

# Multism development of unauthorized cell-phone signal detector for multiple users

Lawal W. and Ogunti E.O.

## Abstracts

The use of mobile phones (GSM) by all categories, classes and ages of people has become widespread. While this is laudable, the abuse of this technology has however been on the high side in recent times. People often tend to forget and sometimes deliberately use their phones in unauthorized places such as examination halls, correctional facilities (prisons and cells), religious places (mosques), banking halls, and confidential meetings. The micro- miniaturization of these devices increases the risk to exploit and misuse this technology for diabolical and illegal purposes. For example, cell phones hidden in a meeting room, or on a person, allows a competitor to listen in or record illegally vital protected information. In hospital settings, Electromagnetic Interference (EMI), due to the presence or use of cell phones near sensitive electronic equipment may cause important patient-care equipment to fail to perform properly, putting patients at risk. The use of mobile phones as aids for cheating in examinations has somewhat become a menace in Nigeria. Consequently, a very real need exists today for individuals, businesses, institutions and the government to take measures to detect and identify the unauthorized use of cell-phones within the bounds of any controlled premise. In this work, attempt is made to provide a mechanism to forestall adverse consequences of unauthorized usage of cell phones in public buildings. Multism 11.0 version was used as appropriate CAD tool for the development of a phone signal detector for multiple users. Any cell phone activity such as making or receiving calls, sending or receiving SMS will be detected within the range of 5.8m.

**Keywords:** Signal detector, micro- miniaturization, Multism, active mode, correctional facilities, multiple users and buzzer alarming.

## INTRODUCTION

Unauthorized mobile phone usage in both private and public places has become a problem that may be difficult to solve. [7]. The technology added to cellular phones in the last 15 years has made them a jack-of-all -trades for information storage and transmission. Features like Bluetooth, USB, micro USB, high resolution cameras, microphones, internet, and 802.11 wireless technology make cellular phones perfect for stealing data. The only way of ensuring that a cellular phone is not in a secure area is to have an accurate method for sniffing (detecting) them. Most cellular phone sniffers available today only alarm if there is a cellular phone or transmission device in the general area. [1],[2],[3],[4]. They appear to alarm randomly and are not very accurate. Detecting a cellular phone signal and location has been a little problematic. The technique in this work provided signal detection as well as signal location. A cell phone detector can detect the signals use in the GSM band at about 900 MHz and Digital Cellular System (DCS) at about 1800MHz. [1],[11],[12]. Since the signals are digitally encoded, the sniffer can only detect the signal activity, and not the speech or the message contents of the signal. The sniffer only receives and doesn't transmit, making it great for areas sensitive to cellular phone usage. Over the last three decades, the number of cell phones, laptops and other electronic mobile devices has increased tremendously [13],[ 6], [8]. In the last few years, these mobile devices have started to be equipped, besides cellular interfaces (GSM), with peer-to-peer communication technologies, such as Wi-Fi or Bluetooth. They enable new services and applications such as context-aware applications. In France, a service that will allow a person passing in front of a movie advertising board to download the trailer on his mobile phone via Bluetooth or Infrared is currently under development. In front of a car billboard, buyers will be able to receive the address of the closest car dealer by SMS. Another benefit provided by these new communication technologies is the possibility given to friends to automatically detect friend's location and exchange information through mobile social networks [13]. The Cellular telephone (commonly mobile phone, cell phone or hand phone) is a long-range, portable electronic device used for mobile communication. In addition to the standard voice function of a telephone, current mobile phones can support many additional services such as SMS for text messaging

and mail delivery, packet switching for access to the Internet, and MMS for sending and receiving photos and video. Most current mobile phones connect to a cellular network of base stations (cell sites), which is in turn interconnected to the public switched telephone network (PSTN) except satellite phone [1],[9]. Cellular telephone is also defined as a type of short-wave analog or digital Telecommunication in which a subscriber has a wireless connection from a mobile telephone to a relatively nearby transmitter. The transmitter span of coverage is called a cell. Generally, cellular telephone service is available in urban areas and along major highways. As the cellular telephone user moves from one cell or area of coverage to another, the telephone is effectively passed on to the local cell transmitter.

## MATERIALS AND METHODS

The first stage in the design of this sniffer system involves the use of a CAD tool, Multism. Here a circuit was design using Op-Amp and RC filter for signal sniffing. The stability of the circuit was established using S-parameter and the K factor of the Op-Amp., else the amplifier may turn into an oscillator. Different sniffing circuits were evaluated through simulation in Multism. The various circuits simulated were shown in fig.1 to 6. A sniffer circuit [1], available commercially was simulated using Multism to confirm its performances. The maximum range cover by this circuit is 1.5m. Since the goal of this research is to exceed 1.5m, efforts were made to redesign the circuit to allow coverage of larger area such as correctional facilities, examination halls and big banking halls, i.e., to have coverage of about 6m in radius. Following design procedure, the circuit of fig1 was developed. Simulation of the design in fig 1 in the GSM frequency of 900MHz and 1800MHz was done.

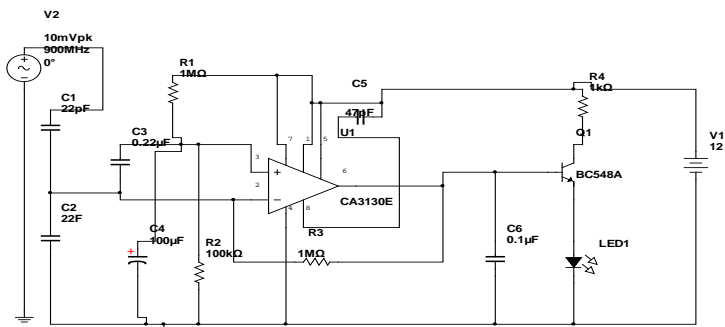


Fig.1. Sniffer circuit without alarm section

10mV was the input voltage applied with R1 and R3 at 1M ohms. It was noticed that the sniffer circuit during simulation was able to sniff the incoming RF signals as indicated by blinking of LED1. It was noticed that the circuit Fig1 was able to detect the signal for about 55 seconds after which it stop detecting when the signal is still ON or coming in, as compared to the circuit in [1], that stop detecting the signal after 36 seconds. The IC1 CA3130 due to its features and applications as indicated in its data sheet were used for both sniffer circuits. This shows that the sniffer circuit of fig 1 is a better design for sniffing RF signals from cell phone in terms of time duration of the signals for detection. Another simulation was done with sniffer circuit [1] and sniffer circuit of fig 1 with modification, that is, instead of using CA3130, LMH6702MA was used. It was discovered that both designs were able to sniff the signals very well throughout the time of sending RF signals. Where the incoming RF signals were varied from 400MHz to 2.2GHz (which are the band for most mobile phone) and the simulations were left to run for minimum of 5 minutes to examine the performances of the two sniffers circuits, circuit of [1] detected signal for 1 minute then went off for 10 seconds then started sniffing again, at interval of every 1 minute with intermittent 10 second-break. Circuit fig 1 sniffed the RF signals sent without stopping throughout the same duration of simulations, at least both sniffers circuit were monitored for 5 minutes during the simulations, and this indicates that sniffer circuit, fig.1 has better performance. Other circuits, such as the one in fig 2 was designed with the two 22pF capacitors removed. Simulation was done with this sniffer circuit with IC1 LMH6702MA while the second simulation was done with IC1 CA3130. During simulations it was noticed that both circuit were able to sniff the RF signals but with a time delay of 35 seconds for circuit with IC1CA3130 and a time delay of 20 seconds for circuit with IC1 LMH6702MA. From all the simulation done with these two ICs it was finally concluded that IC1 LMH6702MA will be best used with sniffer circuit with the two capacitors 22pF being present in the circuit, and with the value of resistors R1 and R3 kept at 1megaohms as shown in Fig 2.

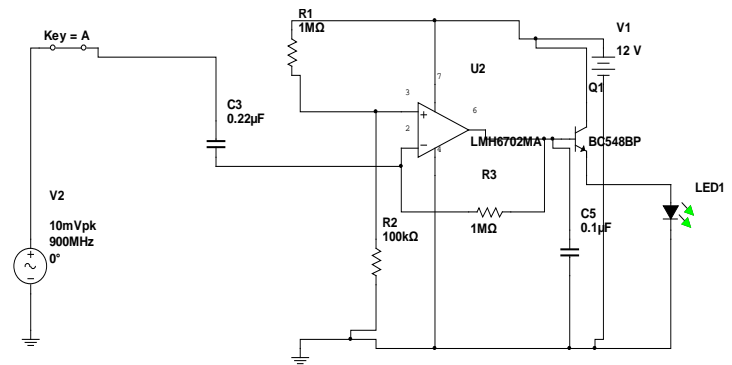


Fig. 2. Sniffer Circuit with LED1 as indicator

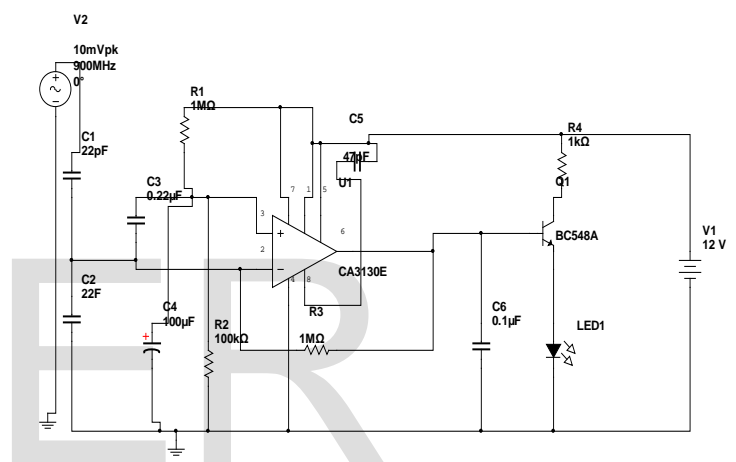


Fig. 3. Improved sniffer circuit

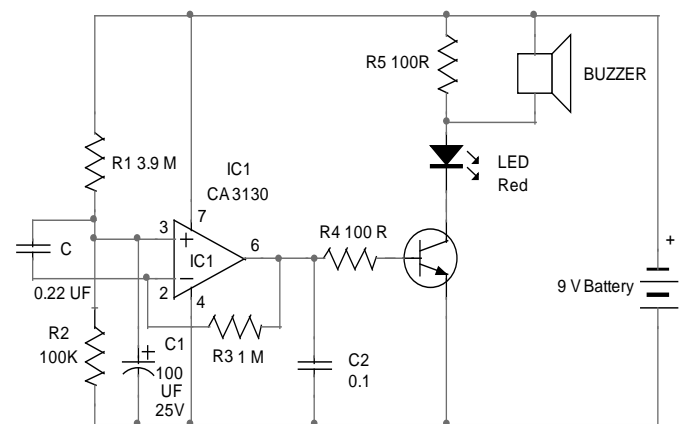


Fig.4. Sniffer Circuit.

Another sniffing circuit (fig. 4) different from [1] was simulated. The performance of the circuit was observed from simulation for various RF signals ranges from 900MHz to 2.2GHz. The sniffer circuit detected incoming and outgoing signals with a delay of 1 minute. It was also noticed from the performance of this sniffer that apart from resistor values that were not the same as the earlier sniffers discussed, the sniffer circuit of fig 1.5 also made use of IC1 CA3130 with capacitor 0.22uF common to all of them. It is important to note here that most of the past models were using IC1 CA3130 with various modifications in their circuit, and

most are detecting in the range of 1.5m to 3m according to their performance analysis. From all the sniffer circuit simulations, the conclusion can easily be drawn that the best design so far for the development of cell phone sniffers is the circuit of fig 1 with IC LMH6702MA, the buzzer (alarm) section could be included in case of noisy environment while the LED will be useful for silent zones like confidential meetings, examinations halls and others. The circuit of fig 3 was chosen as being capable of meeting the goals of the sniffer design for this research work.

information about the detected signal will be displayed on the LCD.

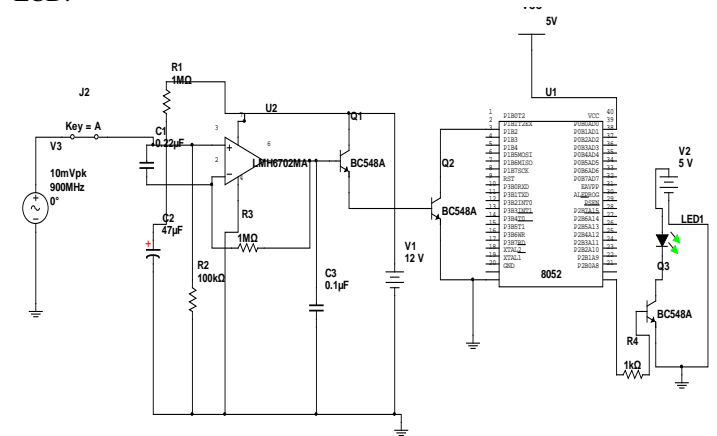


Fig. 6. Sniffer circuit diagram with microcontroller

### Performance Explanation of the Design

Some instruments were used to test for the effectiveness, reliability and performance of the sniffer in Multism 11.0. These instruments were: oscilloscope, frequency analyzer, spectrum analyzer and bode plot.

### Simulation Parameters

Figure 7 shows the generated radiofrequency waveforms as captured on Multism while Figure 8 is a capture of the signal obtained when the developed phone sniffer was tested with the oscilloscope when using the mobile phone. This represents the output waveform of the device when there was mobile signal transmission.

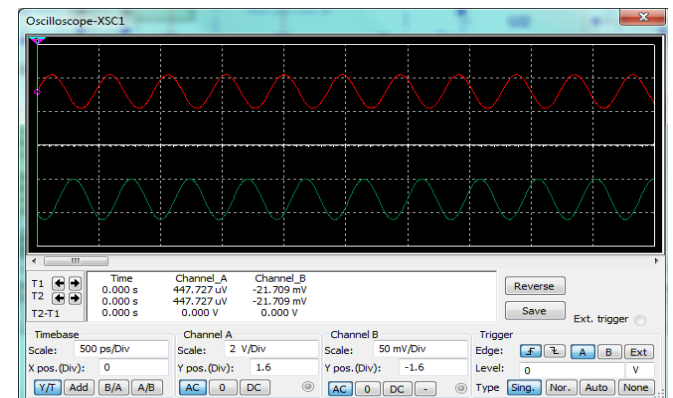


Fig.7. Oscilloscope showing the input and output nature of the signal.

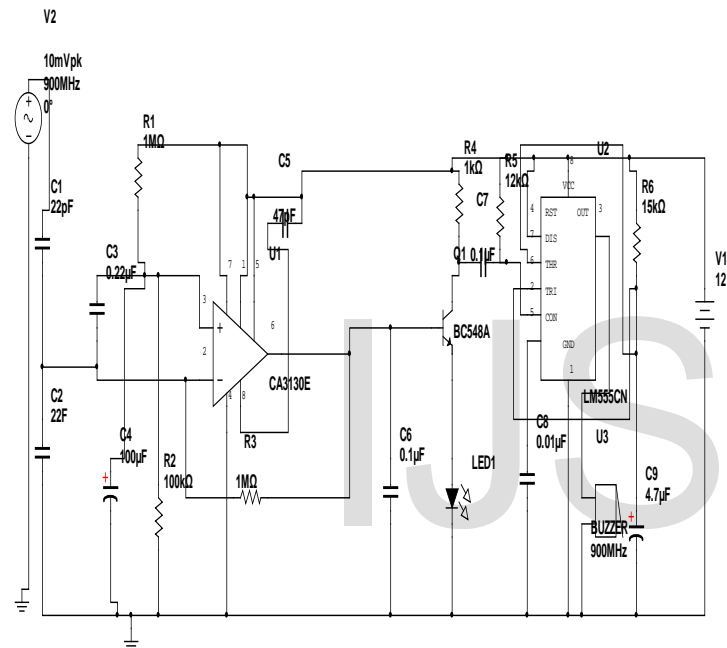


Fig.5: The developed sniffer circuit with buzzer

For this research work, the objective is to improve the performance of the sniffer by increasing the coverage radius of the sniffer (range) from between 1.5m to 3m as claimed in report to about 6m. Additional improvement is on how also to locate the actual location of the mobile cell phones in active mode within the proposed designed range and to improve on the sniffer's efficiency in terms of reducing the cost of development. The control of the sniffer activities was achieved using microcontroller, intel8051series (Atmel 89c52) for single and multiple cell phone sniffers. The code written is uploaded into the microcontroller to control blinking rate of LED1, and also to control the length of time for the buzzer to sound. The microcontroller is also used to power the liquid crystal display (LCD) to display some information like "PHONE SNIFFED POSITION D". The microcontroller has about four ports for the four sniffers to be connected such that each sniffer can be programmed at various positions to monitor an entire region in case the area may be too large for a single sniffer to cover. When users are putting ON the cell phones or when putting it OFF, during calling, receiving calls or sending and receiving SMS within the range of the developed sniffer, the location and

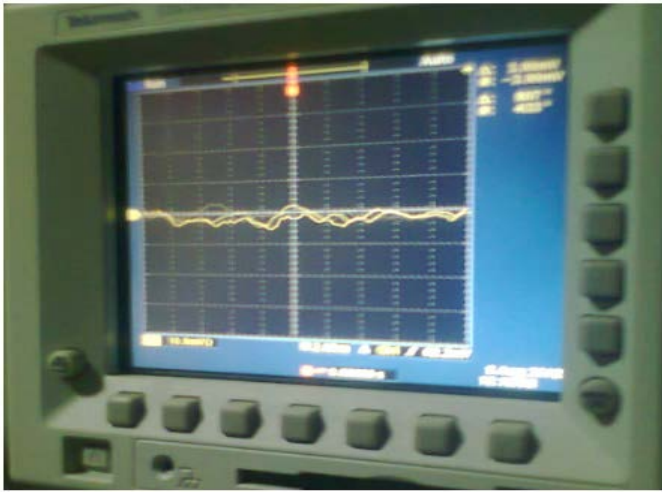


Fig.8. Signals produced by the developed sniffer with mobile phone

The source signal at the input of an amplifier is usually provided by a receiver and its power is relatively small. The RF designer often intends to magnify the input signal and provide an output signal in form of both voltage and current: that is, the output power delivered to the load is considerably higher than that of the input signal. The power transferability of the designed circuit is therefore of interest and the average power gain (APG), total power gain (TPG) and voltage gain (VG) are captured in fig 9 – fig 16

**Impedance**

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 match. Using network analyzer in Multism, the impedance of the sniffer circuit was determined. The result is captured in figure

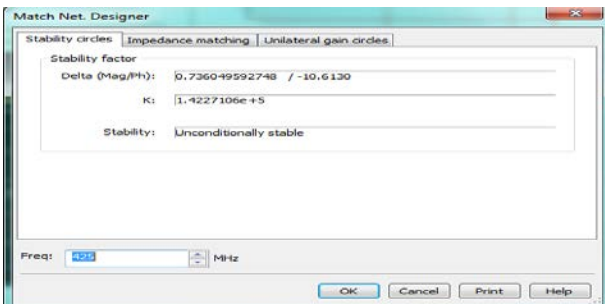


Fig. 9. Network analyzer for Match Net. Designer (stability circle)

**Stability**

Stability circles figure 9 is used to analyze the stability of the sniffer circuit developed at different frequency points. 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. P1 and P2 represent the input and output stability of the circle respectively, the K stability here was 1.4, In this case the sniffer circuit developed using the op-amp CA3130 is said to be “unconditionally stable”.

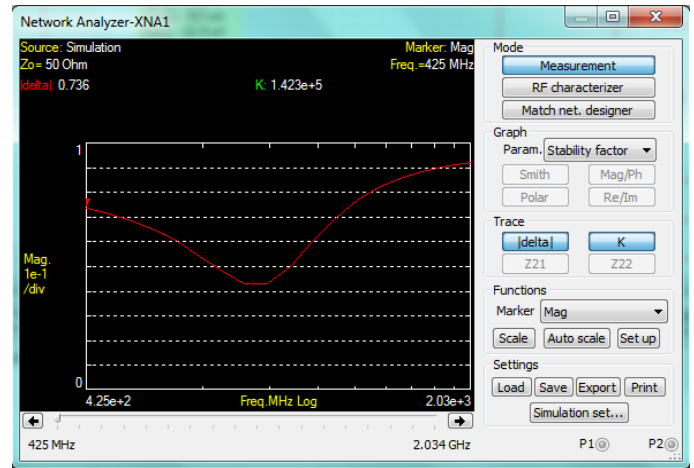


Fig. 10. Network analyzer for Rowlett’s stability (K)  
 From the result obtained for Rowlett’s stability (K) shown in figure 10, the Op- amp to be used in the designing of the sniffer is said to be unconditionally stable.

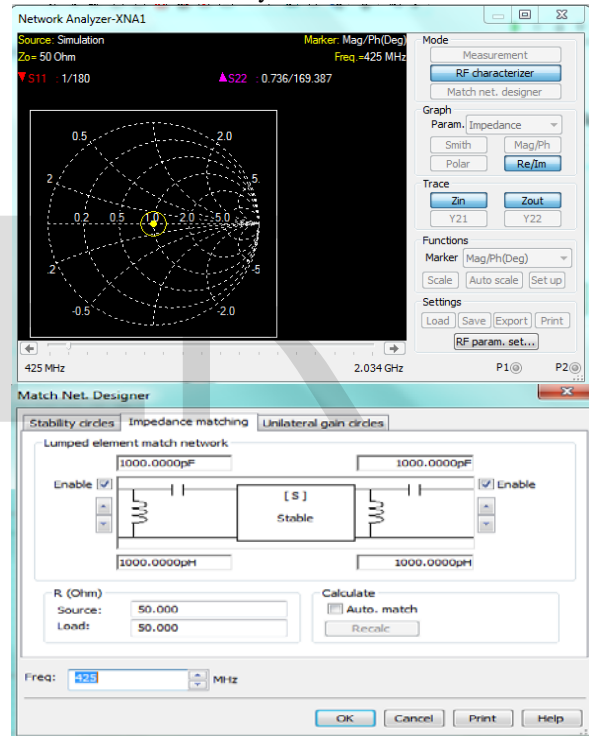


Fig.11. Network analyzer for Match Net. Designer (impedance matching)

The designed sniffer using the Op –amp CA3130 is considered “unconditionally stable”, meaning the amplifier does not oscillate in the presence of any passive load or source impedance. In this case the impedance matching option can be used to automatically modify the structure of the RF amplifier to achieve maximum gain impedance for the sniffer to be developed.

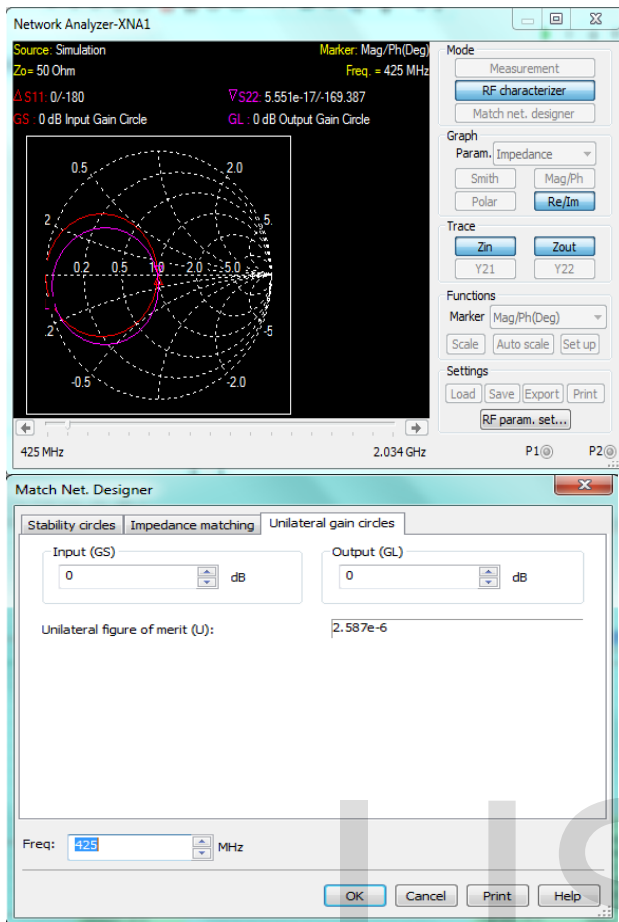


Fig.12. Network analyzer for Match Net. Designer (unilateral gain circles)

This figure 12 of the result was used to analyze the unilateral property of the sniffer circuit developed by the sniffer circuit. Here the transistor used in my design 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.

### Spectrum Analyzer for the Sniffer Circuit

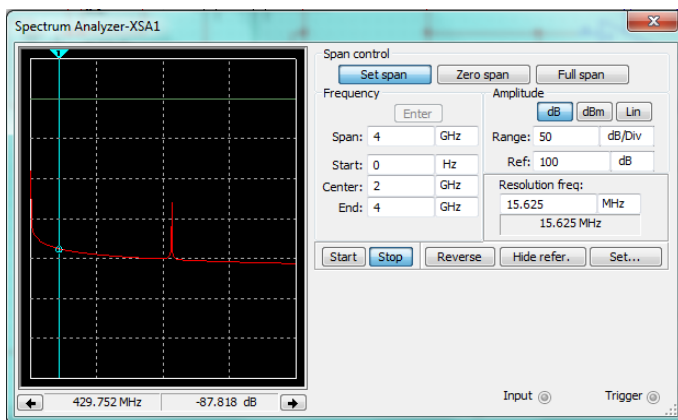


Fig.13. Spectrum analyzer (Amplitude in dB) versus frequencies

The Bode plotter produces a graph of a circuit’s frequency response, signal’s voltage gain or phase shift. (Voltage gain, in decibels)

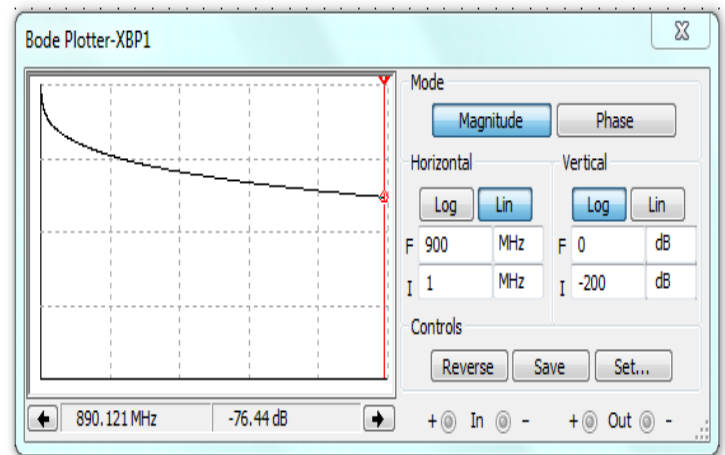


Fig.14. Bode plotter for frequency versus voltage gain in magnitude.

The result figure 14 shows the nature of the graph generated when 890.121MHz of GSM frequency range sent through the sniffer circuit the voltage gain in decibel at this point was -76.44dB.

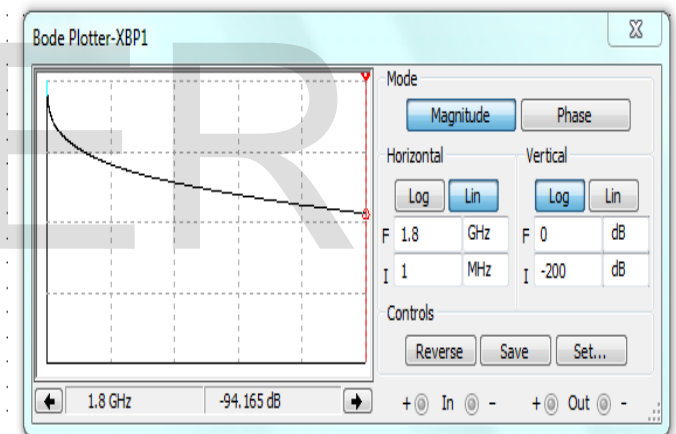


Fig.15. Bode plotter results for the sniffer gain in magnitude.

The result figure 15 shows the nature of the graph generated for frequency versus gain in magnitude when 1.8GHz of GSM frequency range sent through the sniffer circuit the voltage gain in decibel at this point was- 94.166dB.

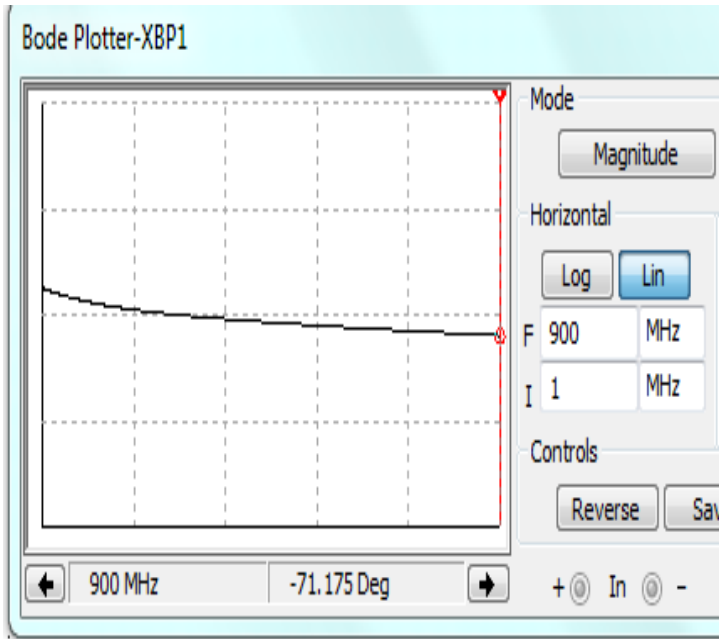


Fig.16. Bode plotter results for the sniffer gain in phase.

The result figure 16 shows the nature of the graph generated for frequency versus gain in phase when 0.9GHz of GSM frequency range sent through the sniffer circuit the voltage gain in phase at this point was -71.175Deg.

## CONCLUSION

Multism 11.0 power probe was used to develop a cell phone sniffer circuit that is capable of sniffing active mobile phone signals of different brands during different activities of mobile phones. Efficiency of this sniffer circuit developed in terms of delay time before sniffing cell phone activities as compare to former models is far better; also in terms of cost it is cheaper. The developed sniffer circuit can be employed in developing the hardware sniffing system that will be capable of sniffing any brand of signal coming out of cell phone during activities within restricted area where the use of mobile cell phones is not allowed. Such restricted areas include banking hall, conference venues, companies, examination halls, religious places like mosques, correctional facilities (prisons), etc. If this solution is implemented, it would greatly reduce the risk of cellular phones getting into secure facilities. Businesses and government would save a lot of money on security. The solution would also greatly reduce the risk of data leakage and loss of revenue.

## REFERENCES

1. Berkeley Varitronics Systems, Wolfhound Cellphone Detector”, Accessed March, 2010. Website <http://www.bysystems.com>
2. Cell Phone Detector”, Circuit-Projects.com Quality Circuits Archive. Accessed March, 2009. Website <http://www.circuit-projects.com/rf-radiofrequency-circuits/cell-phone-detector.html>
3. EVI Technology, Detecting and Locating Cell Phones in Correctional Facilities” LLC June 2007, Accessed February, 2010.
4. ITT Technology , “Detecting and Locating Mobile phones in Correctional Facilities”

(2001) Archived //www.webcitation.org/5yRQRGPgH001. Retrieved 5 May 2011.

6. Kainka, B., (2002). “Mobile Phone Sniffer”. Available at <http://www.electronics-circuits.net/mobile-phone-sniffer-vt39.html>

- 7. Lawal W. and Ogunti E.O., Effects of Unrestricted Mobile Phone Usage in Selected Public Places in Nigeria: a case Study of Akure. Book of proceedings, 4<sup>th</sup> International Conference on Engineering Research and Development (ICERD 2012), University of Benin Nigeria. (conference proceeding)
- 8. “Mobiles fall prey to hack attacks”. *bbc.co.uk*. <http://www.bbc.co.uk/news/technology-13013577>. Retrieved 20 April 2011.
- 9. Nicholas W. Scott study of cellular phone detection techniques Lincoln, Nebraska. April, 2011
- 10. Wannurul, N.B., Phone sniffer: application in silence zone, undergraduate project, Universiti Teknologi, Malaysia. 2011
- 11. Shannon, V., “iPhone Must Be Offered Without Contact Restrictions, German Court Rules” (in English). *TheNewYorkTimes*. <http://www.nytimes.com/2007/11/21/technology/21iphone.html>. Retrieved 2 February 2011.
- 12. The Wireless Association. Contraband Cell phones in prison. [http://www.ctia.org/advocacy/policy\\_topics](http://www.ctia.org/advocacy/policy_topics). Retrieved 9 February 2011
- 13. U.S. Department of Energy “Cell Phone Detection Techniques”, 2007. Accessed January, 2010. Website <http://inspire.ornl.gov>
- 14. Cell buster, Cell Phone Detector” INC 2004 Accessed September, 2008. Website <http://www.cellbusters.com>

## AUTHORS DETAILS

Author Lawal Wasiu is currently a Lecturer at the Department of Electrical and Electronic Engineering, Rufus Giwa Polytechnic Owo Ondo State, Nigeria  
[awwalawwal@yahoo.com](mailto:awwalawwal@yahoo.com), PHN+23408066746750

Co-Author Dr Ogunti E.O is Currently Senior lecturer at the Department of Electrical and Electronic Engineering, Federal University of Technology Akure, Nigeria  
[oguntig@gmail.com](mailto:oguntig@gmail.com) PHN+23408166273397