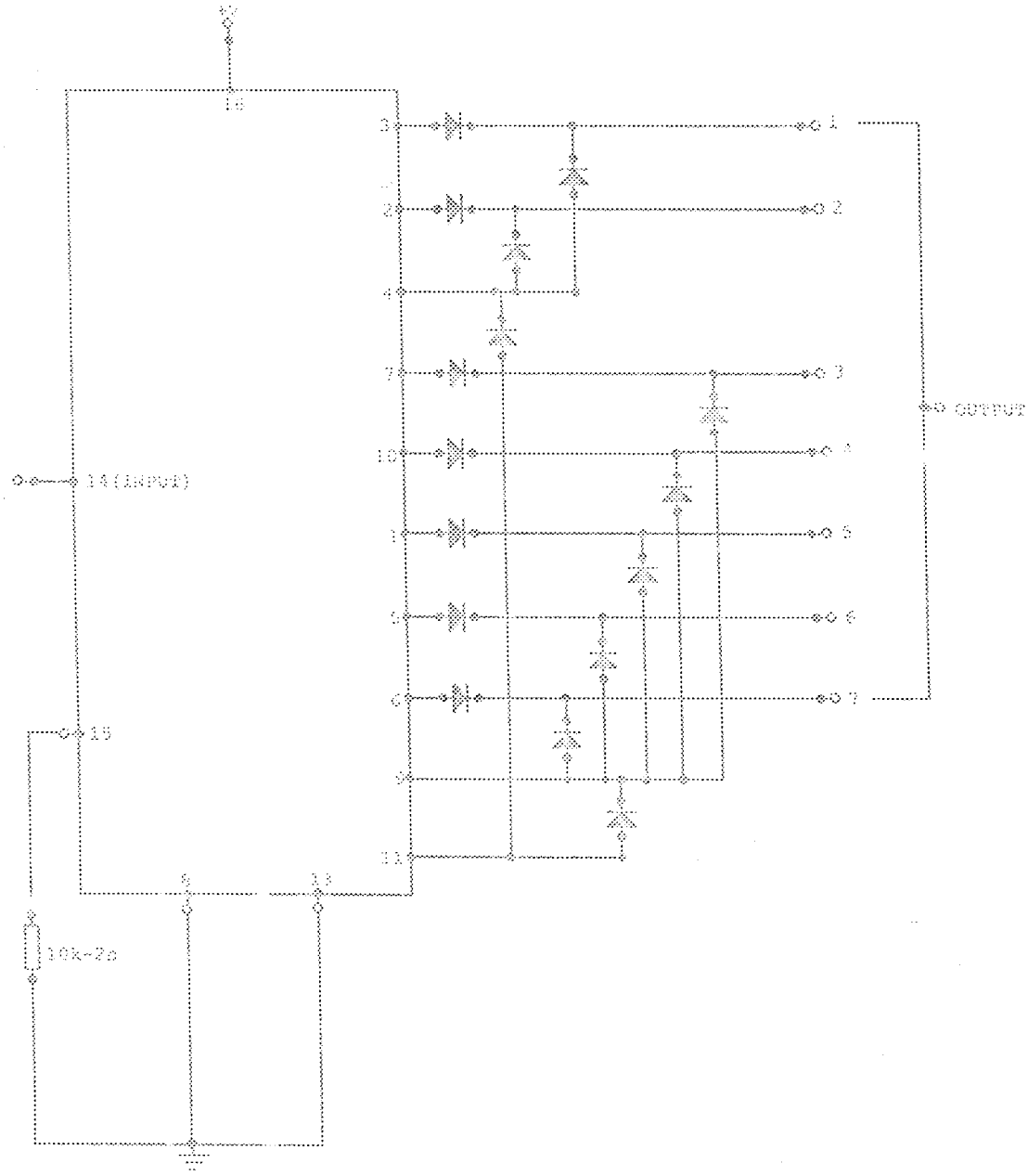


Fig 3.12a Control Unit A

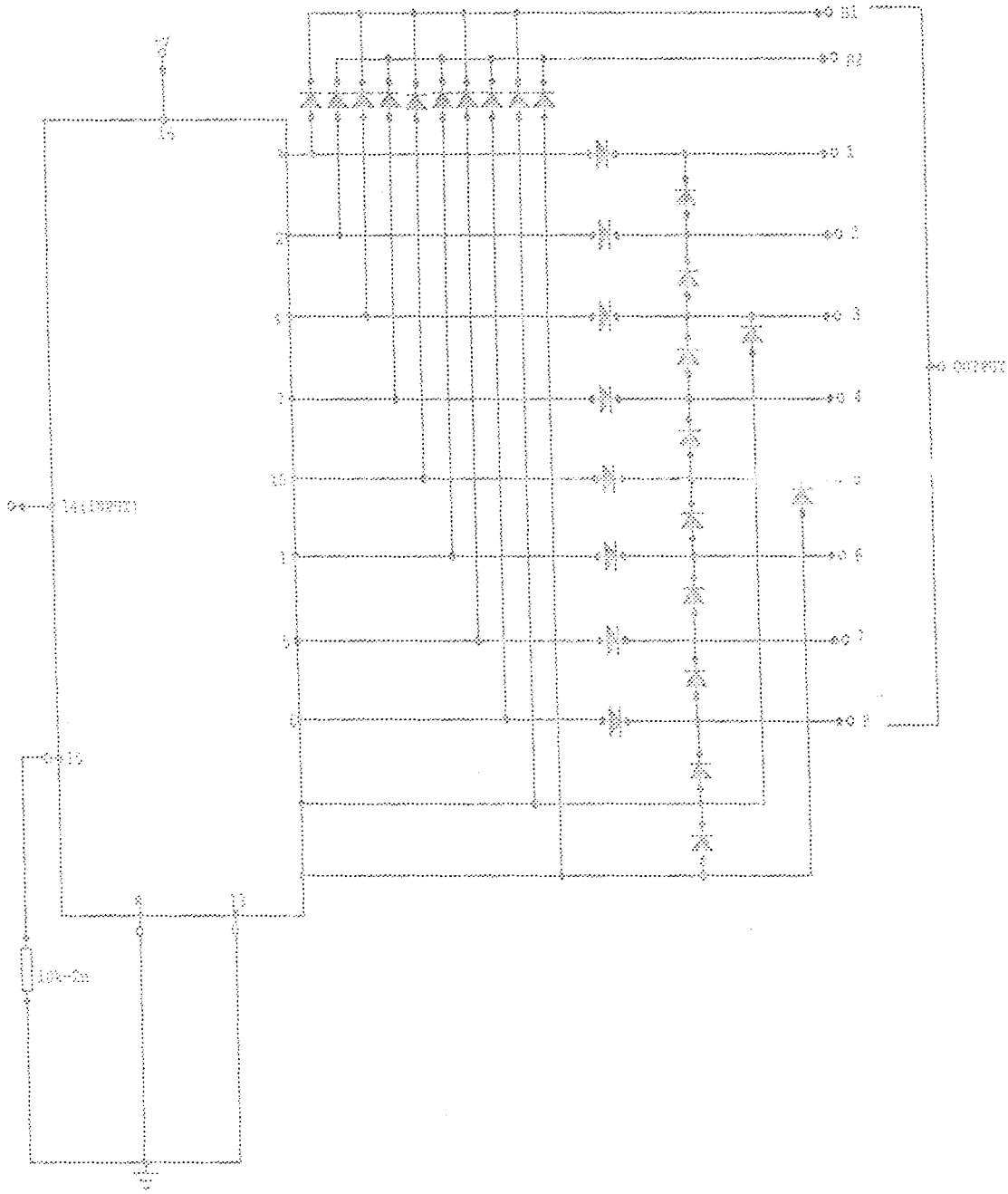


Fig 3.12 b Control unit B

3.9 DESIGN OF THE DISPLAY UNIT

The display unit of this electronics display board is 5 ft 7 inches by 2 ft 8 inches. 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 released using dot matrix format in writing the words.

On the first row," F.U.T MINNA" is displayed.

The second row displays "ELECTRICAL AND COMPUTER "

The third row displays "ENGINEERING DEPARTMENT"

The fourth row displays "You are welcome"

These words are displayed with red colour LEDs, orange colour LEDs, at the middle. Also a boarder line is displayed in two lines using red colour LEDs and Green colour LEDs. The display circuit layout is shown below;

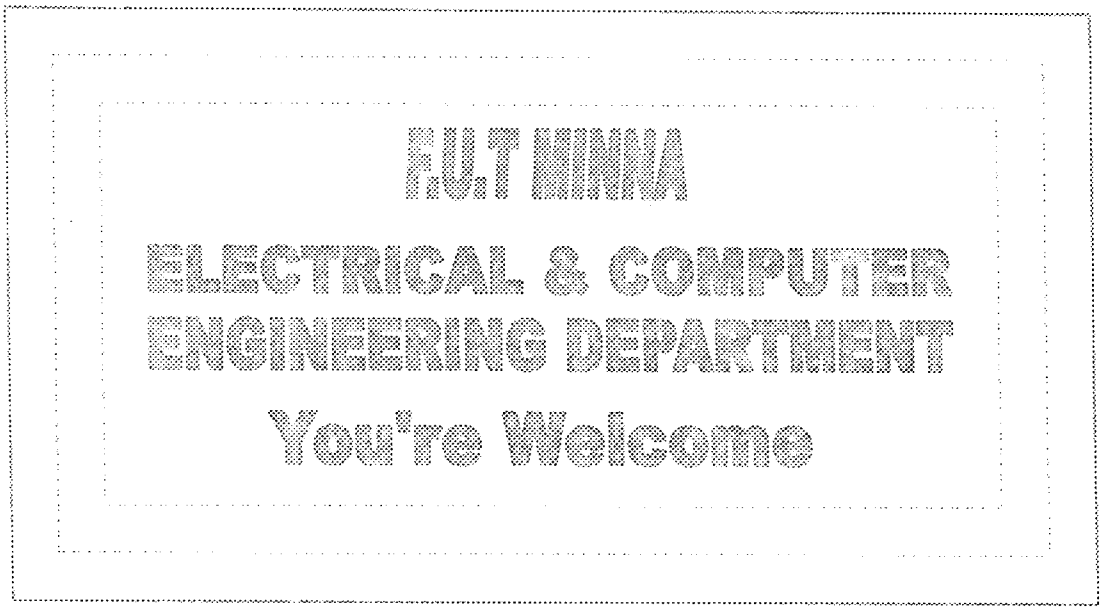


Fig 3.13 Display circuit LAYOUT

The number of LEDs used for each load (letter or word) are as follows;

F.U.T ..... 112 LEDs

MINNA ..... 202 LEDs

ELECTRICAL ..... 252 LEDs

AND ..... 28 LEDs

COMPUTER 243LEDs

ENGINEERING ..... 332 LEDs

DEPARTMENT 304LEDs

YOU----------31 LEDs

, re----------30 LEDs

W----------21 LEDs

E----------10 LEDs

L----------7LEDs

C----------7LEDs

O----------8 LEDs

Me----------24 LEDs

Border line----------484 LEDs

CHAPTER FOUR

TESTING AND DISCUSSION OF RESULTS.

4.1 INTRODUCTION

It is, of course, impossible to see electric quantities (current or voltage). We can detect electrical quantities only by their effects: heating, lighting, magnetic, and mechanical action. For carrying out the required test and measurements of the various electrical quantities in this circuit a range of instruments are implored. The instruments used in the course of this constructions include: Multimeter, Digital meter, Logic probe and pulser.

4.2 TESTING OF THE OUTPUT OF EACH STAGE.

During and after construction, the components were tested for either open or short circuit using the Multimeter. Every node in the circuit was tested for continuity and accurate output (voltage & currents).

The different modules were tested as follows:

- Output of the power supply unit
- Output of the automatic switch.
- Output of the timing circuit.
- Output of the relay circuit and driver.
- The display unit.

4.3 OUTPUT OF THE POWER SUPPLY UNIT.

Every components of the power supply circuit were tested for either short or open circuit after each soldering, so as to note any damage due to heat. The output of the 5V, 9V, and 12V was confirmed using the voltmeter. The emf of the transformer was measured on "NO LOAD" and the potential difference was measured when connected to "LOAD". The output voltage and current was measured after the bridge rectification. The test was performed at every node and all quantities and values were satisfactory.

4.4 OUTPUT OF THE AUTOMATIC SWITCH.

The automatic switch was tested in the dark using an LED and a variable resistor, which was adjusted to suit my design. The variable resistor was adjusted so that the resistance of the LDR will be increasing in proportionate to the brightness of the day.

4.5 OUTPUT OF THE TIMING CIRCUIT.

The output of the 555 timer was tested using an LED and a Logic probe & pulser. The positive terminal of the LED was connected to the output pin (pin 4) of the 555 timer.

For Timer one: The timing, t was designed to pulse at every 1.5sec, this was measured using a logic pulser, an LED, and a watch. Therefore the period was 2t =3secs. The LED terminals were connected between the pin 4 of the 555 timer and the ground, while the pin of the pulser was placed on the output pin to measure the operation of the timer.

For Timer two: The same procedure was adapted to checking the timing effect.

4.6 TESTING THE OUTPUT OF THE COUNTER

The input voltage (V_{in}) of the 4017-decade counter was measured with the Multimeter, while the counting operation was measured using LEDs; these were connected between each of the output pins and the ground. The counting action was perfect according to design. The flashing of the LEDs sequentially at a constant time indicates normal operation of the counter circuit.

4.7 TESTING THE DRIVER CIRCUIT AND THE RELAY.

The input and output of the driver circuit was measured with the Multimeter, the increase in the output quantities (voltage & currents) indicates amplification action of the transistors to drive the relays. The action of the diode was tested with a continuity tester. The clicking sounds of the relays confirm the operation, however the output voltage and current was measured.

4.8 THE DISPLAY UNIT

The test on the load includes: Continuity test, Short and Open circuit test, Measurements of voltage and current. The output power of the entire circuit was calculated on "NO LOAD" and "ON LOAD". The values were compared and proper adjustment was made to balance the load with the output power of the circuit.

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

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

$V_{peak} = 1.414V_{1min} – 2Vd$

$= 1.414 (11.28) – 2 (0.7) = 14.55V$

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

C = 1325uf.

Smoothing capacitor working voltage is

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

Vpeak equals 18.78V

Ie

$1.414 \times 14.28 – 2(0.7) = 18.79$

4.9 MOUNTING AND TESTING OF THE ELECTRONIC DISPLAYBOARD

All the circuits were mounted on a metallic casing, where the final wiring and connections was done. The front and back of the casing was covered with tinted glass and a sheet metal respectively. The repair, servicing, and maintenance were considered. The transformer and the power supply circuit were mounted very close to the vent. The packaging was very flexible: this gives room for servicing and maintenance.

The system was powered and left in the day time to observe the operation .Not until around 6:45pm in the evening when it came on automatically and was on till in the morning. It went off automatically when the daylight falls on the LDR. The above test was satisfactory, as it worked with the design.

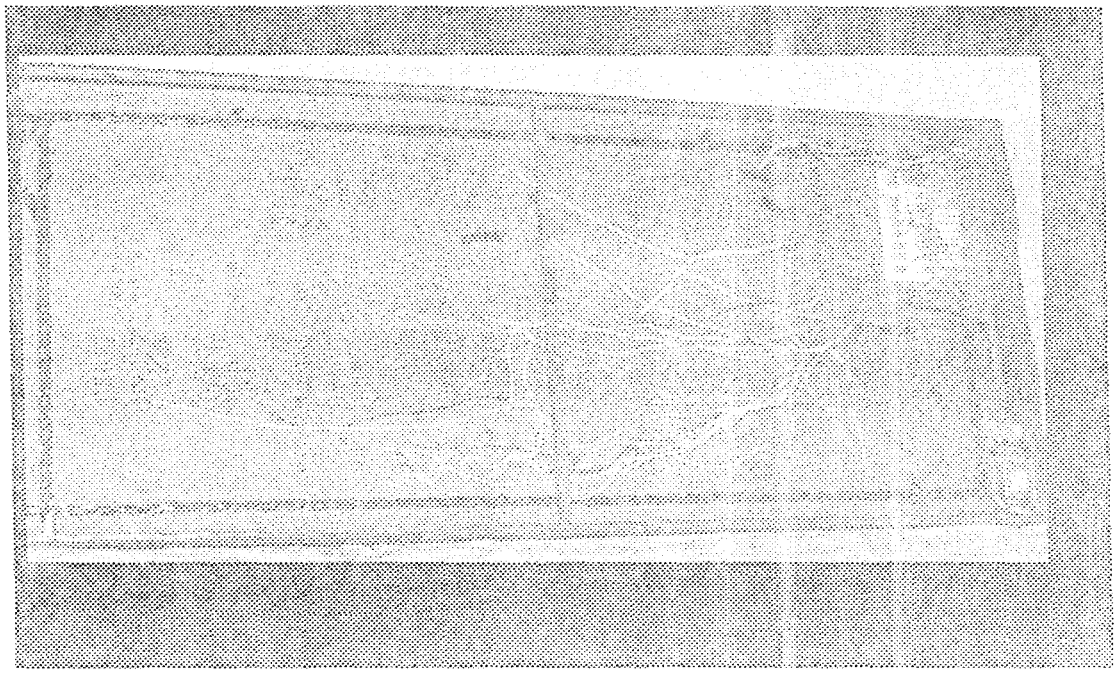


Fig. 4.9(a) System Packaging

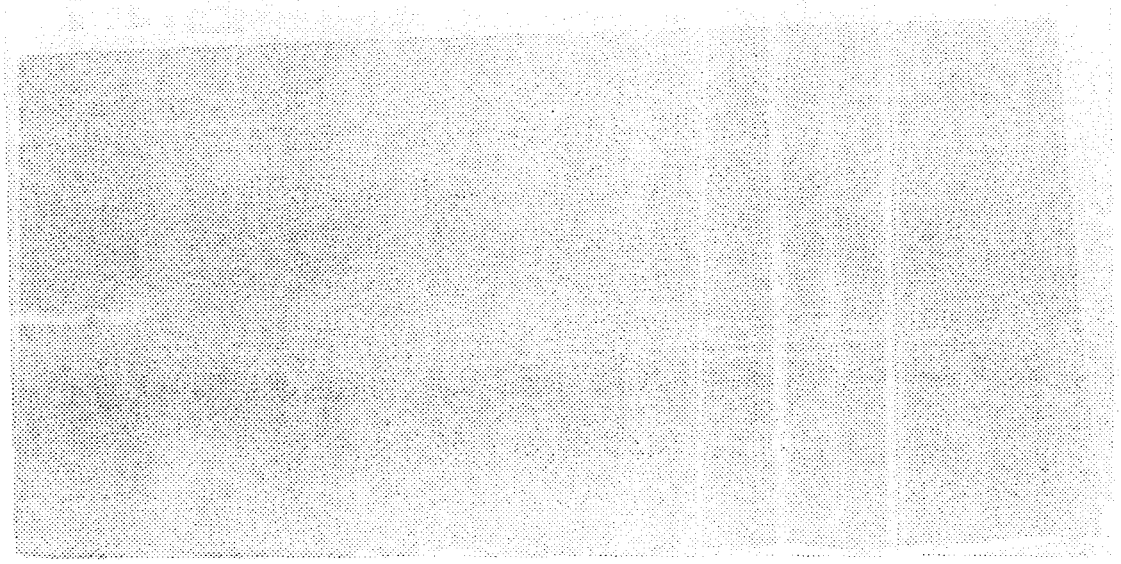


Fig. 4.9(b) Displaying Board

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

Electronic display plays an important role when it comes into advertising, monitoring of digital signals and frequency measurement of such signals. This project has shown one of the various applications of digital circuit. The digital circuit used in this project are however cheap and user friendly, this characteristics make the project to be user friendly. It has shown the practical application of most of the electronics components I have come across in the classroom. It displays the various operations of individual electronic components.

RECOMMENDATION

Although this project has been designed to specification however, this design can still be improved upon.

The electronic display should be improved upon to be a moving digital display.

The design should be programmed using a programmable integrated circuit. This IC will be responsible for the characters of the display.

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	415Ω „ „ „	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 TANTALUM 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 OP-AMP.	1
36	SPNT 6V RELAY	17
37	SPDT 12V RELAY	1
38	BC574 TRANSISTOR	18
39	19V TRANSFORMER	1
40	12V „	1
41	LIGHT EMITTING DIODE 3V 20mA	2200
42	1A FUSE	2
43	13A „	1
44		