DESIGN OF A CELL PHONE DETECTOR 2.

:

BY

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A RESEARCH PROJECT REPORT SUBMITTED TO THE DEPARTMENT **Of** ELECTRICAL ENGINEERING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AW ARD OF A BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING AT KABALE UNIVERSITY

JANUARY, 2021

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APPROVAL

The undersigned have examined the thesis entitled "Design of a cellphone detector" presented by Atuheire Gift, candidate for the bachelor degree of electrical engineering at the faculty of engineering, technology, applied design and fine art, department of electrical engineering, Kabale University and hereby certify that it is worthy the acceptance .

Supervisor **Signature** **Date:08/01/2021**

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I am using this opportunity to express my gratitude to Mr. Samuel Sengo Mushakangoma who supported me throughout the course of this project. I am thankful for his aspiring guidance, invaluably constructive criticism and friendly advice during this project work.

I am sincerely grateful to him for his truthful and illuminating views on a number of issues related to the project

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ABBREVIATIONS

1. GSM- Global System for Mobile Telecommunications
2. FDMA-Frequency Division Multiple Access
3. TDMA-Time Division Multiple Access
4. USB-Universal Serial Bus
5. LED-Light Emitting Diode
6. RF-Radio Frequency
7. BIT-Bipolar Junction Transistor
8. NPN-Negative-Positive-Negative

ABSTRACT

In this project I have designed a cell phone detector circuit using **same** components such as resistors, capacitors, wires ,transistors , two ICs i.e. CA3130 op-amp & NE555 mono stable vibrator ,one LED and one piezo buzzer and de source of 12 volt.

This designed cell phone detector can sense the presence of an active cell phone within its vicinity. It does this by detecting the signal produced by the cellphone and this causes the LED to blink and buzzer to sound.

A BFN38 transistor is the major component incorporated within this project as an RF transistor that can amplify the low Radio frequencies hence the increase on the range compared to the other project circuits without any RF transistor

CHAPTER ONE: BACKGROUND

1.0 INTRODUCTION

Cell phones have become an integral part of people's lives as they are used for communication via SMS, internet, e-mail, calls and entertainment.

Despite, these advantages enjoyed by the advancements in mobile technology, there are threats that have been posed by their usage. In recent years, there has been increasing issues relating to the use of mobile phones in restricted areas like examination halls, aero planes, places with life support machines that that are sensitive to mobile phones.

Hence need for the detection of the active mobile phones by using a detector, that senses the presence of an activate mobile phones so that in case a person enters with a phone in such places either intentionally or unintentionally, they can be notified to and either told to switch them or take them outside.

1.1 PROBLEM STATEMENT

There are many places that have a 'no phones allowed' regulation such as conferences, petrol stations, exam halls,life support machines facilities in hospital. The use of phones in such places can cause a nuisance or a fire outbreak at a petrol station either. Nevertheless; people still enter such places with phones either unintentionally or intentionally. Due to this problem, there is need to detect phones in such places so that the owners are told to switch them off or taken out.

There are already existing systems to detect these phones but they have a low detection of radius of 1.5 meters hence the need to increase the detection range.

1.2 OBJECTIVES OF THE PROJECT

1.2.1 General objective

To design a cell phone detector

1.2.2 Specific objectives

I. To design a circuit that can detect radio frequency signals in its vicinity.

3. To design an alarm circuit that produces a notification when the signals are detected.

4. To simulate the designed circuit.

1.3 JUSTIFICATION

Despite frisking of people before they enter into places where phones are not *allowed,* some manage to smuggle mobile phones into those places Due to this problem **that** has been experienced in these places for years, there is a need to design a system that can detect the presence and usage of mobile phones in these places.

This project is therefore aimed towards designing a cell phone detector that will be installed in these venues. This *will* curb the vice because even though some may manage to smuggle them into the halls, their usage and presence can be continuously monitored by the system and offenders can be caught.

1.4 SCOPE

This project covers the selection criteria of components used in the design and analysis of the cellphone detector carried out using multisim software with a BFN38 transistor as the main component included to increase the detection range as it is an RF transistor that has the ability to amplify, specifically, radio frequencies such that even the faintest signals can be detected.

CHAPTER TWO: LITERATURE REVIEW

2.0 INTRODUCTION

In this chapter I shall discuss the overview of Cell Phone Detector and also discuss about circuit diagram and description of the circuit diagram and the existing detectors,

2.1 RELATED WORK

Projects have been developed based on the existing technology currently available in the open market utilizes mostly discrete components, and design approach is microcontroller based and some of them include:

- This cell phone detector is a pocket sized which can be used to detect the hidden active cell phone. So the proposed system is used to ignore the use of cell phones in some of the public places like exam halls, defense establishments, private rooms, military camp, hospitals, petrol pumps and also very useful for detecting the use of mobile phone for intelligence work and other correlated activities. This system can detect SMS, calls, video transmission even when the cell phone is secreted in silent mode. [1]

- This handy mobile bug or cell phone detector, pocket-size mobile transmission detector or sniffer can sense the presence of an activated mobile cellphone from a distance of one and-a-half meters. So it can be used to prevent use of mobile phones in examination halls, confidential rooms, etc. It is also useful for detecting the use of mobile phone for spying and unauthorized video transmission (2]

- **Kumar Abhisekh** who designed Mobile Phone Detector Using LM358 that can detect incoming and outgoing calls, SMSs, Internet and video transmissions even if a mobile phone is kept in silent mode. When it detects an RF signal from an activated mobile phone, its LED starts blinking and continues to blink until the signal stops. This circuit is limited to a detection range of 10 centimeters. [3]

- In the **Cell Phone Detector circuits** is to detect the RF Signals and it uses Schottky diode to detect the cell phone signal as they have a unique property of being able to rectify low frequency signals, with low noise rate. When an inductor is pla@ed near the RF signal source, it receives the signal through mutual induction. This signal is rectified by the Schottky diode. This low power signal can be amplified and used to power any indicator like an LED in this case but it was limited to the Schottky diode having higher barrier height is less sensitive to small signals. [4]

- This work involves the design and development of a digital signal detector which is capable of detecting incoming and outgoing signals from mobile phones. The presence of an activated mobile phone can be detected by this handy, pocket size mobile signal detector from a distance of one and a half meters, which could be used in preventing the use of mobile phones in examination halls, confidential rooms etc. It is also suitable for detecting the use of mobile phone for spying and unauthorized video transmission. The circuit can detect the incoming and outing calls, text messages, and video. [5]

- **MWANGO AMBROSE NYALE** designed a circuit that detects signals of the range 0.9GHz to 3GHz is used to detect a cell phone when in use. When the signal is detected, an LED blinks to indicate the usage of a cell phone within a radius of 1.5 meters. [6]

- Similarly, another cellphone detector circuit was designed using a Schottky diode that can detect the RF signals because it has a unique property of being able to rectify low frequency signals with low noise rate. When an inductor is placed near the RF source, it receives the signals through mutual induction. These signals are rectified by the Schottky diode. The low power can now be amplified and is used to power any indicator like a LED. This circuit is limited to few centimeters and the Schottky diode with higher barrier height is less sensitive to small signals [7]

- Another cellphone detector circuit according to Jestin Cubetech, can detect both the incoming and outgoing calls, SMS, and video transmission even if the mobile phone is kept in silent mode. The moment the mobile phone detector detects RF transmission signal from an activated mobile phone, it starts sounding a beep alarm and the LED

blinks. The alarm continues until the signal transmission ceases. This circuit is also limited to 1.5 meters detection range. [8]

Some of the cellphone detectors on market include;

- **Berkeley Varitronics Systems Wolfhound Cellphone Detector**

  Berkeley Varitronics Systems wolfhound cell phone detector will detect PCS, CDMA, GSM, and cellular bands using RF signatures. It also has the capability to directionally find or locate cellular phones that are nearby. The wolfhound can detect phones that are in standby mode, actively using voice, or data transmissions. Detects cell phones up to 150 feet away (indoors) and up to 1 mile away (line-of-sight outdoors). Integrated laserassisted directional antenna (green 532 nanometer laser, 50 feet *minimum span)* and its minimum price is about: $2,400.00. [9]

- **Cell busters Cell Phone Detector**

  Cell buster's cellular phone detector provides continuous monitoring for cellular phones and has a voice alert that tells the user to shut their phone off if detected. Detects both the analog and digital cellular phones CDMA, TDMA, GSM, and PCS/PCN types. Cell busters allow you cover an area of up to one hundred feet radius from the Cell Phone Detector hardware. Its price is about: $1650.00. Looking to these systems they are more advanced and can support us to detect different types of cell phones, but these technologies are expensive for our country. [10]

2.2 CELLPHONE TECHNOLOGY

A **mobile phone** is a device that can make and receive telephone calls over a radio link while moving around a wide geographic area. It does so by connecting to a cellular network provided by a mobile phone operator, allowing access to the public telephone network. By contrast, a cordless telephone is used only within the short range of a single, private base station. [11]

FEATURES OF A CELL PHONE

Bluetooth is a secure wireless protocol that operates at 2.4GHz. The protocol uses a master slave structure and is very similar to having a wireless USB port on your cellular phone. Device like a

printer, keyboard, mouse, audio device, and storage device can be connected wirelessly. This feature is only use for hands-free devices but can also be used for file transfer of picture, music, and other data.

Cameras are a very popular feature that was added in the last 10 years. In recent years, high resolution cameras have become a standard feature. Most cellular phones will come with at least a 2 mega pixel camera and the more expensive phones can be as much as 8 mega pixels.

Microphones have been featured on cellular phone since they first came out. In the last 10 years the microphones have become dual purpose; now there are programs on the phone that record voice to file such a simple voice recorder or as part of a video.

Some cellular phones come with **802.11 wireless** built in and allows the phone to connect to any nearby wireless network. This provides an alternate connection method to the Internet and saves money if you are on a limited data plan. Also, connecting with 802.11 is most likely going to provide better throughput than using the cellular phone network.

All these features make cellular phone today very versatile. They can connect with almost any storage medium or computer. In the years to come, cellular phones will continue to gain more and more features.

2.3 CIRCUIT COMPONENTS

2.3.1 RESISTORS:

A resistor is a two terminal electronic component that produces a voltage across its terminals that is proportional to the electric current through it in accordance with Ohm's law. Resistance is one of the key factors used in electrical and electronic circuits. Resistance is the property of materials **to** resist the flow of electricity, and it is governed by Ohm's Law:

$$V=IR$$

Resistors are elements of electrical networks and electronic circuits and are important in most electronic equipment. Practical resistors can be made of various compounds and films, as well as resistance wire (wire made of a high-resistivity alloy, such as nickel/chrome).The primary characteristics of a resistor are the resistance, the tolerance, maximum working voltage and the

power rating. Other characteristics include temperature coefficient, noise, and inductance. Less well-known is critical resistance, (the value below which power dissipation limits the maximum permitted current flow, and above which the limit is applied voltage). Critical resistance depends upon the materials constituting the resistor as well as its physical dimensions; it's determined by design. Resistors can be integrated into hybrid and printed circuits, as well as integrated circuits. Size, and position of leads (or terminals) are relevant to equipment designers; resistors must be physically large enough not to overheat when dissipating their power. [12]

Significance:

As voltage dividers, resistors are placed in series with each other. Their function is to produce a particular voltage from an input that is fixed or variable. The output voltage is proportional to that of the input and is usually smaller. Voltage dividers are useful for components that need to operate at a lesser voltage than that supplied by the input.

Resistors also help filter signals and are used in oscillatory circuits in televisions and radios. In other circuits, resistors are used to direct current flow to particular parts of the circuit, or may be used to determine the voltage gain of an amplifier. Resistors are ued with capacitors to introduce time delays.

2.3.2 CAP A CITO RS:

A. capacitor is a passive electronic component consisting of a pair of conductors separated by a dielectric. When a voltage potential difference exists between the conductors, an electric field is present in the dielectric. This field stores energy and produces a mechanical force between the plates. The effect is greatest between wide, flat, parallel, narrowly separated conductors.

A capacitor can store electric energy when disconnected from its charging circuit, so it can be used like a temporary battery. Capacitors are commonly used in electronic devices to maintain power supply while batteries are being changed. This prevents loss of information. [13]

When an inductive circuit is opened, the current through the inductance collapses quickly, creating a large voltage across the open circuit of the switch or relay. If the inductance is large enough, the energy will generate an electric spark, causing the contact points to oxidize, deteriorate, or sometimes weld together; or destroying a solid-state switch. A snubber capacitor across the newly opened circuit creates a path for this impulse to bypass the contact points, thereby preserving their life; these were commonly found in contact breaker ignition systems, for instance. Similarly, in smaller scale circuits, the spark may not be enough to damage the switch but will still radiate undesirable radio frequency interference (RFI), which a filter capacitor absorbs. Snubber capacitors are usually employed with a low-value resistdr in series, to dissipate energy and minimize RFI. Such resistor-capacitor combinations are available in a single package.

Capacitors are also used in parallel to interrupt units of a high-voltage circuit breaker in order to equally distribute the voltage between these units. In this case they are called grading capacitors.

Schematic diagrams, a capacitor used primarily for DC charge storage is often drawn vertically in circuit diagrams with the lower, more negative, plate drawn as an arc. The straight plate indicates the positive terminal of the device, if it is polarized.

Ideal capacitor is characterized by a single constant value, capacitance, which is measured in farads. This is the ratio of the electric charge on each conductor to the potential difference between them. In practice, the dielectric between the plates passes a small amount of (leakage current. The conductors and leads introduce an equivalent series resistance and the dielectric has an electric field strength limit resulting in a breakdown voltage.

Capacitors· are widely used in electronic circuits to block the flow of direct current while allowing alternating current to pass, to filter out interference, to smooth the output of power supplies, and for many other purposes. They are used in resonant circuits in radio frequency equipment to select particular frequencies from a signal with many frequencies.

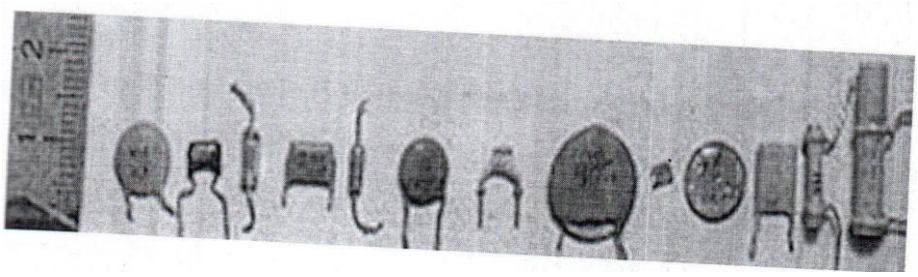


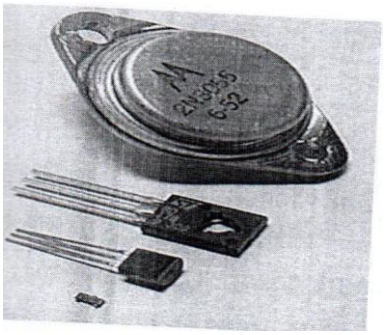
Figure 1: various types of capacitors

2.3.3 TRANSISTOR:

A transistor is a semiconductor device commonly used to amplify or switch electronic signals. A

transistor is made of a *solid* piece of a semiconductor material, with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current flowing through another pair of terminals. Because the controlled **(output) power can be much more than the controlling (input) power, the transistor provides** amplification of a signal. Some transistors are packaged individually. but most are found in integrated circuits. *[* 14]

In any switching circuit, values of input voltage would be chosen such that the output is either completely off, or completely on. The transistor is acting as a switch, and this type of operation is common in digital circuits where only "on" and "off' values are relevant.



igure 2 Transistor

5.

2.3.4 LED:

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices and are increasingly used for other lighting. Appearing as practical electronic components in 1962, early LEDs emitted low-intensity red light, but modem versions are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

When a light-emitting diode is switched on, electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. An LED is often small in area (less than 1 mm), and integrated optical components may be used to shape its radiation pattern. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. However, LEDs that are powerful enough for room lighting are relatively expensive and require more precise current and heat management than compact fluorescent lamp sources of comparable output. [15]

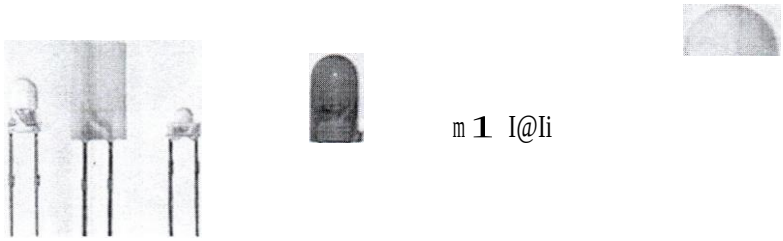


Figure 3 Various types of LED

***2.3.5* PIEZO BUZZER:**

A Piezo buzzer is made from two conductors that are separated by Piezo crystals. When a ·oltage is applied to these crystals, they push on one conductor and pull on the other. The result of this push and pull is a sound wave. These buzzers can be used for many things, like signaling when a period of time is up or making a sound when a particular button has been pushed. The

process can also be reversed to use as a guitar pickup. When a sound wave is passed, they create an electric signal that is passed on to an audio amplifier.

A buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as microwave ovens, or game shows.

Electromagnetic buzzer is composed of oscillator, solenoid coil, magnet, vibration diaphragm, housing, etc. When the power supply is switched on, the audio signal current generated by the oscillator passes through the solenoid coil, which generates a magnetic field. The vibration diaphragm periodically vibrates and sounds under the interaction of the solenoid coil and the magnet. The frequency of the general electromagnetic buzzer is 2-4 kHz.

A piezoelectric element may be driven by an oscillating electronic circuit or other audio signal source, driven with a piezoelectric audio amplifier. Sounds commonly used, to indicate that a button has been pressed are a click, a ring or a beep.

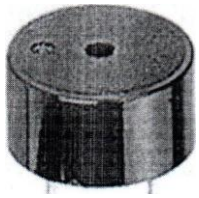


Figure 4 Buzzer

2.3.61CCA3130:

GENERAL DESCRIPTION

CA3130 is a BiMOS operational amplifier IC with MOSFET Input and BiMOS devices have advantages of both bipolar and CMOS transistors. Bipolar transistors can perform fast switching and perform well under high bandwidths. On the other hand, CMOS op-amps consume less :.:rrent.

6.

The CA3130 consists of PMOS transistors at the input and CMOS transistors at the output. These transistors provide the advantages of high impedance, high speed, less current consumption, and high bandwidth. [16]

PIN CONFIGURATION

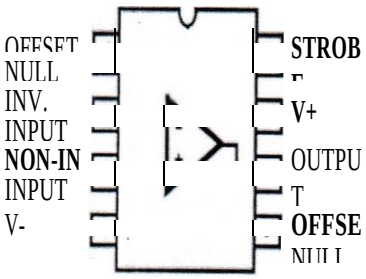


Figure 5 ca3 l 30 op amp

- **Pin 01, 05: offset null**

When the input pins of the op-amp are connected with each other, the voltage at the output should be zero. But no operational amplifier is perfect. Therefore, there is a small offset when die two inputs are shorted together. The offset null pin is used to null these offsets by applying the voltage between the two input terminals of an operational amplifier to null the output voltage.

- **Pin 2: inverting input**

:: is the inverting/negative input terminal of the operational amplifier integrated inside the IC.

- **Pin 3: non-inverting input**

.~ is the non-inverting/positive input terminal of the operational amplifier integrated inside the **C.**

- **Pin 4: ground**

- is the connection for ground or negative power supply.

Pin 6: output

gives an amplified output signal.

7.

• **Pin 7: supply**

le is connected to a positive power supply.

• **Pin 8: strobe**

This pin is used to shut down the output stage. When it is connected to the negative supply, the output value at pin 6 will rise to the potential of the positive supply. It can also be used for phase compensation in comparators.

CA3130 MOSFET OP-AMP PIN OUT FEATURES

- It can perform both single supply and double supply operations, but it is ideal for singlesupply operations.

The ranges of voltage are:

Single supply voltage range: 5V to 16V

Dual supply Voltage range: ±2.5V to ±8V

- Supply current is 1 0mA.
- Maximum output voltage is 13.3V.
- It has a very low input current of 1 mA.
- Maximum source and sink currents are 22mA and 20mA.
- Common-mode input voltage range includes the negative supply rail and the input terminals of this IC can be swung 0.5V below that negative rail.

• The common-mode Rejection Ratio (CMRR) is 80dB.

:...3.7 IC NESSS:

GENERAL DESCRIPTION

• heNE555 IC is a highly stable controller capable of producing accurate timing pulses. With a mono stable operation, the time delay is controlled by one external resistor and one capacitor. ith a stable operation, the frequency and duty cycle are accurately controlled by two external esistors and one capacitor. [17]

PIN CONFIGURATION:

• **Pin 1: Grounded Terminal:**

All the voltages are measured with respect to this terminal.

• **Pin 2: Trigger Terminal:**

This pin is an inverting input to a comparator that is responsible for transition of flip-flop from set to reset. The output of the timer depends on the amplitude of the external trigger pulse applied to this pin.

• **Pin 3: Output Terminal:**

Output of the timer is available at this pin. There are two ways in which a load can be connected **to** the output terminal either between pin 3 and ground pin (pin **1)** or between pin 3 and supply pin (pin 8). The load connected between pin 3 and ground supply pin is called the normally on **ioad** and that connected between pin 3 and ground pin is called the normally off load.

• **Pin 4: Reset Terminal:**

To disable or reset the timer a negative pulse is applied to this pin due to which it is referred to as **reset** terminal. When this pin is not to be used for reset purpose, it should be connected to + Vee **o** avoid any possibility of false triggering.

• **Pin S: Control Voltage Terminal:**

.he function of this terminal is to control the threshold and trigger levels. Thus either the e:cemal voltage or a pot connected to this pin determines the pulse width of the output _, eform. The external voltage applied to this pin can also be used to modulate the output *av*eform. When this pin is not used, it should be connected to ground through a 0.01 micro Farad to avoid any noise problem.

• **Pin 6: Threshold Terminal:**

- ~ is the non-inverting input terminal of comparator 1, which compares the voltage applied to **me** terminal with a reference voltage of 2/3 V cc. The amplitude of voltage applied to this **terminal** is responsible for the set state of flip-flop.

• **Pin 7: Discharge Terminal:**

This pin is connected internally to the collector of transistor and mostly a capacitor is connected between this terminal and ground. It is called discharge terminal because when transistor saturates, capacitor discharges through the transistor. When the transistor is in cut-off region, the capacitor charges at a rate determined by the external resistor and capacitor.

• **Pin 8: Supply Terminal:**

A supply voltage of + 5 V to + 18 V is applied to this terminal with respect to ground (pin 1).

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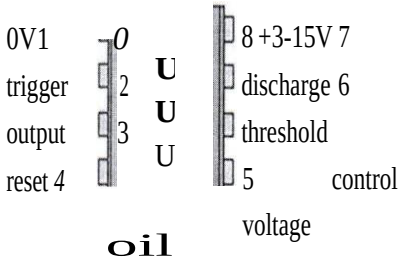

***Figure** 6 NE555 timer*

FEATURES OF THE 555 TIMER

- It operates from a wide range of power supplies ranging from + 5 Volts to + 18 Volts supply voltage.
- Sinking or sourcing 200 mA of load current.
- The external components should be selected properly so that the timing intervals can be made into several minutes Proper selection of only a few external components allows timing intervals of several minutes along with the frequencies exceeding several hundred kilo hertz.
- It has a high current output; the output can drive TTL.
- It has a temperature stability of 50 parts per million (ppm) per degree Celsius change in temperature, or equivalently 0.005 %/ °C.
- The duty cycle of the timer is adjustable with the maximum power dissipation per **package** is 600m W and its trigger and reset inputs are logic compatible.

2.3.8 POWER SUPPLY

A regulated power supply is an embedded circuit that converts unregulated AC (Alternating Current) into a constant DC. With the help of a rectifier it converts AC supply into DC.

Its function is to supply a stable voltage (or less often current), to a circuit or device that must be operated within certain power supply limits. The output from the regulated power supply may be alternating or unidirectional, but is nearly always DC (Direct Current). [18]

The type of stabilization used may be restricted to ensuring that the putput remains within certain limits under various load conditions, or it may also include compensation for variations in its own supply source.

COMPONENTS OF A REGULATED POWER SUPPLY

The basic building blocks of a regulated DC power supply are as follows:

- A step-down transformer
- A rectifier
- A DC filter
- A regulator

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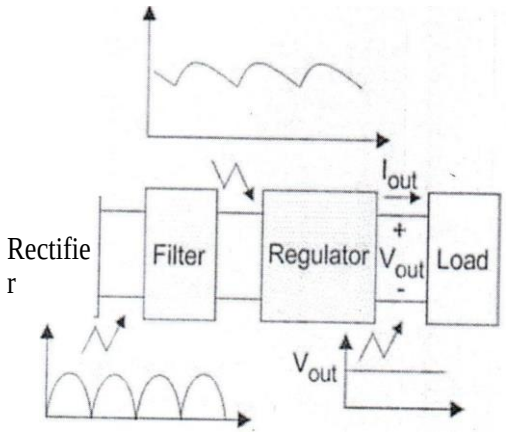


Figure 7: Components of power supply

A step down transformer will step down the voltage from the ac mains **to** the required voltage level. The turn's ratio of the transformer is so adjusted such as to obtain the required voltage value. The output of the transformer is given as an input to the rectifier circuit.

RECTIFICATION

Rectifier is an electronic circuit consisting of diodes which carries out the rectification process. Rectification is the process of converting an alternating voltage or current into corresponding direct (DC) quantity. The input to a rectifier is AC whereas its output is unidirectional pulsating

C.

bridge rectifier consists of four p-n junction diodes connected in the manner shown above. In the positive half cycle of the supply, the voltage induced across the secondary of the electrical ansformer i.e. VMN is positive. Therefore point E is positive with respect to F. Hence, diodes D3 and D2 are reversed biased and diodes D 1 and D4 are forward biased. The diode D3 and D2

ill act as open switches (practically there is some voltage drop) and diodes D 1 andD4 will act **s** closed switches and will start conducting. Hence a rectified waveform appears at the output of ~ rectifier as shown in the first figure. When voltage induced in secondary i.e. VMN is ::~gative than D3 and D2 are forward biased with the other two reversed biased and a positive

ltage appears at the input of the filter.

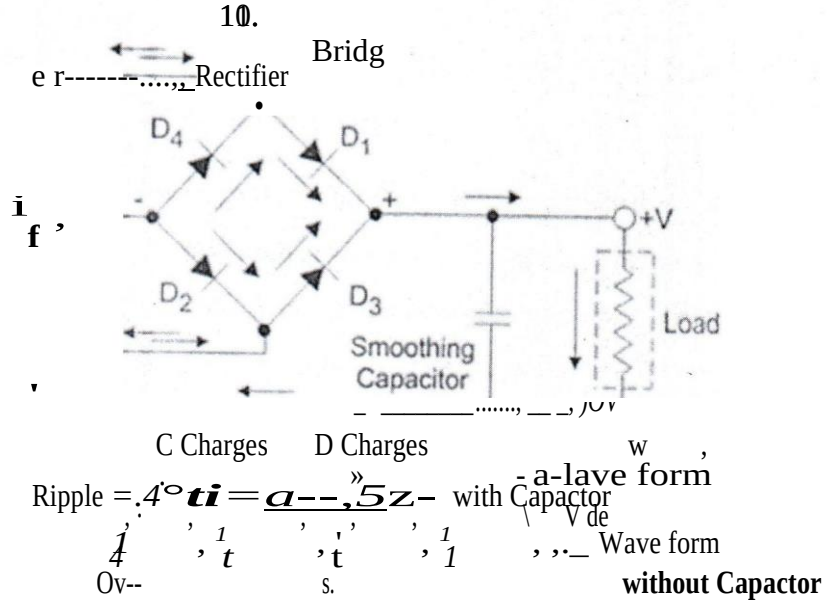


Figure 8: Resuliant output waveform

The rectified voltage from the rectifier is a pulsating DC voltage having very high ripple content. But this is not we want, we want a pure ripple free DC waveform. Hence a filter is used. Different types of filters are used such as capacitor filter, LC filter, Choke input filter, type 5..:.~er. The figure below shows a capacitor filter connected along the output of the rectifier and he resultant output waveform.

s the instantaneous voltage starts increasing the capacitor charges, it charges until the aveform reaches its peak value. When the instantaneous value starts reducing the capacitor starts discharging exponentially and slowly through the load (input of the regulator in this case). :~ce, an almost constant DC value having very less ripple content is obtained.

Ill GULA TI ON

This is the last block in a regulated DC power supply. The output voltage or current will change fluctuate when there is a change in the input from ac mains or due to change in load current at c.::e output of the regulated power supply or due to other factors like temperature changes. This blem can be eliminated by using a regulator. A regulator will maintain the output constant **even** when changes at the input or any other changes occur. Transistor series regulator, Fixed and riable IC regulators or a zener diode operated in the zener region can be used depending on

12.

their applications. IC's like 78XX and 79XX (such as the IC 7805) are used to obtained fixed alues of voltages at the output.

ith IC's like LM 317 and 723, we can adjust the output voltage to a required constant value. The figure below shows the LM317 voltage regulator. The output voltage can be adjusted by adjusting the values of resistances RI and R2. Usually, coupling capabitors of values about _ I µF to 1OF need to be connected at the output and input to address input noise and output transients.

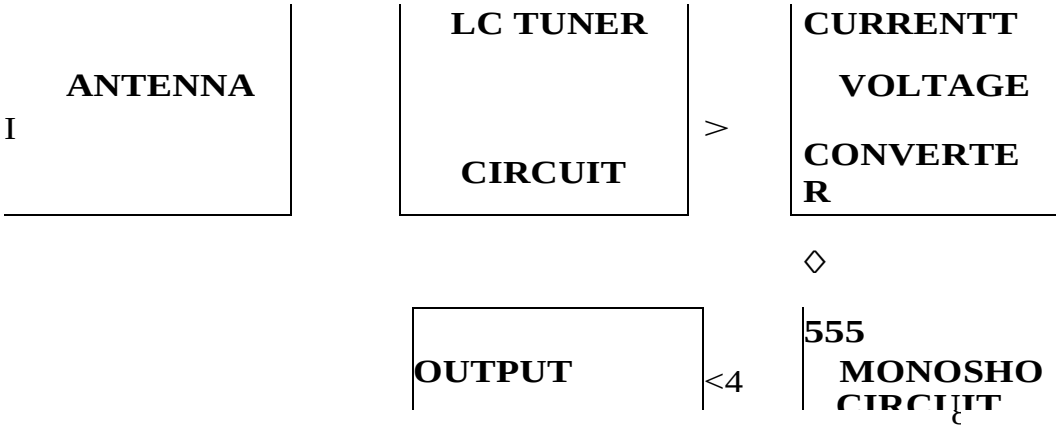
CHAPTERTHREE: METHODOLOGY

3.0 INTRODUCTION:

In this chapter I will discuss the different methods used to achieve the stated objectives, component selection criteria and circuit designing and analysis using multisim14.

3.1 DESCRIPTION OF BLOCK DIAGRAM:

There are five major blocks in the case of cell phone detector. They are



Antenna stage

The first stage is the Antenna stage. An antenna is a device used to transmit and/or receive _ xtromagnetic waves. Electromagnetic waves are often referred to as radio waves. Most ':!:llennas are resonant devices, which operate efficiently over a relatively narrow frequency band, '–£ antenna must be matched or tuned to the same frequency band as the radio system to which it s connected, otherwise reception and or transmission will be impaired. The transmission frequency of mobile phone ranges from 0.9 to 3 GHz with a wavelength of 3.3 to 10 cm. These frequencies sent by an active mobile phone need to be received. This function is carried out by e receiving antenna. An ordinary RF detector using tuned circuit is not suitable for detecting signals in the GHz frequency band used in mobile phones. So, a circuit detecting GHz signal is required for a mobile detector.

!..C runer circuit

Here the circuit uses 0.22µF disk capacitor to capture RF signals from the mobile phones. The ead length of the capacitor is fixed as 18mm with a spacing of 08mm between the leads to get e desired frequency according to Maxwell's equation. The disk capacitor along with the leads ~ **as** a small gigahertz loop antenna to collect the RF signals from the mobile phones. This capacitor along with the lead inductance act as a transmission lines to intercept the signals from te mobile. The capacitor creates a field, stores energy and transfers the stored energy in the ... , , of minute current to the input of a current to voltage converter circuit. This forms the second stage which is LC Tuner stage.

Current to voltage converter

current to voltage converter is an electronic circuit that takes current as the input and produces ±ge **as** the output. An op amp based current to voltage converter produces an output voltage en current is applied to its inverting terminal.

This. the output voltage, of current to voltage converter is the negative product of the feedback **sistance** and the input current.

The current coming to the input of the converter IC upset its balanced input and then converts the current into corresponding output voltage. When the mobile phone signals are detected by the =..:::: capacitor, the output of the converter IC, becomes high and low as indicated by the LED.

***555* mono stable timer.**

n Mono stable 555 Timer circuit triggers on a negative-going pulse applied to pin 2 and this er pulse must be much shorter than the output pulse width allowing time for the timing **pacitor** to charge and then discharge fully. Once triggered, the 555 Mono-stable will remain in ____;:: -HIGH" unstable output state until the time period set up by the Rl x Cl network has **used.** The amount of time that the output voltage remains "HIGH" or at a logic "1" level, is gen **by** the following time constant equation.

"'=**RIx**Cl

\\'here Rl is =resistor value and Cl is capacitor value

Output stage

A buzzer is triggered by using the output of the mono shot timer. The buzzer along with the LED forms the output stage that provide us the indication as sound and light respectively.

3.2 COMPONENT SELECTION

DESIGN AN RF SIGNAL DETECTOR

- copper is used as an antenna because it is an excellent conductor of RF and immune to oxidation and it's length is determined by:

  L h *velocitry of light in air*

  engt *desired frequency*

- **At** high frequency, signals need only very small capacitors for filtering in the pico farad (pF) range (I used 22pF) [13]

- 0.22uF is used as a tuner circuit according to inspection of Maxwell's equation *dD*

$$V \text{ X } H = I + \underline{dT}$$

rs ceramic capacitor with it leads fixed at 18mm long and 8mm wide. These dimensions fixed aride an area sufficient to capture the frequency required frequency. [19]

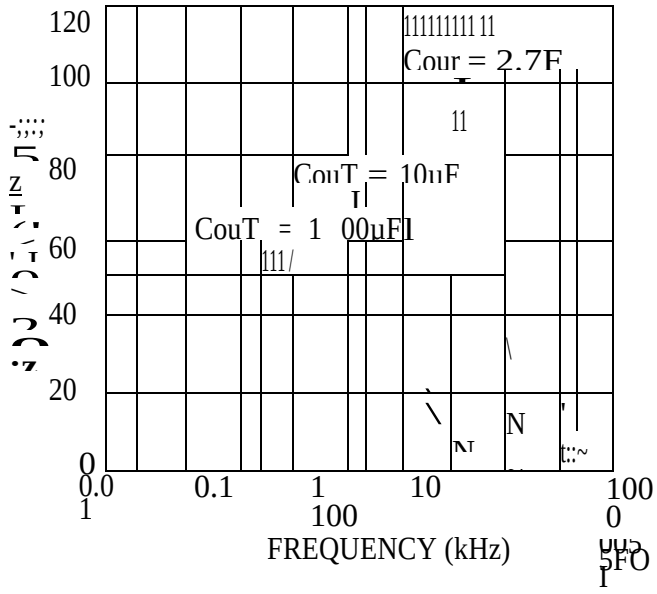
Current to voltage converter-(Op amp-CA3130) has higher impedance, high speed, less current consumption, and high bandwidth which features are desirable for this project.

- -:lie high frequency noise decoupling capacitor should be in the range 0.01 F to 0.1 F

+7pF capacitor is suitable for providing enough compensation for stable unity gain as ndicated in the datasheet.

l ".:X>uF capacitor has the lowest noise figure at 100 KHz according to the graph in figure 9 to ensure stable operation after the reference. [13]

13.



gare *9* .*Voise spectrum*

- **3FR** 96 is an RF Transistor which doesn't change the frequency of the signal and is used for amplification [20]

PRODUCTION OF A NOTIFICATION

• -~ LED is used to produce sound and it is switched through a BC548 transistor which is a general purpose transistor suitable for switching operations

buzzer is used to produce sound at a rate determined by the NE555 timer through its .i:::iing components

- ***I\~*** 555 Time is a cheap and popular IC and used-in precision timing.

  Is RC timing components are obtained using a formula [21]

  T=l. l_*R *C where Tis timing interval

  R is Resistor value

  C is capacitor value

- Its pin 5 should be connected to ground through a 0.01 farad's capacitor **to** avoid false triggering.
- The timer is triggered through a resistor which is obtained from:

V=IR Where V is supply voltage

I is supply current, when the output is 'high' and is typically lmA

• Bypass capacitors are calculated from $C = \frac{1}{27FXc}$

Where XC<(1/10) th of the parallel Resistor

F is the desired frequency

- At high frequency, signals need only very small capacitors for filtering in the pico farad (pF) range (I used 22pF)
- Pull down resistor (1 00k ohms) was obtained from a range of R pull down (minimum) to R pull down (maximum) as calculated below

R pull down max = -=500 ohms $\frac{Vil}{Ipdl}$

Where Ipdl =Iol+Ir (got from datasheet)

R pull down min $\frac{'?''}{Ipdh}$ 372.7k ohms

Where Ipdh =Ioh-Ir (got from datasheet

POWER SUPPLY

Required components

- 240v to 18 v Step-down transformer to step down voltage.
- Rectifier Bridge using 1B4B42 diodes.
- Filtering capacitors 0.1 uF is dictated by the voltage regulator datasheet as shown in figure below.
- Filtering capacitor (0.2uF) is obtained from the formula below

$$V_{rms} \text{ Xx4XF}$$

Where V rms is the root mean square value of the source voltage F is the source voltage frequency

Electrical Characteristics (LM7812)

(Refer to the test circuits. -40°C < *TJ* < 125°C, 1_0 = 500mA, V_1 = 19Vt::~~,:fo = 0.1µF, unless otherwise specified)

Parameter	Symbo	Conditions		Min	Typ	• Max	Unit
Output Voltage	v	1,=·25c		11.5	12.0	12.5	V
		5mA <1 < 1A, P < 15W,/,=		11.4	12.0	12.6	
Line Regulation (Note 12)	Reglin	I,=25C	V_1 = 14.5Vto	-	10.0	240	mV
			V_1 = 16V to 22V	-	3.0	120	
Load Regulation (Note 12)	Regloa	1,=·25c	1 = 5mA4 to	-	11.0	240	mV
			1 = 250m4 to	-	5.0	120	
Quiescent Current	lo	1,=/25c		-	5.1	8.0	mA
Ouiescent Current	J	l= 5m4 1o 1A		-	0.1	0.5	mA
		V_1 = 14.5V to		-	0.5	1.0	
Output Voltage Drift	NV/4	lo= 5mA		-	-1.0	-	*mVtc*
Output Noise Voltage	*VN*	f= 10Hz to 10OKHz, T,= ·25 €		-	760	-	v
Ripple Rejection	RR	f = 120Hz, V_1 • 151/ to 25V		55.0	71.0	-	dB
Dropout Voltage	Vonore	lo =1AT,=25€		-	2.0	-	V
Output Resistance	rO	f= 1KHz		-	18.0	-	mfl
Short Circuit Curren!	lsc	V,= 35/,1,= /250		-	230	-	mA
Peak Current (Note	1	1,=+25c		-	*22*	-	A

Figure I 0: LM78 J 2 voltage regulator datasheet

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0 INTRODUCTION

This chapter discusses about the results of the project and their respective discussions.

4.1 SIMULATION IN MULTISIM 14

4.1.1 POWER SUPPLY

A regulated Power supply was simulated in multisim software and the results were as shown in figure 11.

On running the circuit, the oscilloscope displays the different waveforms i.e. ac waveform versus DC waveform.

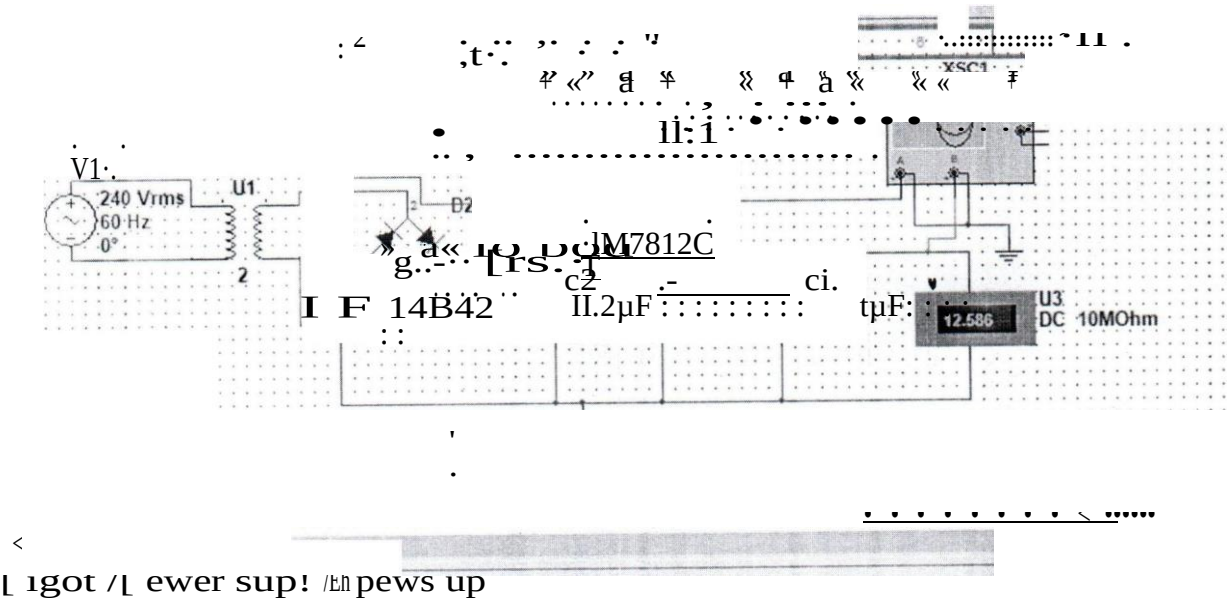


Figure 11: Power supply circuit in multisim

The resulting waveforms of the power supply circuit are shown as below

o r, 'I'e J

19.

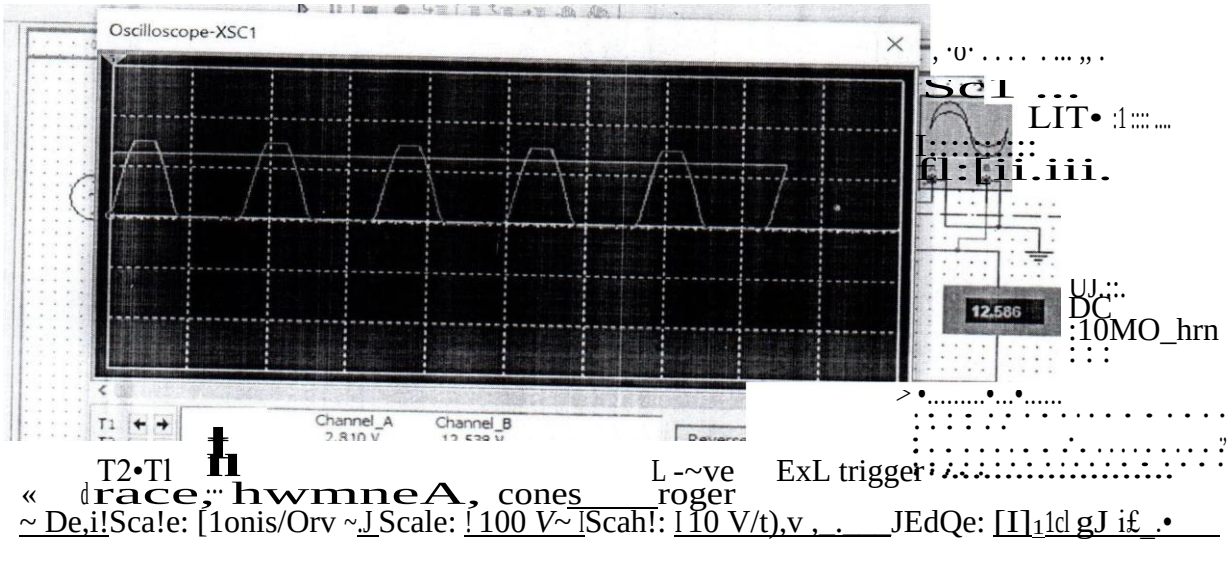


Figure 12 waveforms of the power supply

The developed cell phone detector is shown in figure 12.It works if it is activated by the switch"S l ". The simulation was running and the switch was activated then LED was blinking regularly and the buzzer was beeping.

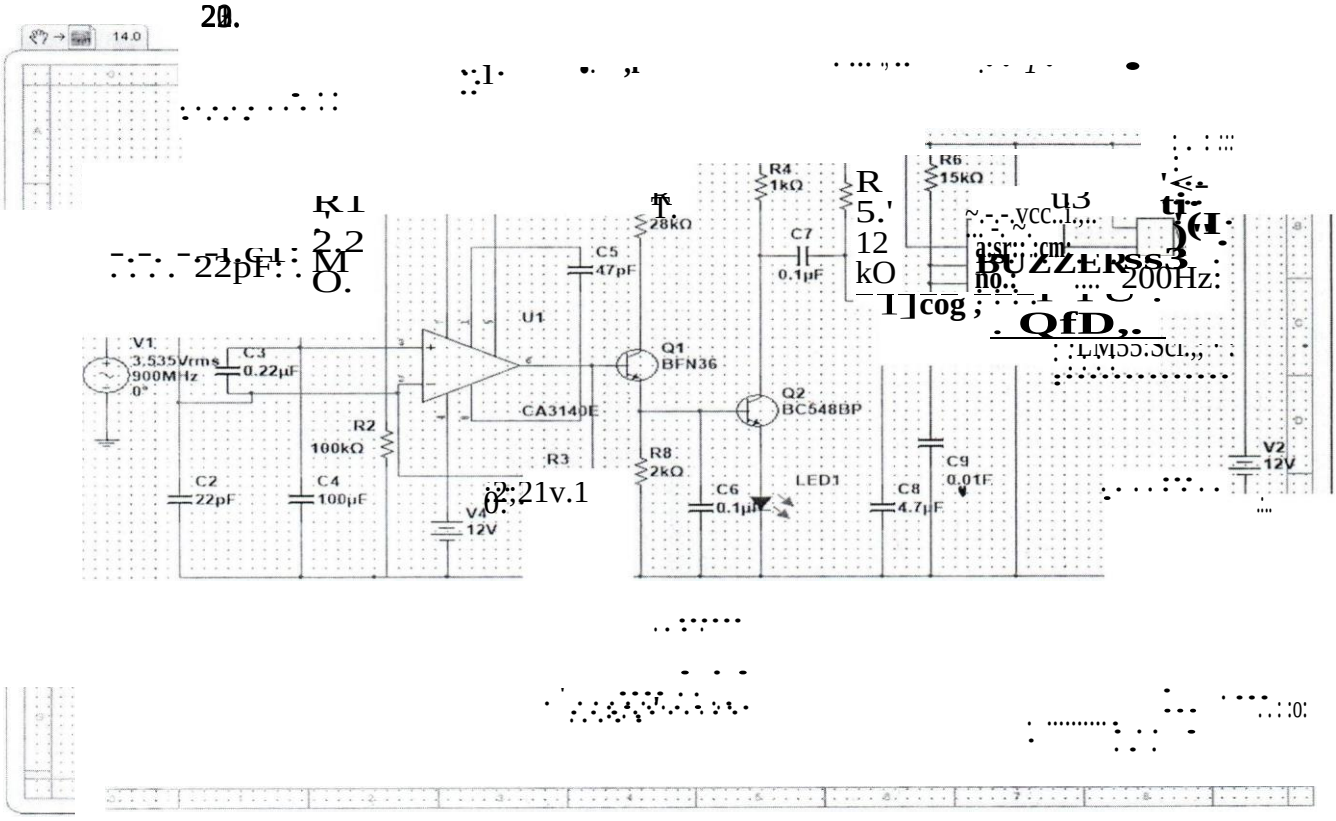


Figure 13 complete running simulated circuit

4.1.2 CIRCUIT ANALYSIS

During designing the circuit for simulation I have used a network analyzer to test for the performance of the circuit in Multisim as shown below in figure 13.

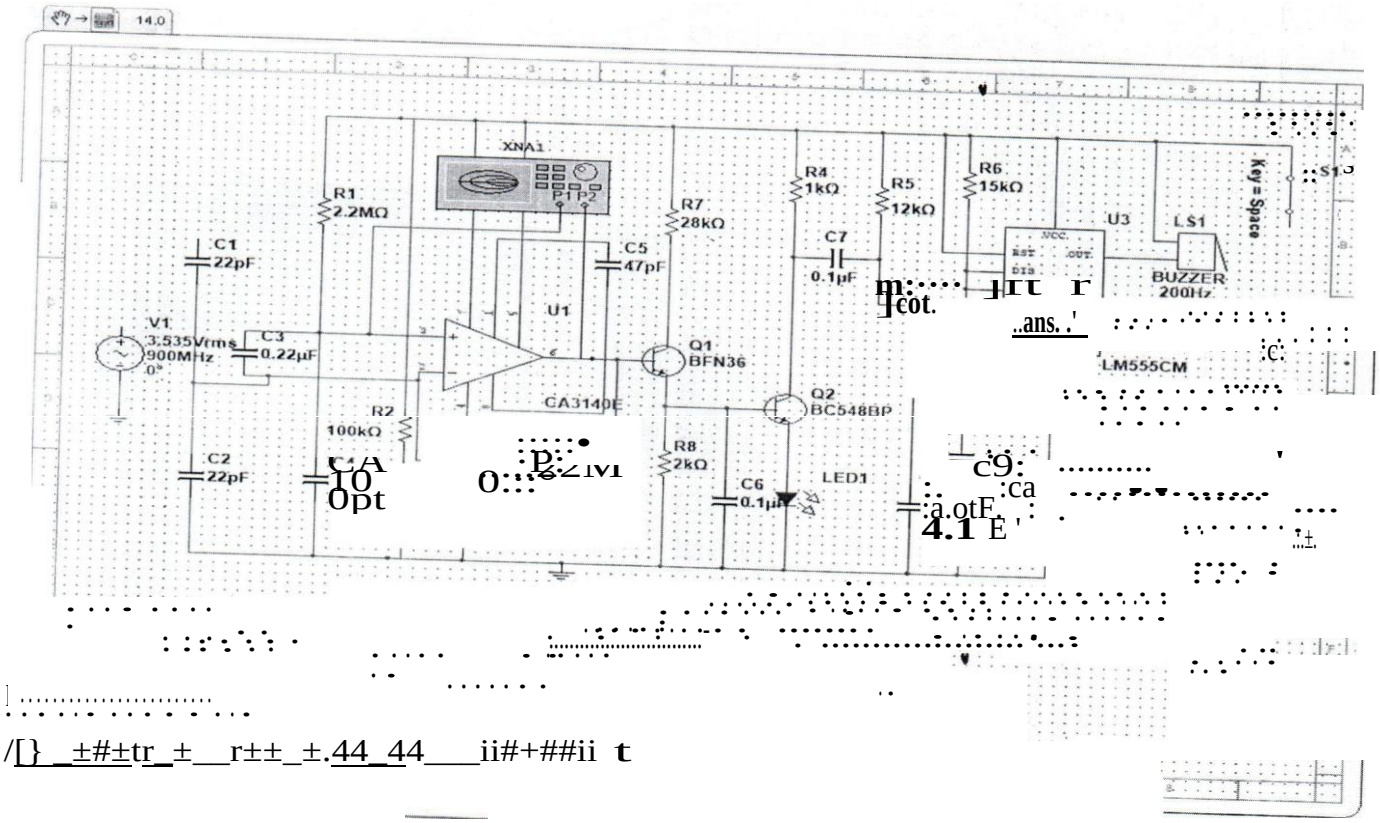


Figure I 4: Circuit with a network analyzer connected to it

IMPEDENCE MATCHING

Impedance matching is very important in circuit design since signals (current) follow the least path of resistance. It will be difficult to deliver a signal to a load if the impedance of the delivering circuit and that of the load is not matched. The impedance of the circuit was determined

.

Results

The impedance of the input and output circuit was found to be matched as seen in the figure 21 implying that a signal can be delivered from the source to the load.

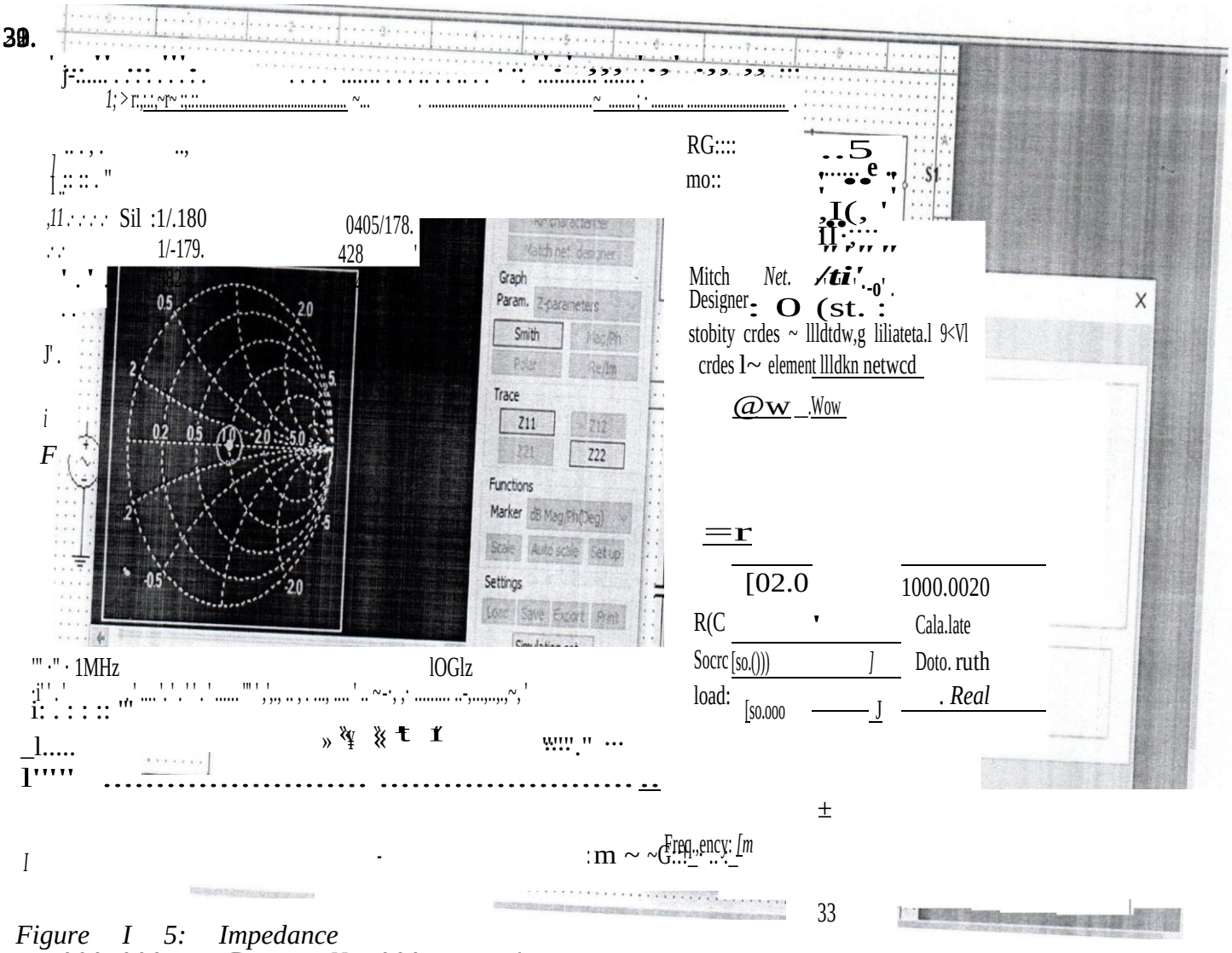


Figure I 5: Impedance matching results

STABILITY

Stability circles are used to analyze the stability of the circuit to deterrnin'e the values of load or source impedance that cause instability. P 1 and P2 represent the input and output-stability of the circle respectively.

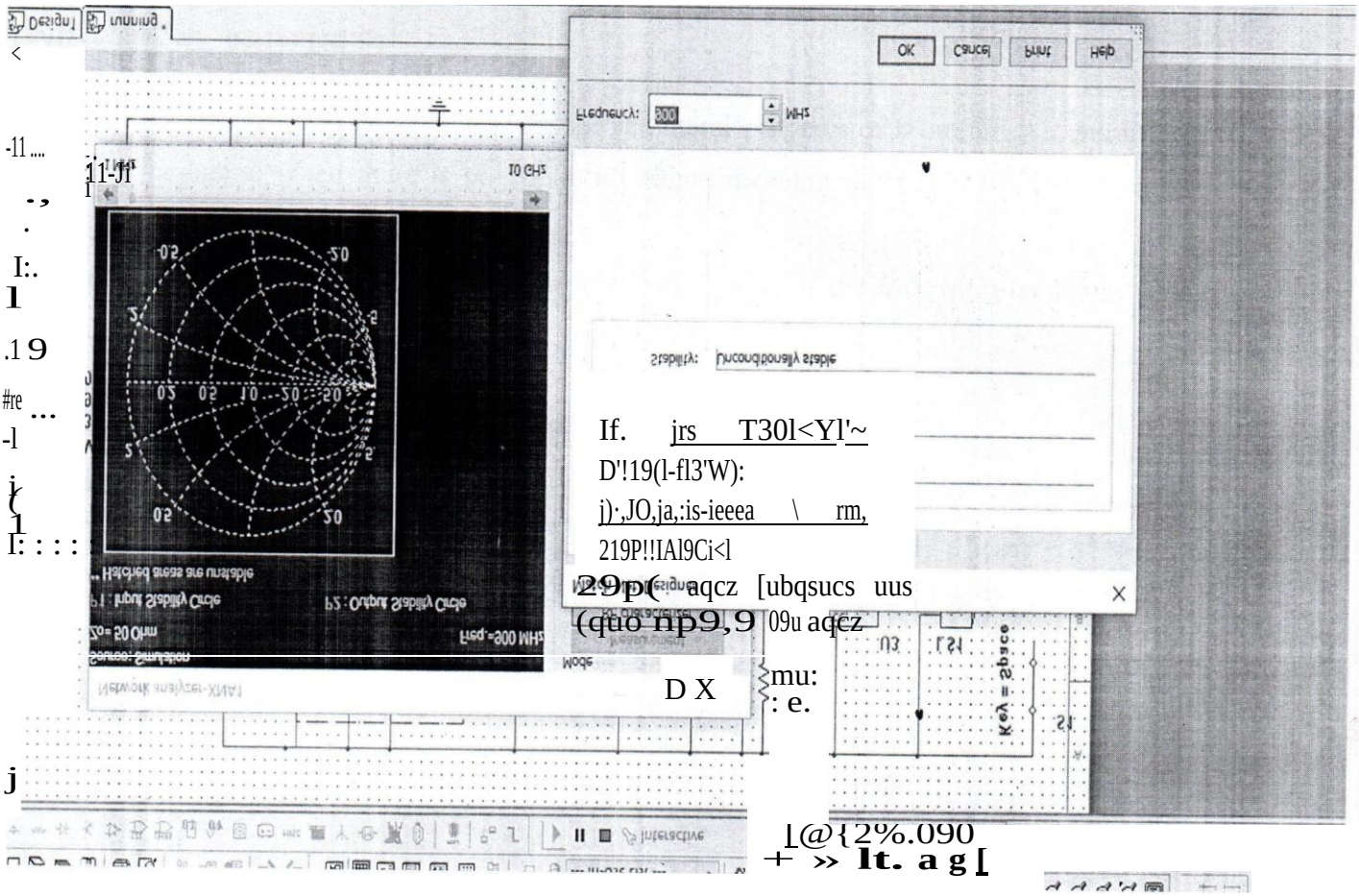


Figure 16: Stability results

Result s

• None of the smith was hatched.

In this case the circuit is said to be unconditionally stable, meaning that any area of the Smith Chart represents a valid passive source or load impedance.

- K was found to be more than 1

In this case the circuit developed using the op-amp CA3 l 30 is said to be unconditionally stable, meaning the amplifier does not oscillate in the presence of any passive load or source impedance

UNILATERAL PROPERTY

Unilateral circles option is used to analyze the unilateral property of a circuit. An amplifier is said to be unilateral when there is no "bounce" effect, meaning the signal reflected from the output port to the input port is zero.

This is determined by calculating the upper and lower limits of the following inequality using "U" value read from the simulation.

$\frac{1}{1+U} < G_T < \frac{1}{1-U}$ where, G_T - transducer power gain,

If the limits are close to one, or "U" is close to zero, the bounce effect is small enough to assume unilateral property for the amplifier.

Results

After calculation, the limits were both equal to I.therefore, since the bounce effect is small, the amplifier is unilateral.

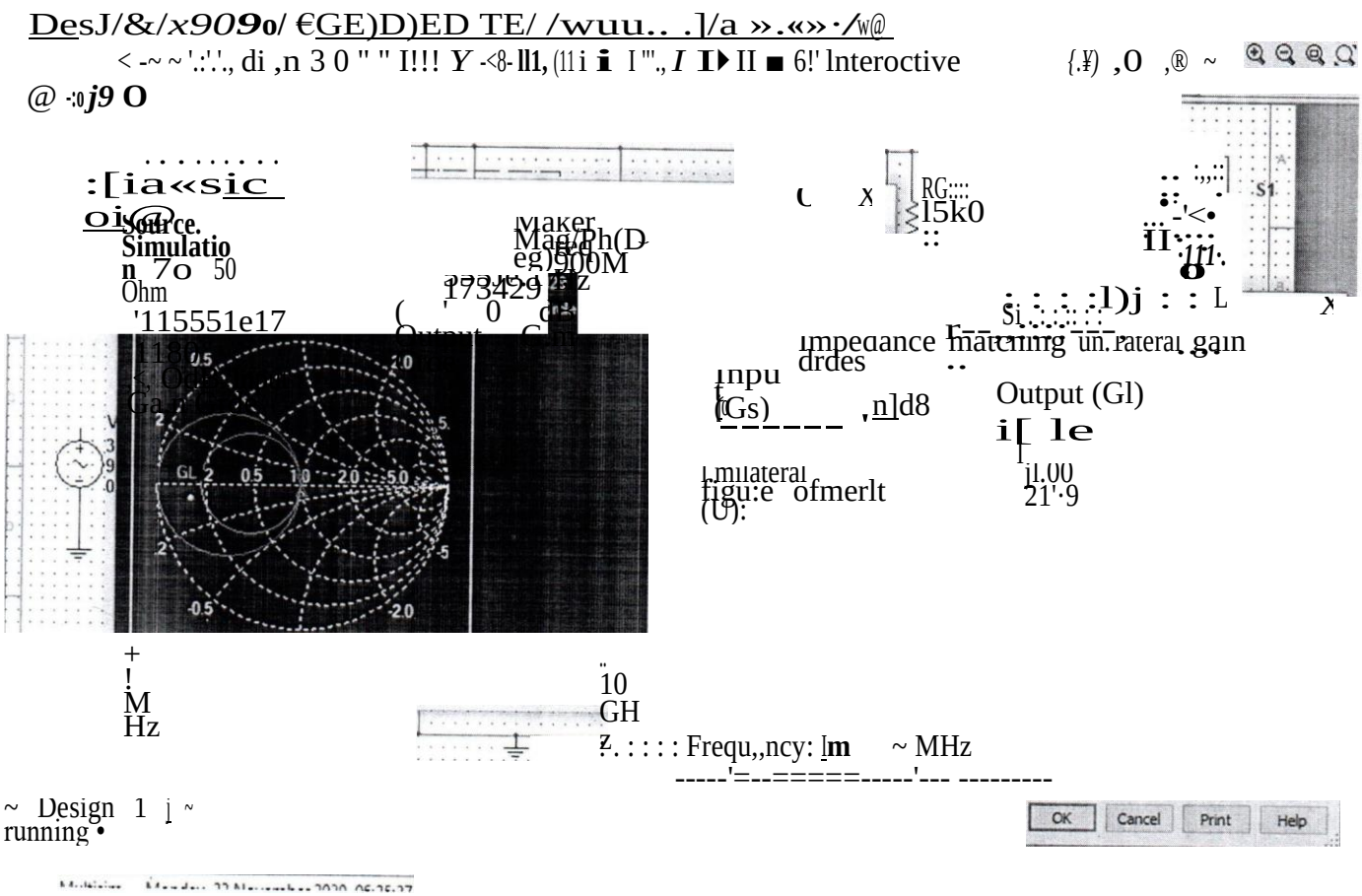


Figure 17 Unilateral gain circles results

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.0 INTRODUCTION:

In this chapter I am discussing conclusion, and the recommendation of cellphone detector designed circuit.

5.1 CONCLUSION:

Since the circuit analysis gave the expected results in terms of impedance matching, stability and unilateral gain, then the incorporated BFR96 RF transistor is capable of increasing the detection range.

5.2 RECOMMENDATION

- In future a system that can locate the position of the detected phone can be incorporated in the design.
- I recommend an incorporation of a system that can show the number of mobile phones detected.

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