DESIGN AND CONSTRUCTION OF DIODE / TRANSISTOR CHECKER / TESTER INCORPORATING ALARM SYSTEM

BY

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CERTIFICATION

This is to certify that this project titled "Design and Construction of Diode/transistor Checker/Tester incorporating alarm system" was carried out by Markus Ali, under the supervision of Mallam M.S. Ahmed and submitted to Electrical and Computer Engineering Department, Federal University of Technology, Minna in partial fulfilment of the requirements for the award of Bachelor of Engineering (B. ENG.) degree in Electrical and Computer Engineering.

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ABSTRACT

The design and construction of diode and transistor checker incorporating an alarm system is described in this project. The project is intended to produce an audible alarm in an 8 Ohms audio speaker as well as a visual light emitted by a light emitting diqde.

This project is intended to produce an output that will either set the alarm ON or OFF depending on the condition of the test component.

When the system is powered ON, the oscillator is free running, its output after passing through the test device is used to trigger ON either an NPN or PNP transistor to enable one detect the working condition.

TABLE OF CONTENTS

CHAPTER ONE

1.1 GENERAL INTRODUCTION

The essence of this project is to help engineers and technicians save useful time being wasted in checking and testing the working condition of transistors and diodes and with certainty.

A transistor and diode tester is a very useful device to have available when trouble shooting electronic circuit. It makes test easier for the user to test the state/working condition of diodes and transistors with maximum efficiency. The result of this is displayed by light emitting diode (LEDs) and an alarm system.

The ON and OFF states of the alarm system depend on the state of the light emitting diode (LEDs). The alarm is designed to tell whether the component is good or bad, but for further analyses the LEDs will show other defect. For example if a component has an open or short circuit, this will be displayed by the number of LEDs that are On while the alarm system remains Off. The design will also enable one to check whether a transistor is NPN or PNP with the result indicated also by the LEDs, and alarm circuit. The checker usually checks each junction of any NPN or PNP transistor.

1.2 AIMS AND OBJECTIVES

The design serve as improvement in testing instrument, since testing does not depend on sophistication or high cost of test equipment but how reliable the test equipment is. This design and construction of a checker using alarm system is a step in the right direction to ease out the prevailing problem being encountered in the testing industry.

1.3 LITERATURE REVIEW

From time past up to date, the observation stands that many people have carried out diversified project work on similar testing instrument and have come up with enviable results as follows.

Tyler (1970's) designed a transistor tester which can conduct a check or both transistor and diode for short circuit, open circuit and good condition.

R.W. Fox (1977) on his part came up with a transistor test which enables one to distinguish a **PNP** from an **NPN** transistor by the application of LEDS as well as getting a rough measurement of the transistors gain.

Another model is Philips (1980's) transistor measuring equipment, type PM 6505b, has been designed for carrying out accurate check on transistor and semi conductor diodes in laboratories, test departments, repairs shops, e.t.c. it has all the facilities necessary for measuring the various parameters in any easy way, provision was been made for the equipment to be switched for measuring **PNP** and **NPN** transistor: in either case the appropriate signal lamp lights up. Any type of semi-conductor diode can be checked for short circuit, forward current rating and leakage-current values, whereas the recording of characteristics in the reverse direction can be displayed on an appropriate oscilloscope.

Wayne Lerr 1988) manufactured also the 4225 Automatic LCR meter. Automatic LCR meter 425 provides direct measurements or inductors, capacitors and resistors at any of three alternative frequencies. In addition to reading the major term (inductance L, capacitance C, and resistance R), it can be switched to measure the resistance loss form of indictors and capacitors, and L or C term present with resistors.

1.4 PROJECT OUTLINE

Chapter One introduces the project and discusses related work done by other people. It also states the use of the design.

Chapter Two deals with the design of a checker / tester using an alarm. It begins by discussing the design of the various sections that make up the project final design. The chapter also presents all the design calculations involved.

Chapter Three treats the construction and testing of the project work.

Chapter Four discusses the result obtained and give some recommendations for improvement on the design. The conclusion of the report is also given in this chapter.

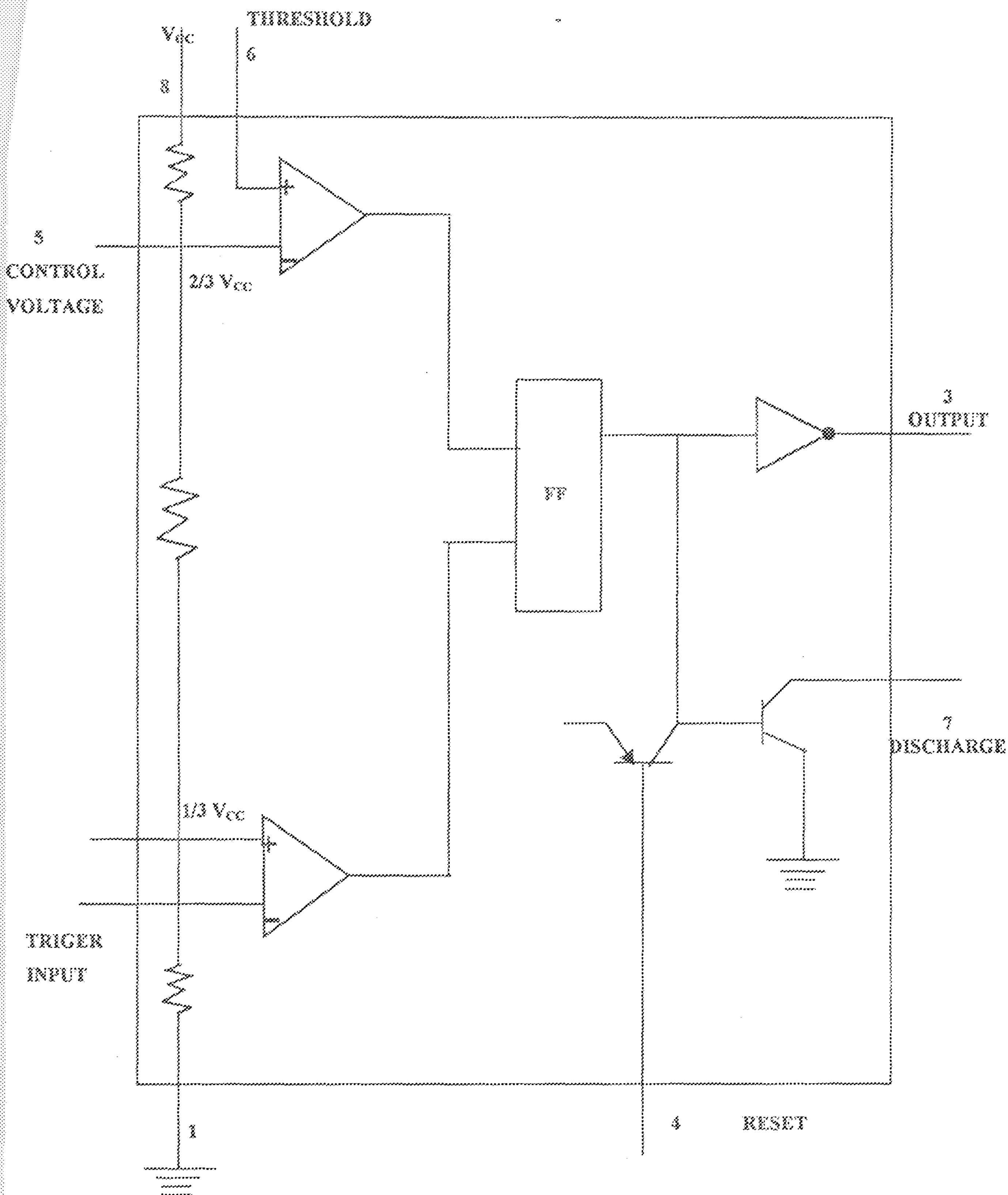


Fig. 1.1 THE INTERNAL STRUCTURE OF 555 TIMER I_C

fig 1.1

The control voltage input (pin 5) allow modifying the (2/3) Vcc level at comparator 1. The rest input(pin 4) going low drives the discharge output (pin 7). The 555 time IC can be connected externally to operate as an astable multivibrator with external resistors and capacitors setting the frequency or timing period.

2.2 THE 555 TIMER AS AN ASTABLE MULTIVIBRATOR.

An astable multivibrator is built using a 555 timer as shown in Fig 1.2(a) Resistor R_A, R_B and capacitor C fix the time during which the capacitor alternately charges and discharges to provide an output signal oscillating between level near zero and Vcc. With reference to the Fig. 1.1 above, the astable circuit operates as follows.

Capacitor C changes toward +Vcc with time constant and the change of the state depends upon the voltages at the trigger input, (pin 2) and the threshold input, (pin 6), the two state being (1/3) Vcc and (2/3)Vcc. Thus at one point in the cycle, C discharges to (1/3)Vcc operating the trigger input, setting the flip-flop and opening the discharge input (pin 7). C now charges toward Vcc through $R_A + R_B$. When Vcc reaches (2/3) Vcc the threshold input causes the flip- flop to reset returning (pin 7) to ground. C now discharges through RA alone towards ground. When Vcc reaches(2/3) Vcc the threshold input causes the flip-flop to reset returning (pin 7) to ground. C now discharges through RA alone towards ground. When Vcc reaches (1/3) Vcc, the cycle is repeated. The waveform are shown in Fig 1.2 (b) and (c).

The timing is analyzed by referring each exponential to the aiming 0voltage given by.

$$2/3V_{cc}\, e^{-T/CR} = 1/3\ V_{cc} \qquad (1)$$

During the changing period from eqn

$T_{HIGH} = CR \log_e 2$

Where R is therefore RA+ RB given

$$T_{HIGH} = 0.7C\,(RA + RB) \qquad (2)$$

During the discharge period from eqn (1) the time is T low and R is RB given

$$T_{low} = 0.7\, R_B C \qquad (3)$$

The period of the wave form

$$T = T_{HIGH} + T_{low} = 0.7\, C\,(R_A+R_B) + 0.7CR_B$$

$$= 0.7\,(R_A+ 2R_B)\, C. \qquad (4)$$

and the frequency

$$f = 1/T = \frac{1.43}{(R_A + 2R_B)\, C} \qquad (5)$$

The duty cycle of an astable multivibrator is defined as the percentage of ratio the rise period of the total period of the wave form i.e.

$$D/C = \frac{T_{low} \times 100\%}{\text{Period } (T)}$$

From eqn (3) ad (4) , the duty cycle can be expressed as

$$D/C = \frac{0.7\, R_B C \ X \ 100\%}{0.7\ (R_A + 2R_B)C}$$

$$= \frac{R_B \ X \ 100\%}{R_A + 2R_B} \qquad (6)$$

The calculation are under design calculation

2.3 AMPLIFIER CIRCUIT.

The complementary transistor (NPN and PNP) with circuit diagram shown in Fig 2.1 (a) was used as amplifier in my design. To obtain a full cycle output across a load using half - cycles of operation from each transistor, when a single input signal is applied to me base of both transistors. The transistors being of opposite type, will conduct on opposite half - cycles of the input.

The bi-polar junction transistor (BJTs)Q1 and Q2 in Fig 2.1(a) are biased at cut off (i.e. it is either ON or OFF).

Therefore, the signal applied to the base of Q1 and Q2 in the circuit of Fig 2.1(a), when signal Vs with significant amplitude is applied to circuit of Fig 2.1(b), Q1 is bias into conduction Q2 is driven further into cut off, on half the alternation, i.e. the negative half, Q2 is bias into conduction and Q1 driven further into cut off. In other words, one out put BJT amplifies positive alternation while the other out put BJT amplifies the negative alternation, the voltage across each transistor are indicated by the light emitting diode and the alarm circuit.

2.4 LIGHT - EMITTING DIODES.

The creation of electron-hole pairs is a reversible process; energy is released when an electron recombines with a hole. In silicon and germanium, recombination usually occurs at defects in the crystal that can trap a moving electron or hole, absorb its energy and hold it until recombination partner comes along. Only occasionally in silicon or germanium but frequently in a Group III-V compound such as gallium arsenide, an electron drops directly into a hole and a photon of energy is generated.

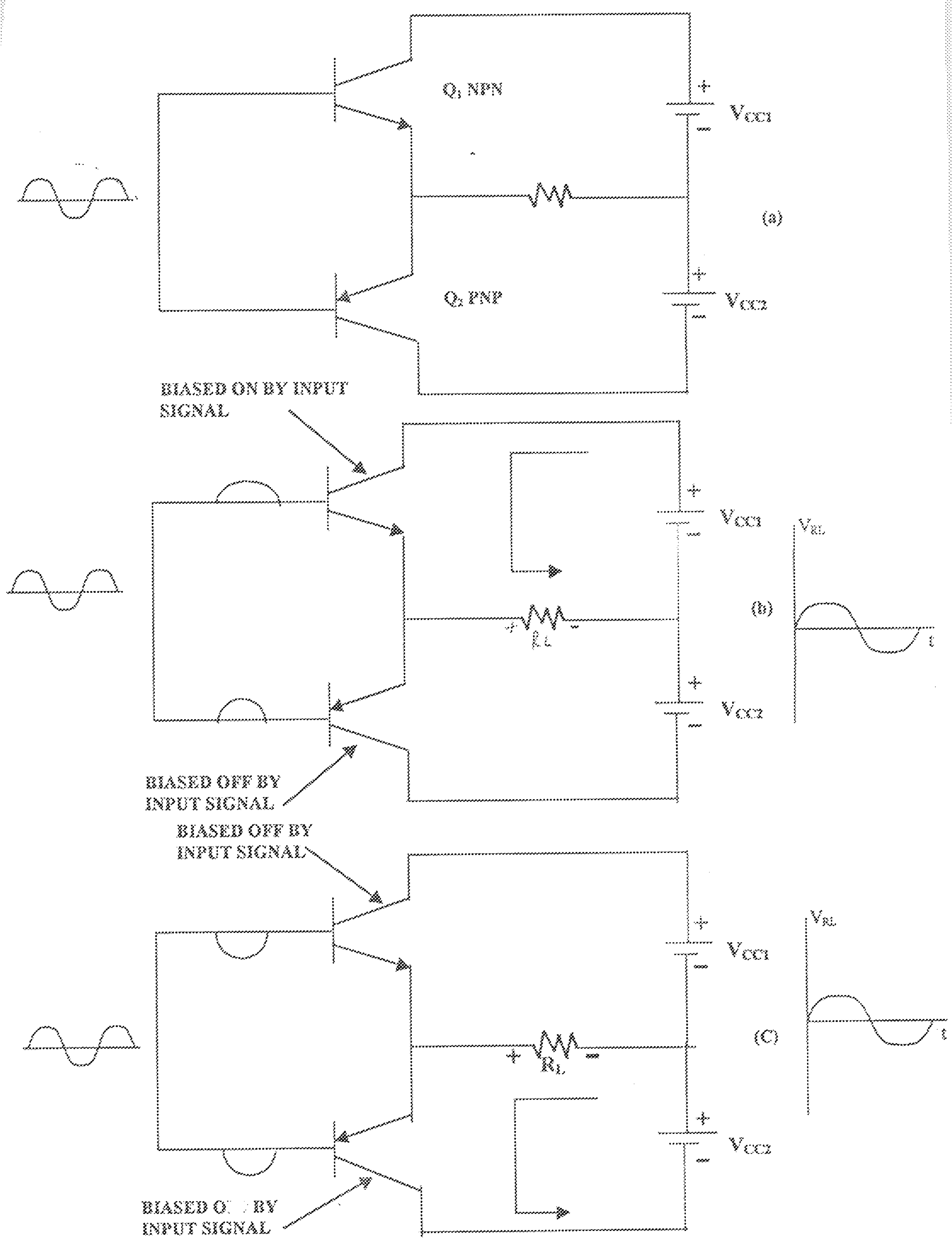


Fig. 2.1 COMPLEMENTARY PAIR CIRCUIT AND OPERATION

Gallium arsènide junctions providing optimum conditions for the generation of radiation in visible range are called light-emitting diodes (LED). Under special condition, the light emitted is coherent and the device is a junction laser. The circuit symbol in as shown in Fig 3.1

2.5 THE TRANSISTOR

The junction transistor is a three-layer device consisting basically of two P-N junction back to back. It three region are the base, collector and emitter. For a transistor to operate, the base region, must be made very thin and the doping of the emitter Fig 3.2(a) shows a NPN transistor biased correctly for operation (an PNP transistor could be substituted if the voltage were reversed in polarity). The emitter base junction is forward - biased, and holes diffuse into the base region. These holes would normally exit via the base, but because of the narrowness of the base region they also come under the influence of the negatively - charged collector. The holes pass potentials, and collector current, IC flows.

A few holes do recombine with electrons in the base region to form a small base current Ib. The ration I_c/I_b is approximately constant, at about 0.98. Sometimes referred to as alpha (x).Since Kirchoff's law apply we can say that, $I_e = I_c + I_b$ and it follows that the base current is about 0.02Ie.

2.6 OPTOISOLATOR

This circuit consists basically of light emitting diode (LED) and a transistor. The transistor is without a base. The transistor uses the light emitted by the light emitting diode to bias the transistor into conduction. The internal circuitry is as shown in Fig 3.3.

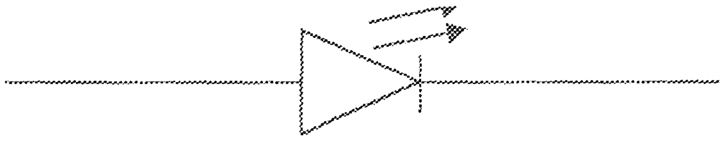
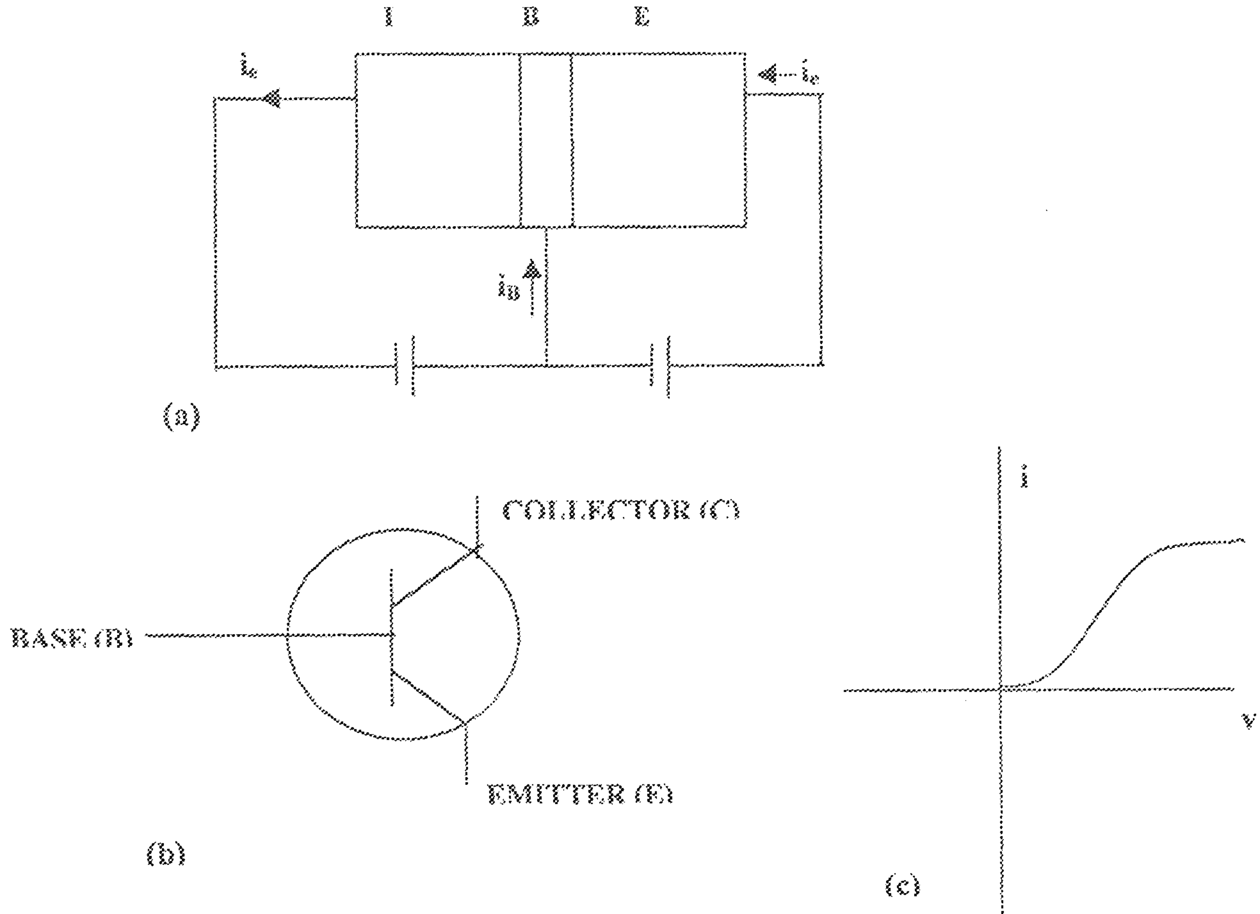


Fig. 3.1 SYMBOL OF LED



ig. 3.2(a) BIASING OF TRANSISTOR (b) SYMBOL OF TRANSISTOR (C) v-I CHARACTERISTIC

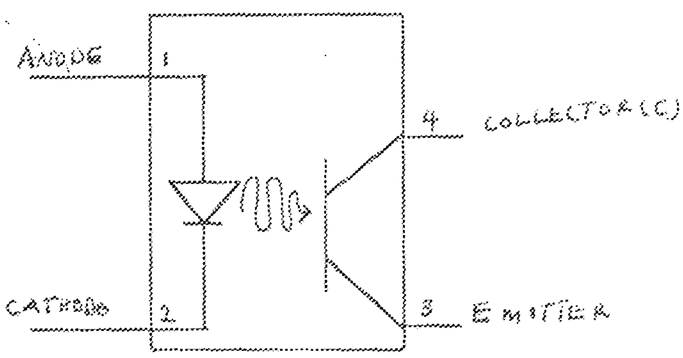


Fig 3.3 OPTOISOLATOR

2.7 RELAYS

Electronic magnetic relays are switching devices used in electronics. They consist of a coil with iron core and a movable iron pole-piece which operates one or more sets of switch contacts. The coil is isolated from the switch contact so that a low-power circuit driving the coil can switch an independent circuit. Relays are capable of fast switching and can often be driven directly by logic circuits. A relay coil is, of-course an inductor. A relay connection as used in my design is as shown in Fig 3.4, with the relay switching off the voltage only when the two opto-isolator connected to it are biased to conduction, and the freewill diode connected across the relay is to prevent voltage flow when the circuit is off.

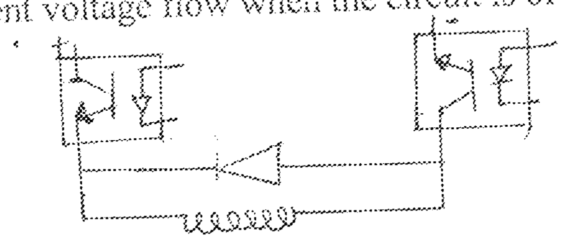


Fig 3.4 RELAY CONNECTION.

2.8 POWER SUPPLY.

This consists of the transformer, usually step-down transformer. The ac supply is being stepped down, rectified and filtered at this section of the design. Thus, the 220v from the main supply is rectified and filtered to produce the smooth dc value of current required.

2.8.1 RECTIFICATION

This is the power of conversion from an ac with zero average voltage into a

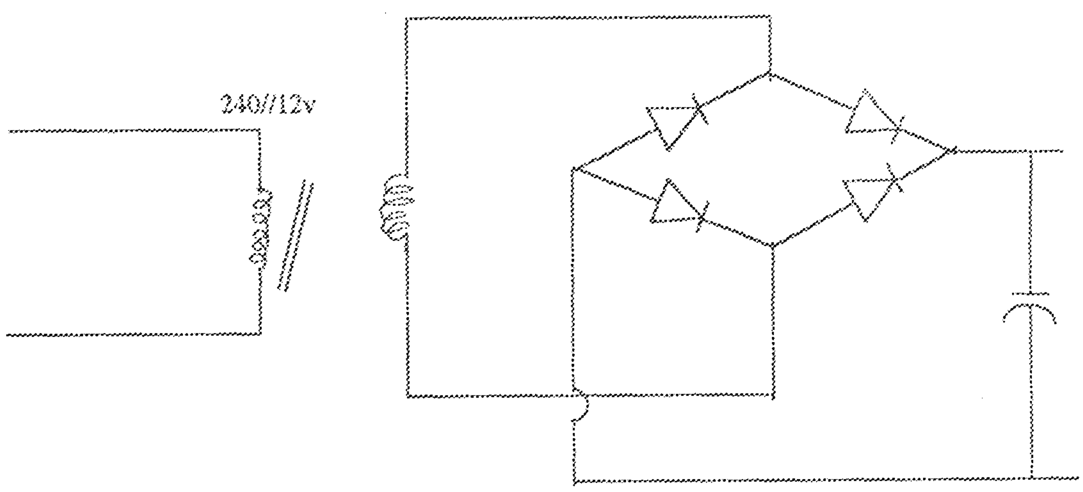


Fig. 4-1 THE BRIDGE RECTIFICATION

pulsating d.c voltage. The rectifier circuit use diodes as the central component. There are two types of rectification, these are

- Halve wave rectification.
- Full wave bridge rectification.

For the purpose of this design work, full wave bridge rectification is used. The bridge rectifier is less expensive and more efficient. This device consists of four diodes.

V_s = Source voltage.

V_d = Average output voltage

V_m = Maximum voltage

$$V_d = 1/2\pi \int_0^{\pi} \sin Wt \, d(Wt) \quad \text{.........................} (7)$$

$V_s = V_m \sin Wt.$

For a full wave rectification.

$$V_d = 1/\pi \int_0^{\pi} \sin Wtd\,(Wt) \quad \text{.........................} (8)$$

Integrating equation (8)

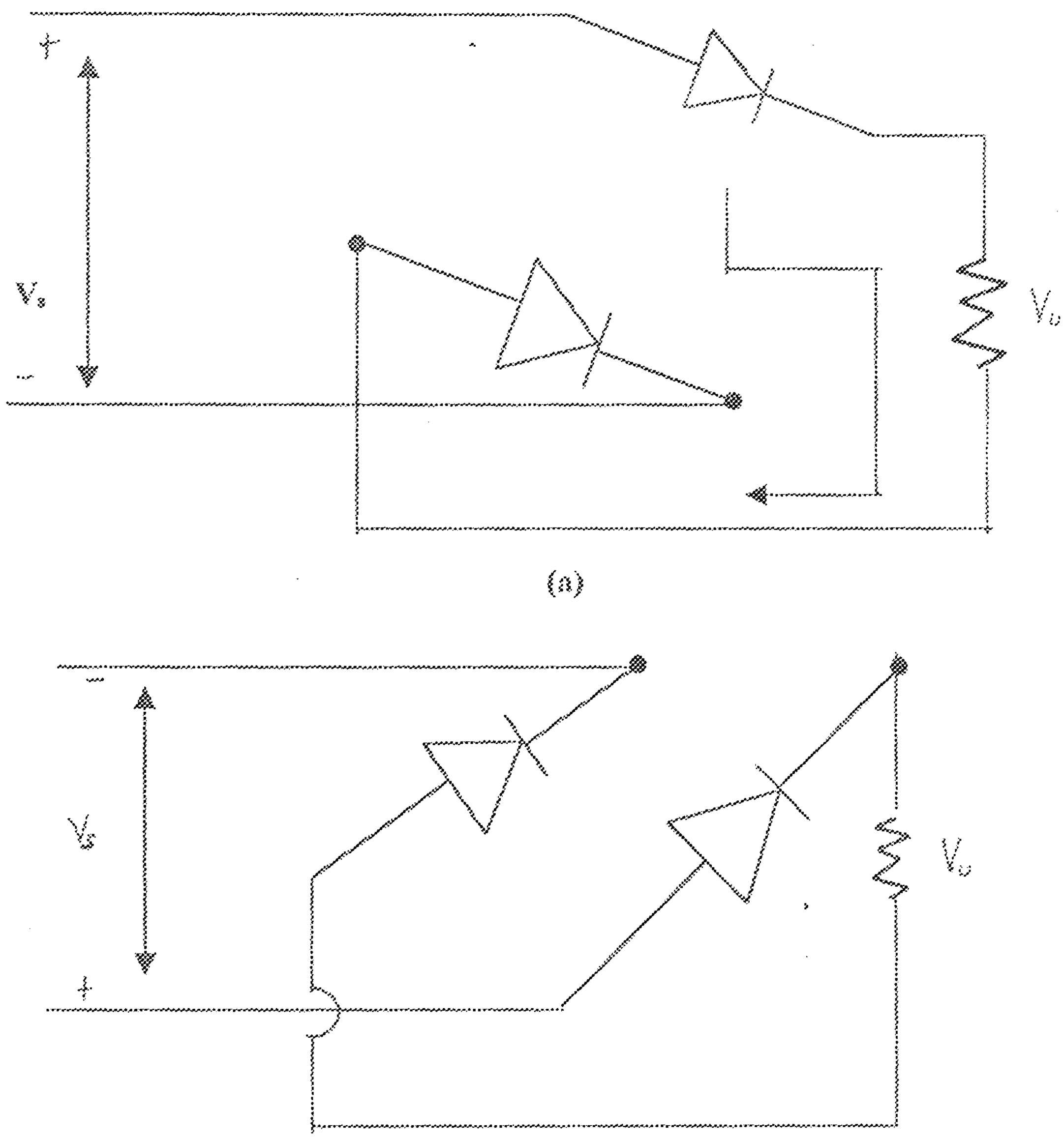
$$V_d = \frac{2}{\pi} Vs - [\cos Wt]$$

$$V_d = \frac{2}{\pi} V_s \ [2]$$

$$= \frac{2}{\pi} 2 \ V_s$$

OPERATION OF BRIDGE

Fig 4.1 shows the general bridge rectifier circuit. At the first positive half of



(b)

Fig. 2.3 CONDUCTION PATH IN A BRIDGE RECTIFICATION

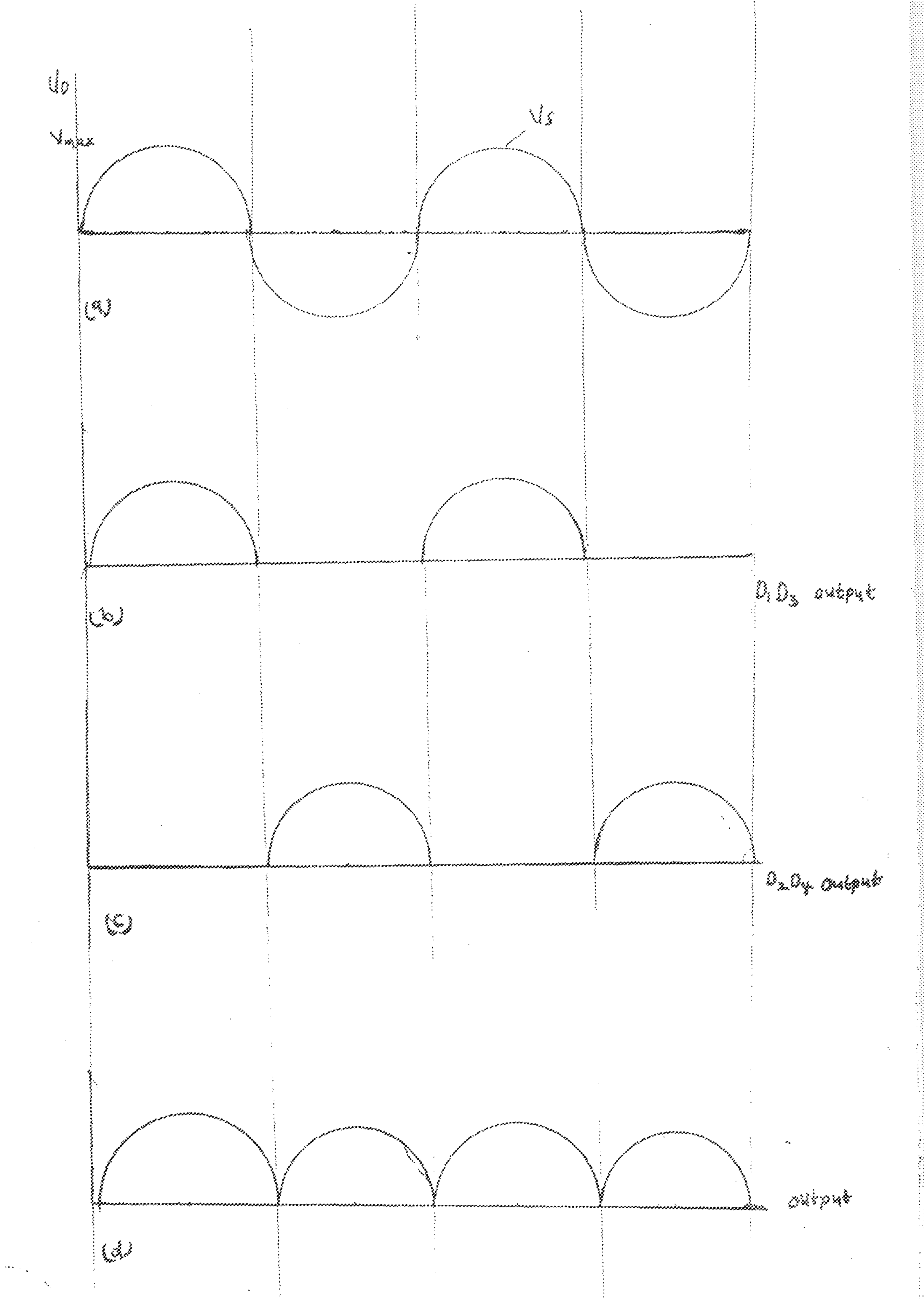


Fig 4.3 The circuit wave form.

the ac supply diodes D1 and D2 are forward bias and diodes D2 and D4 are reverse biased, current then flows through diode D1 and D2.

At the negative half of the ac supply diode D2 and D4 are forward biased then D1

and D2 reverse biased. Current then flow through diode D2 and D4.the circuit operations are shown in Fig 4.2 and the wave form are shown in Fig 4.3

2.8.2 FILTERING

The output of the full-wave rectifier is a pulsating voltage. Before it can be applied to the other circuits, the pulsation must be reduced. A more pure dc is needed to prevent noise from being impressed on the ac line.

There are three main type of filters which could be employed to smoothen out pulsation in the output of a rectifier. They are

- Capacitor filter
- R-C filter
- Choke filter

For the purpose of this design the capacitor filter is used. This is because it is readily available and performs well.

The capacitor filtering depends on the property of capacitor to charge (store energy) and discharge (release energy) from its operation.

OPERATION OF A CAPACITOR

A capacitor connected across the rectifier output provides filtering as shown in Fig 5.1. The capacitor is able to store electrons. When the diode or rectifier is

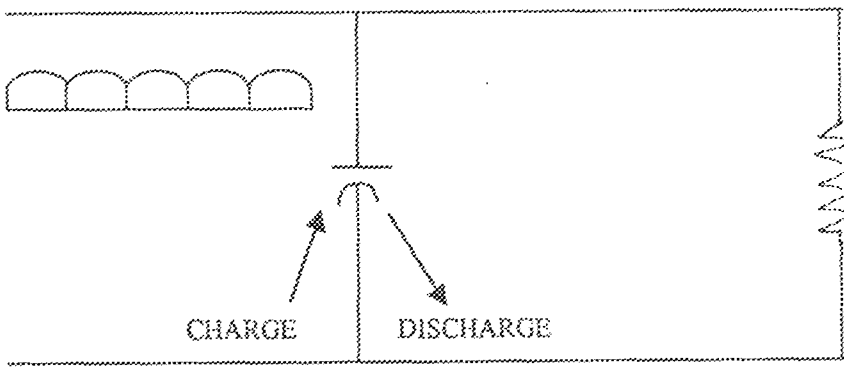


Fig. 5·1 Filtering action of a capacitor

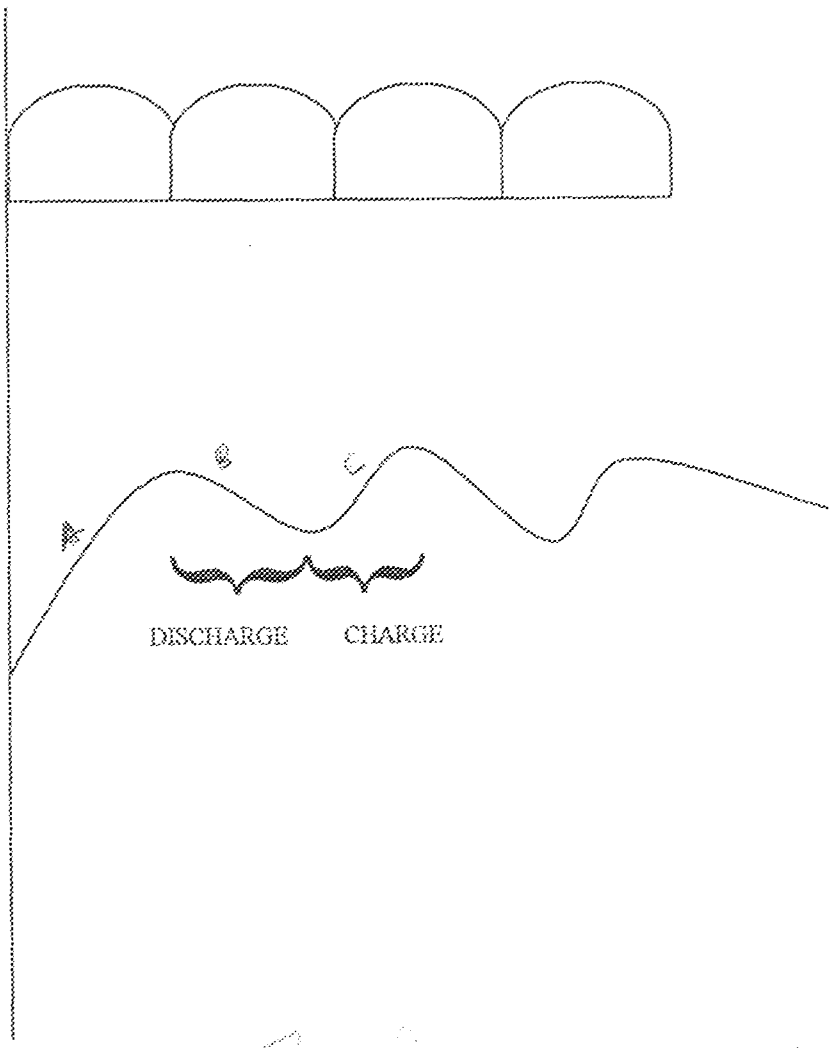


Fig 5·2 The Waveform of a filtering capacitor conducting, the capacitor charges rapidly to about the peak-voltage of the wave. It is limited only by the load applied to the rectifier and the reactance of the transformer windings. Between the pulsation in the wave, voltage from the rectifier drops. The capacitor then discharges through the load. The capacitor, in effect, is a storage chamber for electrons. It stores electrons at pêak voltage. It supplies electrons to the load when rectifier output is low.

The operation action can be seen in the wave diagram shown in Fig 5.2. The periods labeled A,B and C in the Figure cover different actions taking place. During A (Fig. 5.2) after switch-on, the capacitor charges through the forward biased rectifier diode in series with secondary winding voltage to V_{max}. At the start of B, the diode turn off and the capacitor supplies the load current

on an exponential decay time. With a sufficiently large value of capacitance of the capacitor voltage decay, only partially before in periods C, it is recharged to its peak voltage periods. B and C are repeated.

Capacitors used for this purpose are electrolytic types. This is because large capacitor are needed in a limited space. Their values are calculated under design calculation.

2.9 DESIGN CALCULATION

From equation (5)

$$f = 1/T = \frac{1.43}{(R_5+2R_6)\,C} \qquad \text{where } R_A=R_5,\ R_B=R_6$$

f = The frequency of the generating pulse

T = The period of the wave form

$T = T_{HIGH} + T_{low}$

where

T_{HIGH} - The charging period for the high frequency oscillator

T_{low} - The charging period for the low frequency oscillator

$T = 0.7\,(R_5 + 2R_6)C$ from eqn (4)

where 0.7 is a constant for the IC, R5 ad R6 are changing resistor and C is the capacitor being charged. Taking the value of $R_5 = 1k\Omega$, $R_6 = 33k\Omega$, C= 0.047μF.

$$f = 1/T = \frac{1.43}{[1000+2\,(33000)]\,0.047\times10^{-6}}$$

$$= \frac{1.43}{[1000+66000]\,0.047\times10^{-6}}$$

$$= \frac{1.43}{67000 \times 0.047 \times 10^{-6}}$$

$$= \frac{1.43}{3.149 \times 10^{-3}}$$

$$= 454.1124.$$

The frequency of the multivibrator used was 500 Hz.

The frequency of the alarm circuit is calculated as shown below, following the procedure above.

For equation (5)

$$f = 1/T = \frac{1.43}{(R_9 + 2R_{10})\, C4} \qquad \text{where } R_A = R_9,\ R_B = R_{10}$$

C4 the capacitor being charge.

Taking the value of $R_9 = 220\Omega$, $R_{10} = 47k\Omega$, $C_4 = 0.1\mu F$.

$$f = \frac{1.43}{(220 + 2\,(347000)\; 0.1 \times 10^{-6}}$$

$$= \frac{1.43}{[220 + 94000]\; 0.1 \times 10^{-6}}$$

$$= \frac{1.43}{94220 \times 0.1 \times 10^{-6}}$$

$$= \frac{1.43}{0.009422}$$

$$= 151.77$$

The frequency of the audio alarm is 160Hz.

From equation (6)

The duty cycle (D/C) of the multivibrator is given by

$$D/C = \frac{R_6 \times 100\%}{R_5 + 2R_6}$$

with $R_5 = 1k\Omega$, $R_6 = 33\ k\Omega$.

$$D/C\ \% = \frac{33000}{1000 + 2\ (33000)}$$

$$= \frac{33000}{1000 + 66000}$$

$$= \frac{33000}{67000}$$

$= 0.4925$

$D/C = 49.25\%$

The voltage divider theorem is used to calculate voltages across resistor R1,R2, R7, R8 which is the voltage across D1,D2,D3,D4 respectively.

Therefore $V_{cc1} = V_{cc2} = \dfrac{R_1 V}{R_1 + R_2}$

taking $R_1, = 330\Omega$, $R_2 = 330\Omega$, $V = 12v$

$$V_{cc1} = V_{cc2} = \frac{300 \times 12}{330 + 330}$$

$$= \frac{3960}{660}$$

$$= 6V.$$

Therefore the voltage across R_1 and R_2 given by V_{cc1} and V_{cc2} is 6v likewise $V_{cc3} = V_{cc4} = 6v$.

Rectification

$$V_{dc} = \frac{2\sqrt{2}\, V_s}{\Pi} \qquad V_s = 12v.$$

$$V_{dc} = \frac{2\sqrt{2} \times 12}{3.14}$$

$$= \frac{39.94}{3.14}$$

$$= 10.8\ V$$

$$V_{max} = \frac{2\ V_s}{2 \times 220} \qquad V_s = 220$$

$= 311.13V.$

But PIV 77 V_{max} for the purpose of this project PIV value 600V was chosen. A bridge rectifier with PIV rating of 600V was used.

The ripple factor can be greatly reduced by a filter consisting of capacitor shunted across the load resistor.

Therefore: $r = 1/(2\sqrt{3}\,(f R_L C))$

Where r = ripple factor

f = frequency

R_L = load resistance

C = capacitance

let $r = 1.7 \; 10\text{-}2$

$V_p = 2\, V_{rms}$

$V_{rms} = 240$ v

$V_p = \sqrt{2} \times 240$

$= 339.4$ v

let $I_d = 500mA$

$$R_L = \frac{V_p}{I_d} = \frac{339.4v}{500 \times 10^{-3}}$$

$= 678.82$

$f = 50Hz$

$$C = \frac{1}{2\sqrt{3} f R_L r} = \frac{1}{2\sqrt{3} \times 50 \times 678.82 \times 1.7 \times 10^{-2}}$$

$= 500.3\mu F$

For the purpose of this project, based on the above calculation 500μF capacitor was used.

2.10 OPERATION PRINCIPLE OF CHECKER CIRCUIT

To test a diode or LED with the checker, do the following

1. Connect the diode and LED to the E and C terminals of jack J1

2. Move switch S2 to the Diode - EB/EC position

3. Press switch S1 and not which LEDs light and whether the alarm is on.

4. Use table 2.0 to determine whether the diode or LED is good, short - circuited or open.

Table 1.1. (S2 in Diode - E_b/E_c position)

D3	D4	Condition	Remarks
on	off	Good and alarm on	Cathode lead in Pin C of J1
on	on	Short and alarm off	Replace diode
off	off	Open and alarm off	Replace diode
Off	On	Good and alarm on	Cathode lead in Pin E of J1

To test a PNP or NPN transistor with the checker, do the following

1. Plug the transistor into J1. The emitter lead must be to E, the collector lead to C and the base lead to B of the Jack.

2. Move switch S2 to the Diode -EB/EC position.

3. Press switch S, and note which LED's light whether the alarm is on.

4. Used table 2.1 to determine whether the transistor is either PNP or NPN and what its condition (good short -circuited, or open).

5. Move switch S2 to the Bc position (Bc stand for base collector).

6. Press switch S1 and note which LED's light ad whether the alarm is ON.

7. Use table 2.2 to determine whether the transistor base collector junction is good short, or open.

Table 1.2 (S2 in Diode - EB/EC position).

D1	D2	D3	D4	CONDITION	REMARKS
OFF	ON	OFF	ON	Good and alarm is ON	NPN transistor
ON	ON	ON	OFF	EB short alarm is OFF	}
OFF	ON	ON	ON	EC short "	
OFF	OFF	OFF	OFF	EB open "	replace transistor.
OFF	ON	OFF	OFF	EC open "	
ON	OFF	ON	OFF	Good and alarm is ON.	PNP transistor
ON	ON	OFF	ON	EB short alarm is OFF	}
ON	OFF	ON	ON	EC short "	
OFF	OFF	OFF	OFF	EB open "	
ON	OFF	OFF	OFF	EC open "	replace transistor

Table 1.3 (S2 in Bc position).

D3	D4	CONDITION	REMARKS.
ON	OFF	Good and alarm is ON	NPN transistor
ON	ON	Bc short and alarm OFF	replace transistor
OFF	OFF	Bc open ad alarm OFF	replace transistor
OFF	ON	Good ad alarm ON	PNP transistor.

The 555 timer IC, being connected as a free-running multivibrator with a frequency of 500Hz. Switch S2 directs the output of IC, (Pin3) to either the emitter (E) or base (B) terminals of J1.

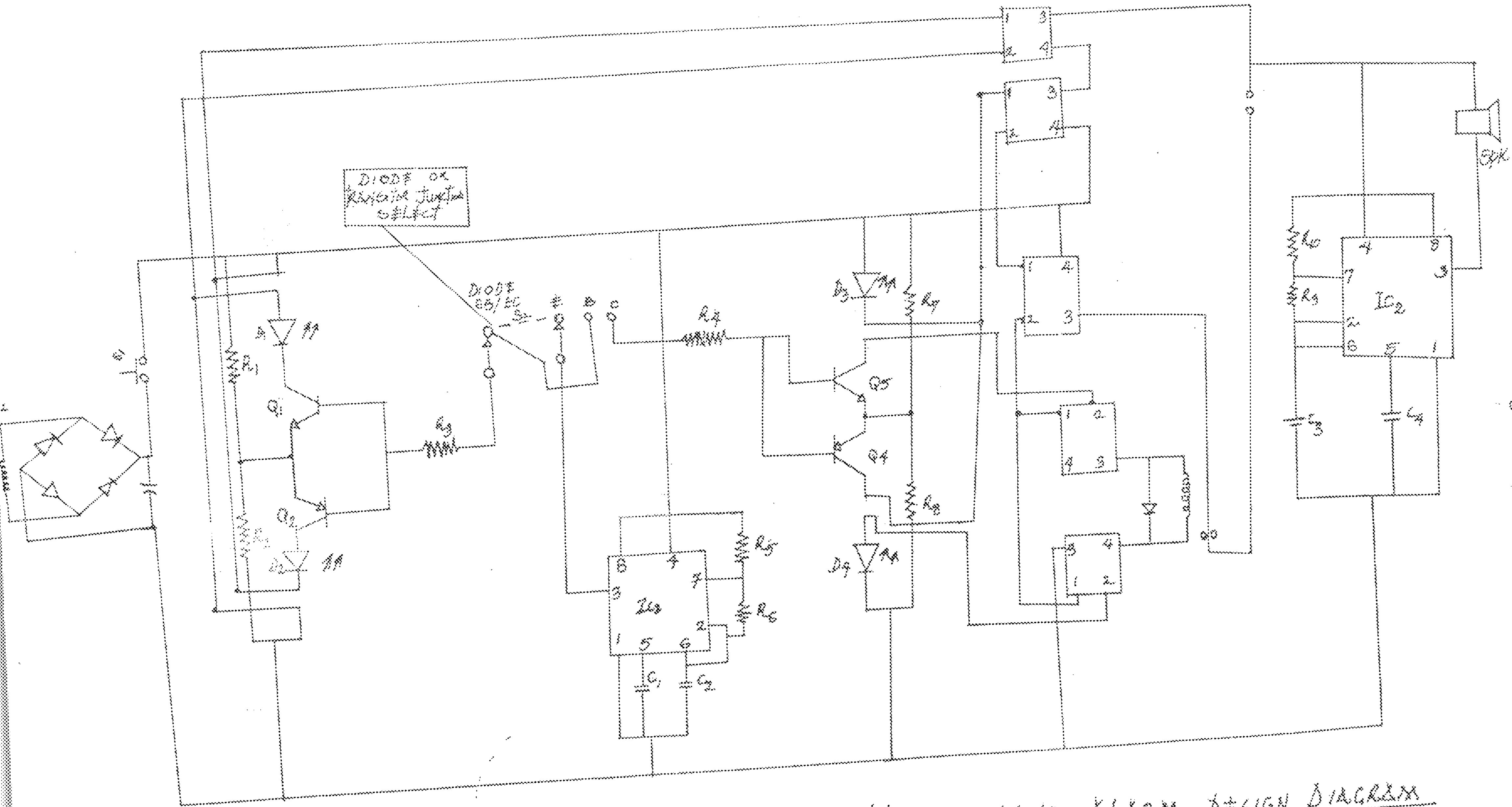


Fig 2.11 TRANSISTOR/DIODE CHECKER/TESTER USING ALARM DESIGN DIAGRAM

CHAPTER THREE

CONSTRUCTION AND TESTING.

3.1 CONSTRUCTION

The components that were used are as follows:

C_1, C_3 0.01µF, 25V disk capacitor

C_2 0.047 µF, 25V disk capacitor

C_4 0.1µF 25V disk capacitor

D_1 through D_4 light emitting diode.

IC_1,IC_2 555 timer I_c

Q_1, Q_3 2N3904 NPN transistor

Q_2, Q_4 A733 PNP transistor

R_1,R_2,R_7,R_8, 330, 1/4 -W resistor

R_3, R_4 8.2k, 1/4 W resistor

R_5 1- k, 1/4-W resistor

R_6 33-k, 1/4-W resistor

R_9 22k, 1/4-W resistor

R_{10} 47k, 1/4-W resistor

Optoisolator 1,2,3,4,5,6,7,.

Relay (12 volt)

Rectifying diodes.

12 volt transformer

500μF filtering capacitor

S1 Normally open push - button switch

S2 DPST switch

Speaker.

The tools required for the construction are as follows:

(I) Soldering iron

(ii) Soldering lead

(iii) Multimeter tester (Digital)

(iv) Picker

(v) Cutter

(vi) Vero-board

(vii) Bread - board

The construction is then undertaken by testing the design outline stage by stage. In this regard the power supply section was first considered and the astable circuit was connected as indicated in the design and then tested on the breadboard. When the required out put was finally obtained after series of checking and cross checking to ensure correct connection of all components, it was transferred to the Vero board. This was followed by the counter circuit (that is, amplifier, alarm circuit) which was also connected as specified in the design and checked before being soldered to the Vero board. This process was followed for implementation of the entire circuit designed. Care was taken to ensure that the circuit connections were appropriate before soldering. But then, it was still observed that a working circuit on the breadboard would suddenly fail to work on being transferred and soldered to the Vero board. The problem was traced to the conductor lines of the Vero board which were been shorted as a result of the soldering carried out. In each case with this problem being encountered, care was taken to solder and also to locate fault when problem arose. Necessary precautions were taken in the connection until the project functioned as expected.

3.2 TESTING

For the sake of testing the transistor diode checker using alarm which was constructed, it is necessary to put a test diode or transistor.

Assume that a good tester diode is placed across J1 with the cathode to E and anode to C close. Switch S1, and move S2 to the Diode - EB/EC position as shown in the design diagram. The 500Hz wave form from the oscillator IC, will be rectified by the test diode. Negative pulses are applied to the base leads of both transistor Q_3 and Q_4. Negative pulses will only turn on Q_4 causing LED D_4 to light. The current path to light D_4 would be up through D_4, Q_4, R_7 and S1 and back to positive of the battery. Light emitting diode D3 does not light because transistor Q_3 needs a positive (not negative) pulse at the base to turn it on. According to table 2.0 since D_4 is on and the D3 off, this test diode is good and the cathode is connected to E and the alarm is ON.

CHAPTER FOUR

4.1 CONCLUSION

A review of the objective of this work is briefly considered in this section. The aim of this project is to provide a better way of transistor and diode testing, and to improve on the area of constructing of such testing device.

The main area of contribution of this project to the already established work are, the used of the alarm which makes fault detection easier. Also its design is simple, reliable and easy to consiruct.

The checker circuit will check each junction of an NPN or PNP transistor.

4.2 RECOMENDATION

Knowing the importance of transistors and diode in practical electronic circuit and to upgrade our workshop to present day need, I would suggest that the department should go a step further to improve on this work by making it more presentable and acceptable for public use.

The department can as well collaborate with the university and other technology body to establish a workshop where more attention will be given to this work either in the form of improvements or further developments.

When applying the constructed checker, all the operating instructions must be strictly adhered to the connections correctly carried out and the working component perfectly maintained and tested to ensure good working condition for good efficiency.

Care should be taken to avoid the overpowering of the design piece which will result to its damage.

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