Fully-Integrated Energy Harvesting Mobile Antenna Based on GSM 1.8 GHz and Wi-Fi 2.4 GHz

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CERTIFICATE OF CORRECTIONS & APPROVAL

Certified that work contained in this thesis titled " Fully-Integrated Energy Harvesting Mobile Antenna Based on GSM 1.8 GHz and Wi-Fi 2.4 GHz ", carried out by GC Adnan Rafique, GC Anees Rasool, GC Umaid Altaf and GC Abbad Rauf under the supervision of Dr. Zeeshan Zahid for partial fulfillment of Degree of Bachelors of Electrical Engineering, in Military College of Signals, National University of Sciences and Technology, Islamabad during the academic year 2019-2020 is correct and approved. The material that has been used from other sources it has been properly acknowledged / referred.

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Dedicated to our exceptional parents and adored course mates whose tremendous support and cooperation led us to this wonderful accomplishme

Fully-Integrated Energy Harvesting Mobile Antenna based on GSM 1.8 GHz and Wi-Fi 2.4 Ghz

By

Dr. Zeeshan Zahid

Abstract

RF energy harvesting is one of the various areas in which research is still ongoing. RF electric waves used by devices can be harvested and used for efficiency. This paper demonstrates the efficiency of power harvesting using Circular Polarized Antenna and voltage Doublers to harness that power and convert it into DC voltages to use for self-charging Mobile self. In this project, the development of an energy harvesting mobile antenna is also described, based on research conducted by Dr. Zeeshan. for the purpose of charging a portable cell phone battery from an RF signal available at the nearest BTS (Base Transceiver System) continuously. It should be noted that in the construction of an antenna given bandwidth requirements and display levels it is necessary to develop uniform networks to improve antenna performance and help increase radiation and reduce the loss of response to the desired frequency. Finally, the antenna is designed without network comparisons and, tested by a network analyzer using software called HFSS (High-Frequency Structure Simulator). By making many changes to our Circular Polarized Antenna reference design we have integrated our antenna to operate at our desired GSM band 1800 MHz and 2.4 GHz Wi-Fi band and achieved high power output from the harvested RF power. With the addition of a modified version of the schottky diode-based voltage in the region we reach a high input power of RF. Antenna performance and simulation learned by HFSS software (High-Frequency Structure Simulator). Circuit performance is learned through the software Proteus 8 Professional.

Key Words: *HFSS, Energy Harvesting*

Table of Contents

List of Figures

List of Tables

Chapter I

INTRODUCTION

Wireless devices running on battery devices these days have the following difficulty:

- Maintenance is required for the charging of mobile phone batteries.
- The charger must be carried at all times.
- Increase battery usage.
- Using of non-rechargeable energy sources.

An effective solution to the above problems discussed is considered to be, and this - "the extraction of external sources – this technique is known as" energy harvesting ". The most widely used and widely used outdoor is wind, solar, vibrate, thermo-electric, temperature-gradient, radio-frequency (RF), acoustic, etc. Significant improvements for the less power Wireless electrical equipment is also a main factor in such RF driving technology.

In this paper, we focus on the technology of generating energy from electrical energy. Radio waves are everywhere the signal transmission of TV, radio, telephones, etc. Artist trumpets are an important element in the telecommunication systems for transmitting Radio Freq power over KW. When dealing with mobile communications, very small milli-watts of RF power are removed from the atmosphere like the sensitivity of high-end telephone receivers is very high. A major factor in this reduction is the transmission of material (i.e. barriers) in the RF wave path and the loss of energy in the form of heat in the building materials. Many wireless devices, such as cell phones, use a few milliwatts of power from microvats in their sleep / active mode. So using a scavewering cycle, we can quickly affect the RF power is available at the outdoor environment and can be used this power to operate mobile phones. Now, we can look at our proposed cycle to achieve such a task.

1.1. Mobile Antenna Theory

Mobile phone antenna design is a logical complexity. There are network requirements and control requirements. In addition, each phone has several horns:

- Basic mobile antenna (transmits and receives)
- Variety of Cellular Antennas
- G.P.S antenna (Find only)
- Wi-Fi antenna (transmits and receives)
- N.F.C antenna

Let's start by talking about the basic mobile antenna because we have proposed our project on the GSM antenna.

1.1.1 Basic design of Cellular-Antenna:

The main cellular antenna is the one main communication antenna at the mobile phone, so it is very important. This antenna is usually the only mobile antenna to be transferred, so it has many features and requirements. The requirements for the transmission part of the main cell antenna are:

1.1.2 S.A.R (Specific Absorption Rate):

S.A.R is basically the measurement of the body ability for detection when a phone is moving and has high power. Minimum absorption e.g. is less than 1.6 mW / g [greater than one] and less than 2 mW / g. The position and type of antenna can significantly affect S.A.R values, and you cannot sell your phone if S.A.R is too high. This has been approved by various governmental agencies around the world.

1.1.3 T.R.P (Total Radiated Power):

Cell phone dealing companies (Verizon, China Mobile, AT&T, etc.) set a certain amount of output power (T.R.P) for each frequency band supported by the phone. In addition, T.R.P has specs where the phone is placed over the toy head. T.R.P is the function of transmitting radio power through the antenna power.

Accepting the requirements of the main cell antenna:

1.1.4 T.I.S (Total Isotropic Sensitivity):

In addition to TRP, cell carriers maintain a minimum specificity of the number of isotropic nerves (T.I.S) for each cell in which the cell normally operates. Similar to T.R.P, there are T.I.S indicators when the phone is attached to the toy head. T.I.S is a function of effective radio sensitivity, efficiency of young people and gentleness.

We need to know how often the antenna works. The main cell phone antenna is usually a low bandwidth (somehow in between 0.7 and 0.96 GHz), and a highband (somehow in between 1.71 and 2.7 GHz). Most of the cell phones support the following band combinations / frequency:

GSM - GSM900, GSM1800, LTE (4G) and many more.

The number of band frequencies increases every year. A telephone made for the Pakistani market can only support standard bands defined by mobile service providers. Some companies are trying to develop global telephones that support all bands, severely disrupting the antenna design.

Note that the transmission waves are on the edge of the band, by detecting the waves on the upper edge of the band.

The location of the original mobile antenna is almost the same at the end of the app. The reason for this is because of the S.A.R requirements and because the T.R.P network carries it when placed on a mannequin head (can be called as "head spec"). We'll show you the "headache" problem now. Suppose the antenna displays a T.R.P of 20 dBm (this is 0.100 uW). This means that T.R.P is 20 dBm when the wire is disconnected on its own (zero loss because of human body). If the phone is measured near the human head, the T.R.P will drop due to implants in the human body. Installation will be less if the basic cell antenna is below or at the end of the fence, because the antenna bulk will be far from the head.

For radiation active in the frequent sounds of a mobile phone / cell phone, the antenna must be the size of the entire machine. This means that the antenna is not a removable object, but uses the entire phone structure to make the antenna.

1.2. Definitions:

1.2.1 Polarization:

Polarization can be expressed as the weekly oscillation direction of the electric field. Mobile Communications: Rated Transmission Systems: Local Strength

1.2.2 Half Power Beam Width:

This term refers to antenna lubrication. H-P-B-W can be expressed by points in a horizontal and vertical diagram, indicating where the intensity of the radiation is half the amplitude in a large radiation wave. These points can also be called as 3dB points.

1.2.3 Propagation Pattern:

In many cases the scattering feature of the antenna can be explained by direct and indirect radiation drawings at high altitudes. Cellular communication is defined by the magnetic field (H-plane) and the electric field elements (H-plane). The most common description of a size 3 is to describe a complex antenna.

1.2.4 Gain:

Of course man cannot increase power with the advantage of an antenna. A non-profit antenna is powerful in every way. The acquisition antenna focuses power on a defined angular section of space of 3 dimensions. lamda / 2-dipole is used as a reference to describe a gain. In high frequency ensembles, the benefit is always defined as the reference to the isotropic radiator. The isotropic radiator is an ideal undetectable antenna with a feature of omnidirectional radiation on the plane and H-plane.
Receipt (with isotropic radiator dBi) = gain (relative to λ / 2-dipole dBd) + 2.15 dB The gain of the antenna is associated with the radiation aspect of the antenna. Profitability is measured by HPBW testing on horizontal and vertical planes (Fig.1).

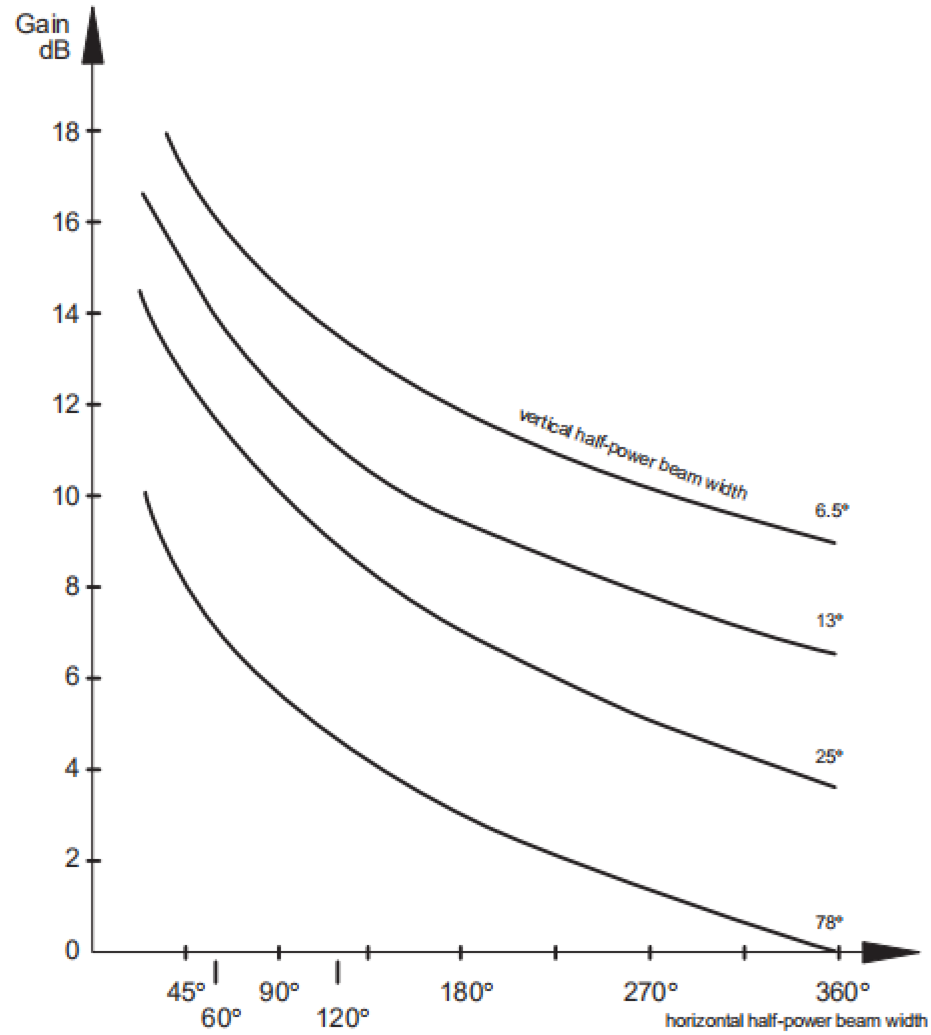


Figure 1.1: Half-power beam width vs Antenna gain

1.2.5 Impedance:

Frequencies based on the frequency of an antenna are usually adjustable by measuring or adjusting the frequency to meet the 50-ohm standard. Adjustments are found beyond the normal range using the reduction circuits.

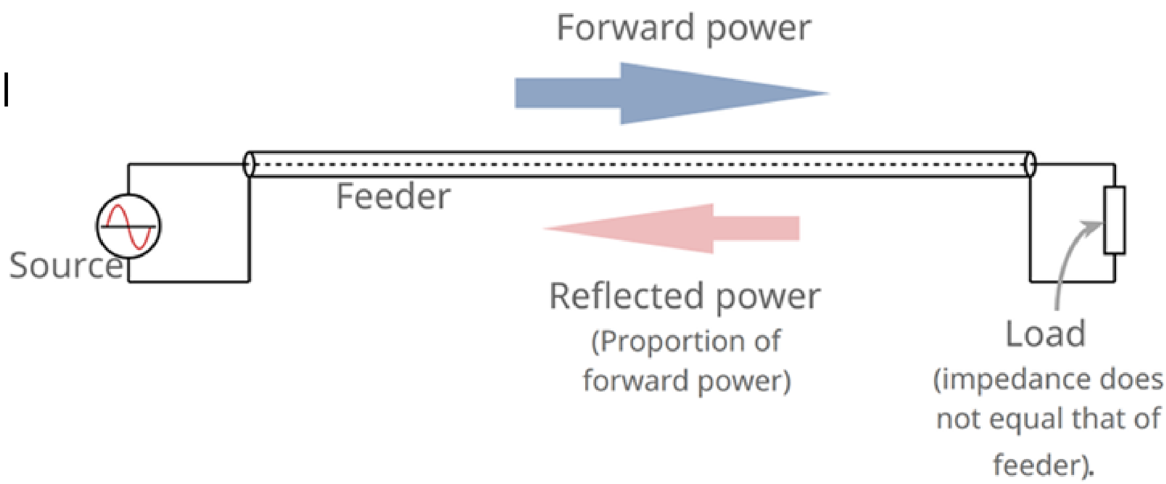
1.2.6 Mechanical properties:

Antennas are always placed on exposed sites. The outlet antenna should be designed to withstand the required equipment loading. Car antennas, for example, have to withstand high wind speeds, movement, saloon baths, and the need for minimal air noise. Antennas portable radio devices are often mistreated and sometimes played by the user.

The worms of the first station are subject to high power loads at high wind speeds, wrinkles, snow, ice, destructive weather, and the court.

1.2.7 VSWR / Return Loss:

A distortion of 50 ohms directly is found most commonly. VSWR defines how impedance varies from 50 ohm with a wide antenna. Due to this error, the power sent from the transmitter is no longer taken without damage. Part of this energy is reflected in the antenna and then returned to the transmitter (Fig.2).



$$VSWR = \frac{1 + \sqrt{P_{ref} / P_{fwd}}}{1 - \sqrt{P_{ref} / P_{fwd}}}$$

Figure 1.2: Reflection Coefficient, VSWR, Return Loss

Transmission and Restore Energy The corresponding electric current makes a vertical wave with minimum and maximum (Umin / Umax). This wavelength measurement (measurement of electrical potential) defines the antenna reduction rate and is measured in advance by a scale measurement of the antenna. 1.5 VSWR is common in mobile communications. In this scenario the actual component of complex disorder may differ between the following values:

Maximum value: 50-ohms x 1.5 = 75-ohms
Minimum value: 50-ohms: 1.5 = 33-ohms

The term Reimbursement has been used recently. The reason for this is that the voltage / UV / UV return rate can be measured with a direct coupler. This is defined as the co-operation of the pointer. Figure 6 shows the relationship between shape display, regression loss detection, VSWR and reflective power.

1.3. Base station antennas:

1.3.1 Omnidirectional Antennas:

1.3.1.1 Comparison of the ground plane and λ / 4 skirt antennas:

The Omni-directional λ / 2 antennas are of a ground plane or λ / 4 skirt-nature (Fig. 3).

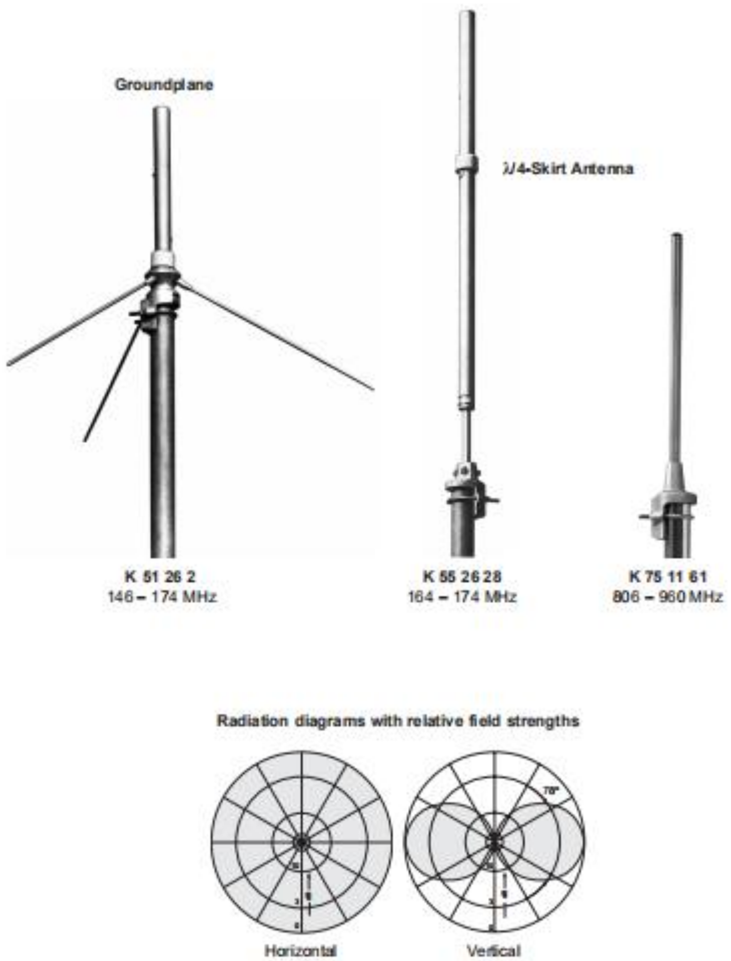


Figure 1.3: Groundplane and □/4-Skirt Antenna

The words show how the antenna is pushed out of the hole. In the first case, a light plane is available with three columns of counterweight, in the other case, decoupling is available using a λ / 4 skirt. m. The ground plane antenna, on the other hand, covers a wide range of absolute frequency because it is a wide antenna.

1.3.1.2 Side-mounted Omni directional antennas:

Unfortunately, it is not always possible to put one of the ants on top of a rope. This position does not always exist. The result is that the Omni direct antenna is unable to block our mounting, which leads to a major shift in the direct drawing. Mushroom range has a definite effect on radiation properties. If the distance is λ / 4, then the default setting is available, while the bi-directional drawing is the result if the mete-antenna distance is λ / 2 (see Figure 4).

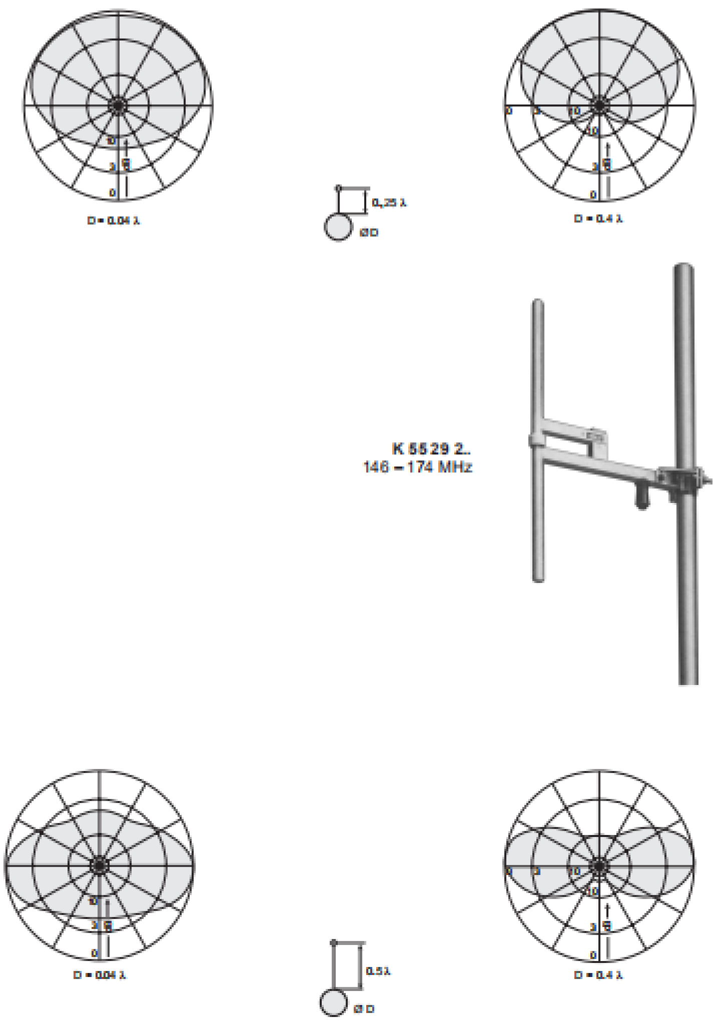


Figure 1.4: Offset Omni-Directional-Antenna

Therefore, the radiation drawing can be replaced by changing the distance of the antenna to give the space needed to cover. To achieve this effect, the ground plane or λ / 4 skirt selects the antenna relative We use a bracket arm or a bracket with certain brackets.

1.3.1.3 Omni directional antennas with gain:

The λ / 2 waterfalls discussed so far produce the same amount of energy in a piece of string in all azimuth directions (Fig.8). A strong vertical frame of 78 degrees. One can see that much of the energy goes up and down, resulting in much of the energy lost in the desired horizontal plane. Versions that are connected by a straight and vertical machine can be reduced by half the width of the power concrete far in the middle of the wavelength (Fig.5).

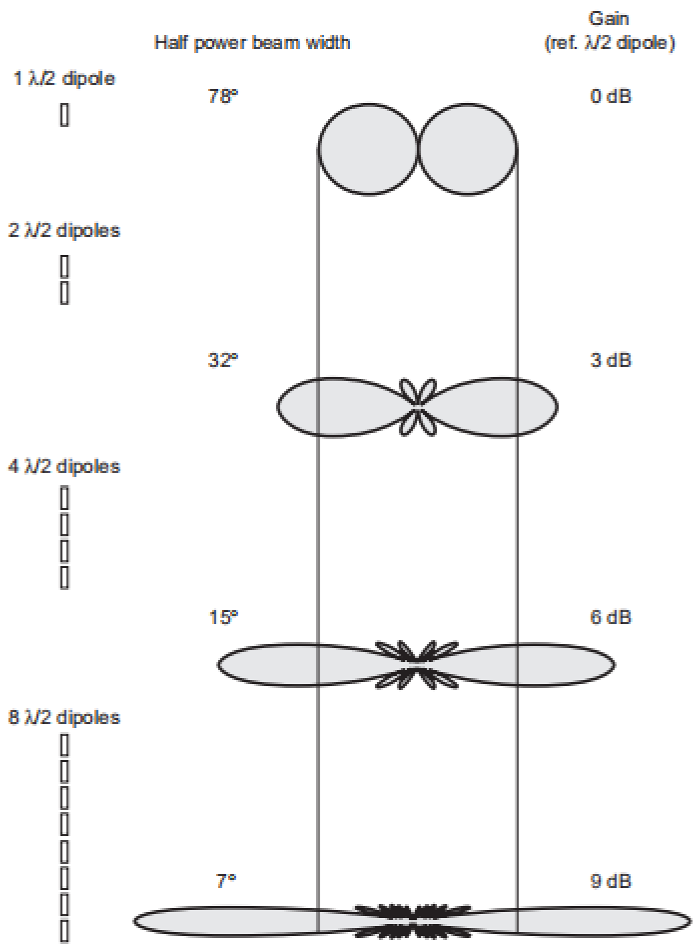


Figure 1.5: Gain via vertical beam

The result is an increase in radiation exposure in a horizontal plane. This increase is called profit, which is nothing more than digging into the energy of the directed radiation defined. Repeating the number of dipoles increases 3 dB (twice the power).

Fig.6 shows an example of a GSM-Gain antenna, which is connected by several comments inside a standard Fiber-glass tube.

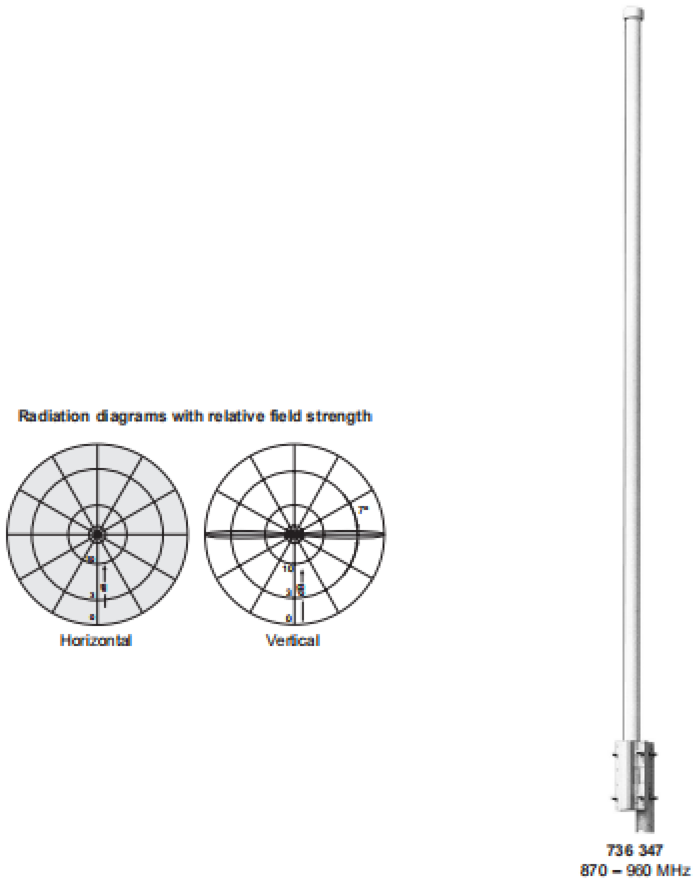


Figure 1.6: 9 dB Omni directional Gain Antenna

1.4. Antenna Systems:

Special applications that are not available using a single antenna are often accomplished with the combination of ants. The combination is made up of a few antennas and a distribution system (power separator and connected cable). Often the combination is designed to achieve maximum profit. Many different antennas can be used to achieve various corresponding radiation signals by changing the number of antennas, azimuth direction, space, phase, and power measurement. A semi-omni directional model can also be produced. The increase in the required antennas and the width of the tower. For example, eight 1.5 console panels are required at 900MHz. The radiation directed by Omni is not repetitive but is the result of one or two article production products. The calculation of such radiation patterns is determined by the amplitude of each antenna and the phase testing phase. The amplitude of each sample can be read from the database but only one step is called the antenna maker. However, segment is the most important aspect of the Calculator, because strict measurement using scatter only can lead to completely incorrect results.

1.5. Purposes

The main purpose of this project is to present and validate the results obtained from the construction of the available mobile circular antenna, as well as the renewable energy circuit to extract power from RF signals. The main objective is to introduce a circular antenna for mobile phones and to receive GSM signals with a bandwidth frequency of 1800 MHz and a Wi-Fi signals frequency of 2.4 GHz. This feed is commonly used and used as a feeder in the re-energizing circuit, and is used to amplify the feed supply to the voltage levels we need, and to convert the input into DC voltages. The power re-cycle is used to charge the battery of this removable mobile phone. This is done through the use of new antenna design techniques and to improve the proposed design by modifying the structure of the structure that defines the electric fields.

1.5.1. Specific Purposes:

The specific purposes of this thesis are:

- Understand the functionality of the proposed structures in the designs of the chiefs' novels and how they work to benefit our design.
- Build GSM cover and antenna cover for PCB mobile device device. Considering the new research and research phones, the space used in this project is a 70mm x 140mm triangle.
- Creating a real antenna model does not require short but extensive analysis to confirm the results of the simulation and, therefore, compare the results and highlight the differences in the model made.

1.6. TECHNOLOGY:

Based on the research of the novel and after reading it, the project takes two parts, the first dealing with the use and development of software in wing design, and the second dealing with software development.

1.6.1. Software:

1.6.1.1. HFSS:

HFSS is a state-of-the-art commercial solution from Ansys to electronics. Acronym is a structure for building high frequency. HFSS is one of the many marketing tools specially used for the design of antenna and the design of favorite radio frequency components which includes filters, lines of transmission and feeds.

This software was used to design the antenna for analytical purposes. We create our antenna design in this software and then before using it on the hardware we go through showing our required results. The advantage of using this software is that before we apply our design to Hardware we have unlimited options to test and make changes to our design as per the requirement of our desired results. Until we do not get our desired results we keep making software changes and when we get our required software results then we use this design on Hardware. In this way we use avoidance from the additional costs of our project to make and look over and over again using Hardware.

1.6.1.2. Proteus:

Proteus 8 Professional is software that can be used for schematics, PCB architecture, drawing code and even strategic measurements. If we want to check out our circuit diagram. Breadboarding is a great option, but it is easy to get confused if your cycle is large. We can try to create a PCB and test it, but it takes a lot of time and effort. A very good idea to imitate. We therefore use the physical configuration of our electronic circuit before launching this software. Because it gives us the benefit of imitation before making mistakes in Hardware, we have no choice but to make changes to the software. We have used this software for the construction of the scheme and we will discuss it in detail in the following chapters and its implementation to make the renewal cycle we have already discussed.

CHAPTER II

THEORY OF ENERGY HARVESTING AND RF SIGNALS

2.1. Energy Harvesting

Wireless or wireless electrical devices are becoming increasingly popular as they need to be connected to an electrical grid. As a result, in industrial and domestic areas many devices are powered only by batteries and the connecting cables are primarily designed to recharge the battery. Battery makers have greatly improved battery life, however, they need to be repaired from time to time; And thousands of operating hours should be added to the battery cost. Also, exhausted batteries produce waste that needs to be recycled. Today, the prices of lending on raw electronics are increasing, and in order to be "green", the electronic system must be efficient, efficient and compliant with the three R rules: reduction, recycling and recycling. With the increase in copper prices for many years, that does not help. However, worldwide, theft of copper wire has become a major problem. Therefore, wireless electronics faces many technological and environmental challenges, such as green power and efficiency of battery charging times, increasing number of system autonomy and long battery life, load models and transmission cycles. . In this regard, Energy harvesters have been one of the most effective and efficient ways to extract energy from the environment and face some of the above challenges. Harvesters are electrical devices that inherit the same principles and structures as electrical transducers. Therefore, they are transducers designed to draw not only a pattern of energy from the physical universe, but also high energy. Energy harvesting systems can extract energy from sources located in industrial areas or elsewhere. Vibrating equipment, radiation, natural light or input, sound, air or liquid. Thereafter, this energy is used to feed and maintain electrical equipment. The main purpose of energy harvesting is not to generate large amounts of energy but to save untapped energy and use it in the day-to-day operation of the electronic system. Therefore, the standard operating mode of the energy harvesting system should be harvested during energy costs, while the final equipment must meet demand and supply within the allotted time. In summary, the main objectives of energy conservation are:

• Save and / or extend function
Low cost
• Easy installation
• Remove or decrease reliance on terry batteries
• Reduce litter
• Remove power cords
• Increase life expectancy

There are three main components of a common investment plan:

• The reaper
• Low power management
• Low energy storage system.

The process begins with a divorce that removes energy from the environment. After that, the power control system converts the measured power into a standard, efficient and electric system. Ultimately, the final plan will save a lot of energy. The current research work classifies and analyzes the technologies of different electrical manufacturers, their physical and / or chemical performance, technological maturity, their performance and uniform electrical distribution. At the same time, this function provides application examples.

Energy Harvesters Technologies

There are many technologies that increase table power The diagram summarizes the state of the plant technology and classifies them according to their level of behavior, operating mode, energy efficiency, system efficiency, state of technological development, and signal production type. This energy-enhancing technology is described in more detail in the following sections.

Harvester	Physical/Chemical Operation Mode	Power Density	Efficiency (%)	Mature/Emerging	References
Photovoltaic effect	**Photovoltaic**	Outdoors: 15 mW/cm^2 Indoors: 10–100 $\mu W/cm^2$	Until 40	Mature	[17,32,33]
Piezoelectric effect	**Piezoelectric**	330 $\mu W/cm^3$ shoes insert	Until 30	Mature	[17,18,32]
Electromagnetic law	**Faraday's**	Human: 4 $\mu W/cm^3$ @ kHz Industrial: 306 $\mu W/cm^3$ @ kHz	Until 67	Mature	[18,33]

Vibration-dependent Electrostatic capacitors		50 μW/cm^3 to 100 μW/cm^3	9.5–23.6	Emerging	[17]
Pyroelectric	**Olsen cycle**	3.5 μW/cm^3 at the temperature rate of 85 °C/s @ 0.11 Hz	1–3.5	Emerging	[32,34]
Thermoelectric Seebeck effect		Human: 100 μW/cm^3 Industrial: 100 mW/cm^3	10–15	Mature	[15,17,32]
Harvester	**Physical/Chemical Operation Mode**	**Power Density**	**Efficiency (%)**	**Mature/ E merging**	**References**
Magnetic	Ampere, Maxwell, and Faraday laws	1.8 mW/cm^3 with 400 A at 4 cm from conductor	0.1325	Emerging	[18]
RF	Ubiquitous radio transmitters	GSM: 0.1 μW/cm^2 WiFi: 0.01 μW/cm^2	50–70	Mature	[15,34]
Wind and Water	Faraday's law	1.16 mW/cm^3 at the speed of 5 m/s 4.91 μW/cm^3 at the speed of 3 l/s	0.61–17.6 1.7–29.5	Emerging in small scale	[30,32,33]
Acoustic	Helmotz effect	1.436 mW/cm^2 at 123 dB	0.012	Emerging	[31]

Table 2.1: Summarized characteristics of Current "Technologies" of energy Harvesting.

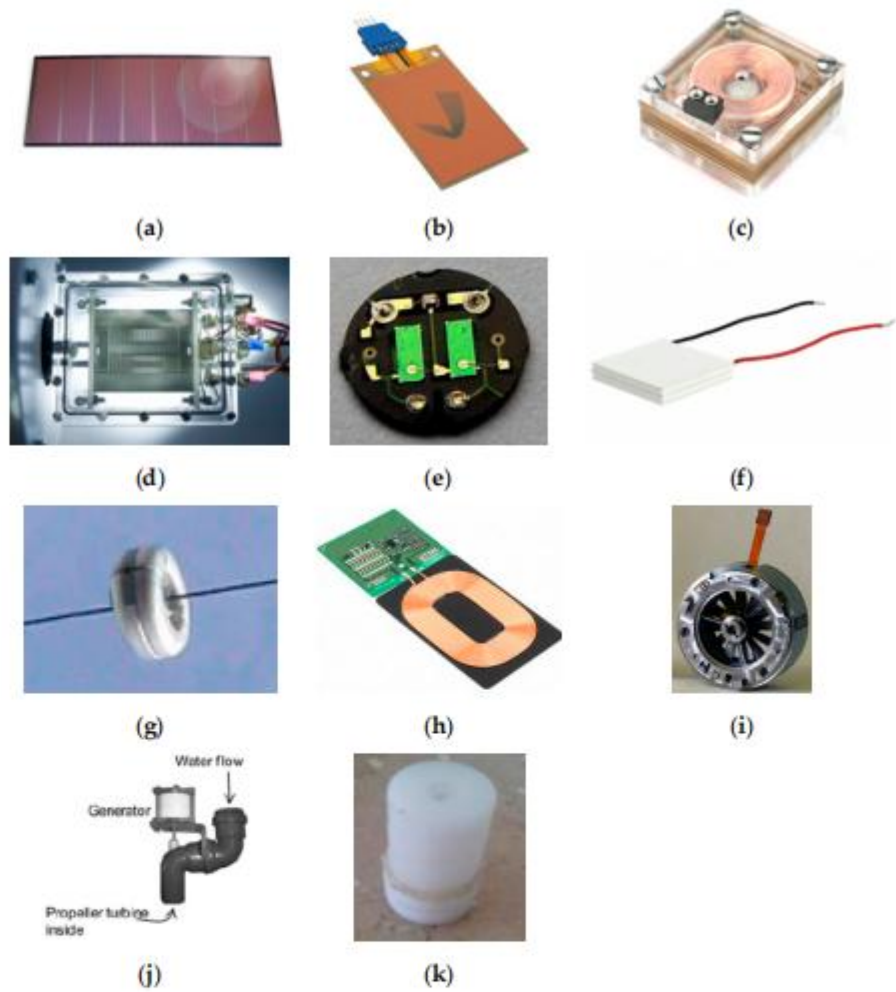


Figure 2.1: Energy harvesters technology. (a) Photo-Voltaic; (b) Piezo-Electic; (c) Electro-Magnetic; (d) Electro-Static; (e) Pyro-Electric; (f) Thermo-Electric; (g) Magnetism; (h) Radio-Frequency; (i) Air-Flow; (j) Liquid-Flow; (k) Acoustic-Sound.

2.2. RF Signals:

Radio-waves are the types of electromagnetic radiation known to be used in communication technologies including television, cell-phones and radios. These devices detect radio waves and convert them into vibrations mehendi on the speaker to create sound waves.

The RF spectrum is a very small part of the electro-magnetic/EM spectrum. The E-M spectrum has been divided into seven regions to reduce wavelength and increase power and frequency. RF radiation, micro-wave, infra-red (IR), bright-light, ultra-violet (UV), X-rays and regular gamma rays.

The radio waves keep long flats within the EM spectrum, ranges from about 1 millimeter/0.4-inches to sixty-one miles, according to NASA. There are also low-frequency monkeys with up to 3,000 wheels per second, or 3 kHz, three billion hertz, or three hundred GHz.

Radio broadcasting is limited compared to limited resources and farm. Farmers should manage their land in such a way that they get the highest yields in size and variety and separate the radio from consumers with great success. The U.S. E-Commerce Division, the National Telecommunication and Information Administration regulates the distribution of frequencies in line with radio.

The National Telecommunication and Information Administration generally classifies radio into nine categories:

Band	Frequency range	Wavelength range
Extremely Low Frequency (ELF)	<3 kHz	>100 km
Very Low Frequency (VLF)	3 to 30 kHz	10 to 100 km
Low Frequency (LF)	30 to 300 kHz	1 m to 10 km
Medium Frequency (MF)	300 kHz to 3 MHz	100 m to 1 km
High Frequency (HF)	3 to 30 MHz	10 to 100 m
Very High Frequency (VHF)	30 to 300 MHz	1 to 10 m
Ultra High Frequency (UHF)	300 MHz to 3 GHz	10 cm to 1 m
Super High Frequency (SHF)	3 to 30 GHz	1 to 1 cm
Extremely High Frequency (EHF)	30 to 300 GHz	1 mm to 1 cm

Table 2.2: Bands, Frequency Ranges and Wavelength Ranges

2.2.1. Low to medium frequency:

The smallest ELF radio waves in all radio frequency areas are long and useful for water and rock penetration in underground and underground communication in mines and caves. According to the Stanford of Very Low Frequency Group, lightning is a very powerful-source of energy for Extremely LF / Very LF waves. Lightning-producing waves invade and return between

Earth and the ionosphere (a powerful layer of atmospheric ions and free electrons). This lightning distortion distorts important radio signals that travel to satellites.

According to the RF page, LF and MF radios include marine and aviation radio, as well as AM (amplitude modulation) radio. According to How Stuff Work, AM radio waves range from 535 kHz to 1.7 MHz. AM radio has a very long range of noise, especially at night when the ionosphere waves are good in reverse, but it is less of a disturbance that affects sound quality. When the signal is partially restricted - for example, by a wall-mounted structure such as a metal skirt - the volume can be reduced accordingly.

2.2.2. High frequency Punches:

H.F, V.H.F and U.H.F bands include F.M radio, broadcast television, community radio, cell-phones and G.P.S (Global Positioning System). These bands usually use "frequency modulation" (F.M) to insert or impress sound or data signal to wave carriers. In frequency change, the amplitude (maximum range) of the signal remains constant, but the frequency is higher or lower and corresponds to the signal or data signal.

Eagle F.M results in better signal quality than A.M, and ignores variability in the receiver receiver as long as the signal exceeds the minimum limit, because environmental factors do not affect frequency as they affect altitude. According to How Stuff Work, F.M radio enzymes fall between 0.088 GHz and 0.108 GHz.

2.2.3. Shortwave Radio:

The National-Association of Shortwave-Broadcasters (N.A.S.B) says Shortwave radio uses frequencies ranging from 1.7 MHz to 30 MHz in the HF band. At that point, the Shortwave show is divided into several categories, some of which are dedicated to mainstream broadcasters such as Voice of America, British Broadcasting Corporation and Voice of Russia. Globally, there are Shortwave station officials, according to the NASB. Shortwave channels hear thousands of miles because the barking signals come from the ionosphere and return hundreds or thousands of miles from their source.

2.2.4. High frequency:

SHF and EHF represent the highest enzymes in the radio spectrum and are sometimes considered part of the microwave band. Air molecules absorb these encryption frequencies, reducing their width and performance. However, their short medals allow signals to be placed on smaller machines with satellite antennas (satellite antennas). This allows for short-range short-circuit connections between fixed areas.

SHF, which is less sensitive to air than EHF, is used for short-range applications such as Wi-Fi, Bluetooth and wireless USB (Universal seri Bus). According to the RF page, SHF can only work on optical lines, as waves are more likely to blow up objects such as cars, boats, and airplanes. And as the waves hit things, the SHF can also be used for radar.

CHAPTER III

DESIGN AND DEVELOPMENT OF ANTENNA

3.1. Circular Polarization:

Electromagnetic polarization waves in which electromagnetic waves or the electric veeter form a circular wave path that is the pathway to propagation by the same wavelength. As shown in the figure below:

At the electric level, electromagnetic wavelength coagulation is a form of collision where, in each region, the electric field has a high directional force but its direction varies with a recurring rate in the pre-travel plane.

In electro-dynamics the power and direction of an electric field is defined by the vector of its electric field. In the case of a circular circle, as seen in the accompanying image, the digital icon of the electric field, somewhere in the area, defines the circle as time goes on. In any case, the electric field of metal indicates a point in the helix placed next to the scatter. The circular polarization wave can switch to one of two possible sensors: angle-angle polarization where the vect of the electric field rotates right to the scattering side, and leaves a circular polarization where the vein rotates to the left of the concept.

A variety of antenna devices can be used to emit cold circular radiation, which can be traced "Rotating and circular rotation can be achieved by using different feed arrangements or small rotations in objects ... Two orthogonal paths can be obtained with a 90 ° time difference between them. For example, an easy way to activate a split is. of the square section is obtained by eating the element by 90 with.

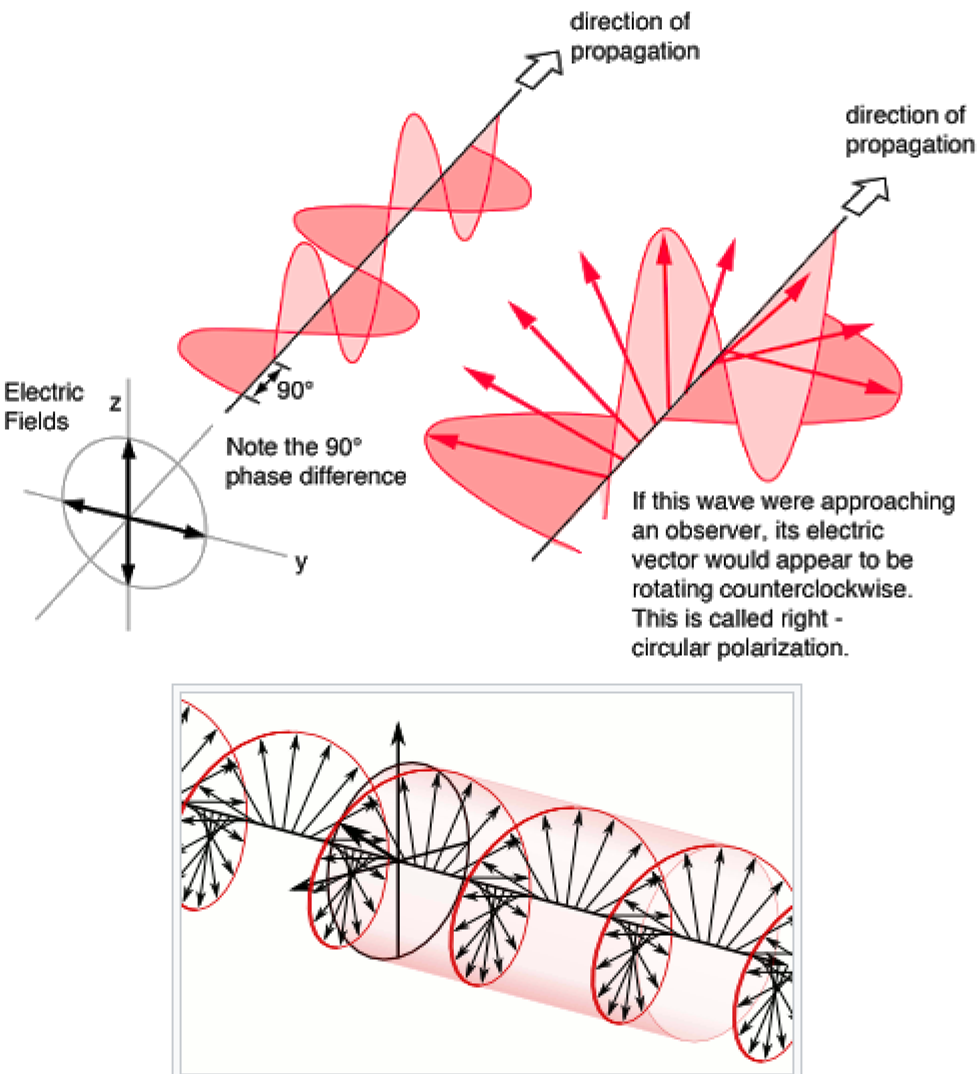


Figure 3.1: Circular Polarization

3.1.1 Circular Polarization Advantages:

Circular polishing has a few important advantages over direct coating, which makes it attractive:

3.1.1.1 Faraday Effect:

The Faraday effect deals with the interaction between light and magnetic field. It directly affects, but not rotates, polarized signals, and at lower frequencies the effects become more severe. When signals pass through the atmosphere they become polarized, leading to the negative reception of the opposing polarity. Compatible polarizing feeders aligned to attract Faraday effect, usually with the help of a tracking device; Adjustments can be made by rotating the feed system or by applying flexible polarization to the feed system. The layout must be perfect because it takes a lot of time. One result of the wrong order is an increase in distortion. Fortunately, this is not a matter of concern for circular rotation because accurate signal alignment is not required.

3.1.1.2 Atmospheric Conditions:

Circular polarity is highly resistant to signal deterioration due to weather conditions. These conditions create a change in signal transduction and affect the polarization intensity worse than circular polarity. A high-frequency signal that passes through the rain can cause signal emission and cause additional problems with rainfall. Moist clouds are also a factor; When the signal passes through the cloud system, it will increase to 1 dB. Water droplets can also have harmful effects on the feeding horn. An important point to note, however, is that the higher facial enzymes decompose faster, harder, and for longer than their normal counterparts.

3.1.1.3 Easy to Install:

All you have to do is make sure the satellite antenna is on the right track; Point and forward. This allows for faster rounding of feed feeds with minimal risk of false positives.

3.1.1.4 Higher Link Reliability:

There is a high reliability of the connection as there is a small risk of malfunction and interference. The Faraday effect does not affect transmission with circular polarization, so there is no need to adjust the configuration. Lastly, because the transmission is sent and / or received at different frequency ensembles, the interruption (cross-polarity) does not matter.

Our Antenna consists of three parts:

- Program implementation
- Monopole-Pole Type Antenna
- Loop-Type Element

3.2. Monopole-Type Antenna:

A monopole is a type of radio antenna that consists of a straight line, and is usually placed directly above the antenna area also known as the ground plane. The length of this antenna is adjusted from the frequency range used.
In our antenna this type of monopole faces the rotation of the circle. If we remove this part from our antenna where the same design will work as a covered line antenna.

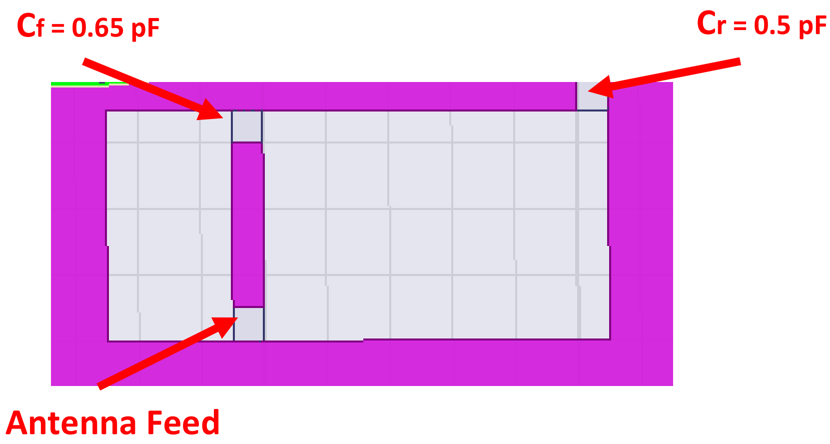


Figure 3.2: Monopole-type Antenna of GSM 1800 MHz

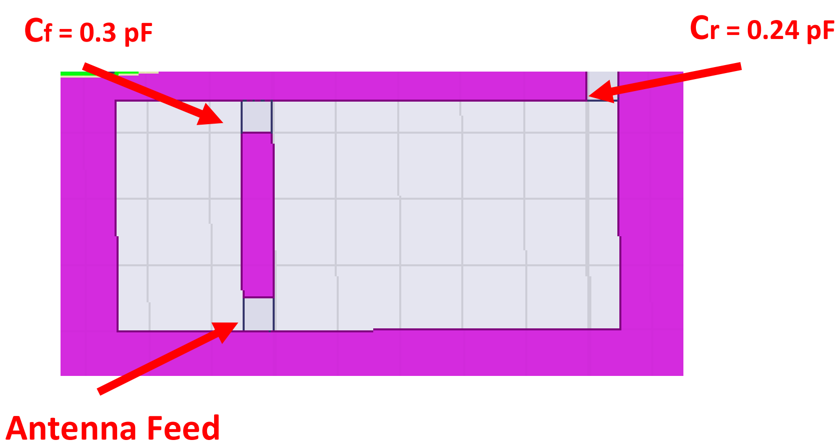


Figure 3.3: Monopole-type Antenna of Wi-Fi 2.4 GHz

3.3. Loop-Type Element:

Loop type object consists of two triangular loops called outer loop and inner loop. The outer loop is known as a resonance loop and is designed to incorporate triangular precision into a flying plane. Loop contains resonance capacitor Cr. The outside of the lab is used to control the frequency of the resonance on the antenna simply to say that this is used for the purpose of scanning the antenna.

There is another area known as the feed loop which is the internal loop, which contains a feed capacitor identified by Cf.

In the antenna Lf and Cf it shows the malfunction of the feed loop and the feed capacitor. The malfunction of the illuminated capacitor and the outer loop must be Lr and Cr.

Loop-Type Element

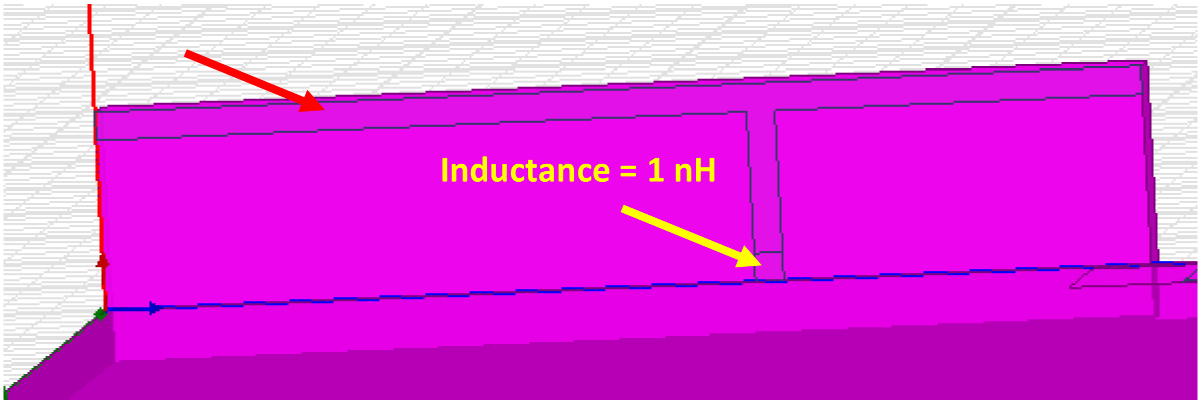


Figure 3.4: Loop-Type Element (Same for both GSM and Wi-Fi antennae)

Configurations of proposed Circular polarized antenna have been shown in the Fig below.

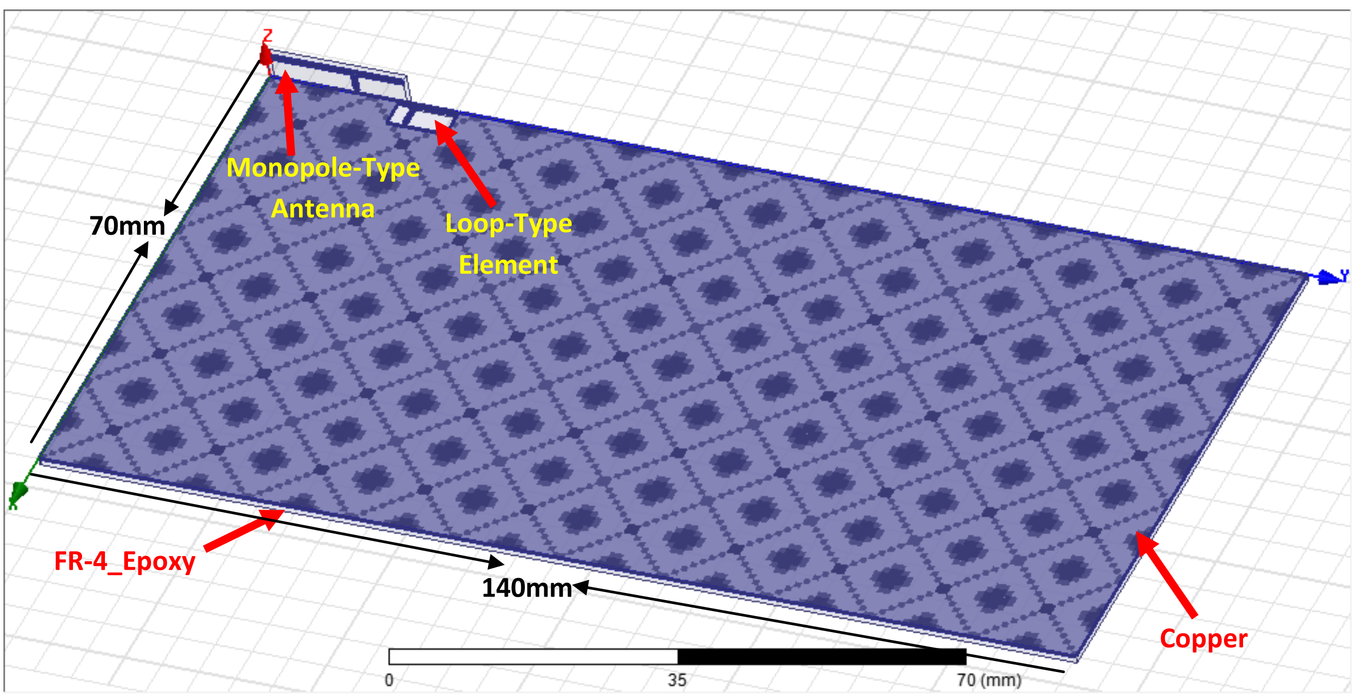


Figure 3.5: Top View (Same for both GSM and Wi-Fi antennae)

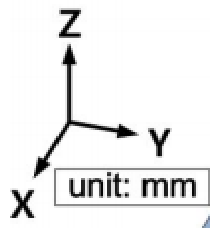


Figure 3.6: Axis notation for design of antenna (Same for both GSM and Wi-Fi antennae)

3.4. Specifications:

We built our antenna to work on the 1800 MHz GSM band and the 2.4 GHz Wi-Fi band. The purpose of this antenna is to receive GSM signals from nearby BTS or Wi-Fi routers from a nearby device (Router / Mobile hotspot). This will be used as an input circuit for regenerative power and then with the help of circuit reinforcement this input is adjusted and amplified to give us a DC output as an output.

The reference paper we used to design this antenna was specified in the design of 1.575 GHz and as the full descriptions of all parts of the antenna were described earlier, using the redesign techniques we redesigned our antenna to our required 1800 MHz and 2.4 GHz.
After doing a lot of work on it and hitting and trying we've got our desired results.
The desired results are shown as follows:

3.5. Results:

3.5.1. S11 Plot:

The S11 structure of the antenna outputs shows how much power the antenna is output and how much power is displayed on the back. The amount of energy emitted backwards from the antenna is known as coagulation and is expressed by S11. This is sometimes expressed using Gamma or loss recovery. It is calculated in dB's. If the S11 value is zero it means that the full power of this antenna is shown back and nothing is shown. But the fact is that our antenna works best when the antenna power is exhausted. It means that when the S11 building value is below zero our antenna shows power at a certain level.

According to this meeting if the S11 patch antenna plan shows a curve below -10dB then it works well. And when this curve drops to 10dB it shows that, the higher the antenna power is released.

As we have designed the mobile antenna, as with the mobile antenna assembly, the S11 building curve below 6dB is good enough.

Our built-in antenna works very well. If you look at the curve it will go beyond the limit.

The S11 structure of the GSM frequency antenna frequency 1800 MHz is shown in the figure below:

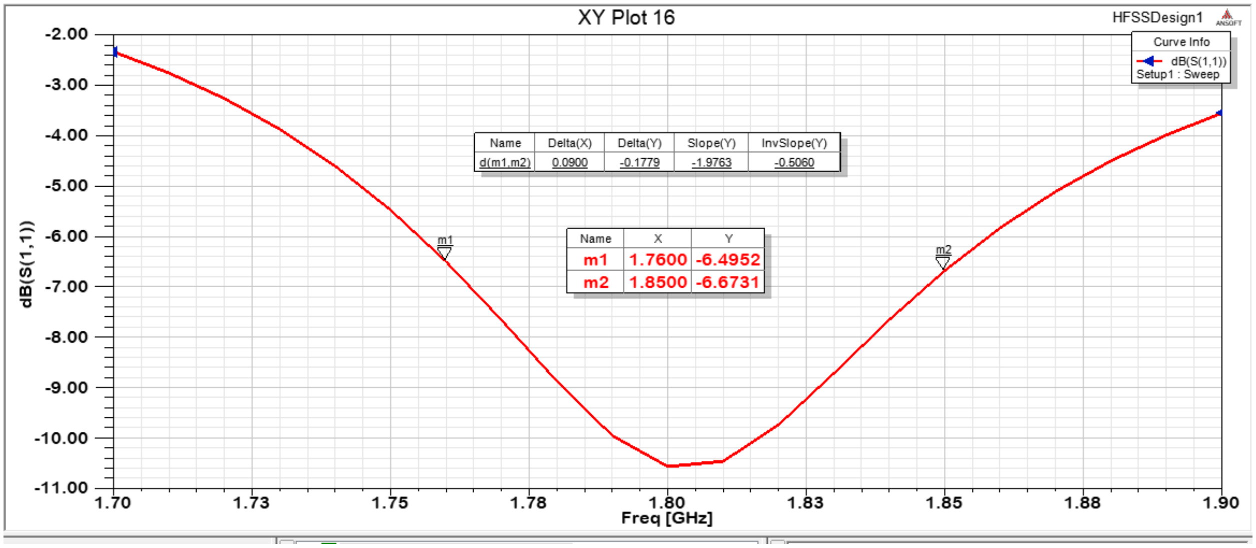


Figure 3.7: S11 Graph of Proposed GSM-Antenna

S11 plot of GSM antenna of frequency 1800 MHz is shown in figure below:

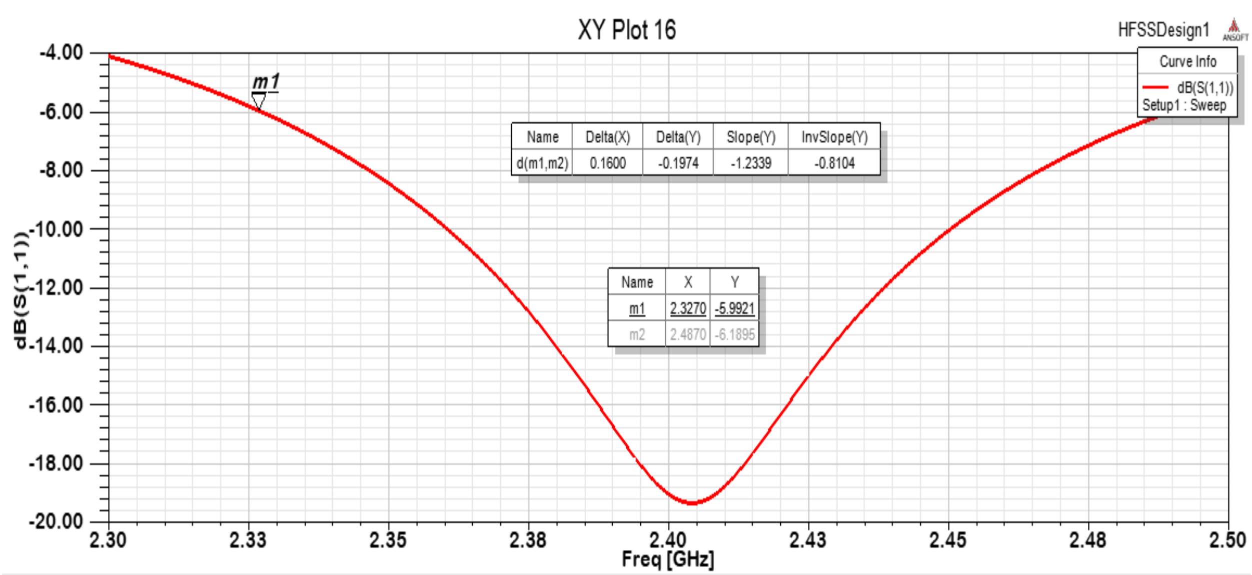


Figure 3.8: S11 Graph of Proposed Wi-Fi-Antenna

3.5.2 Bandwidth:

The difference between highest frequency signal and the lowest frequency signal is known as bandwidth in terms of signal. It also tells us that at how much minimum and maximum frequency this antenna is working. First of all antenna should radiate some power then we will go further for bandwidth. If S11 is zero and antenna is not radiating anything then how can we find its bandwidth?

As per the convention of mobile antenna S11 curve going under -6dB showing that this antenna is working well for some extent. So the minimum threshold to calculate bandwidth for mobile antenna is S11= -6dB.If we look at our executed results we can measure bandwidth of our proposed antenna.As the marker in the Figure is showing the difference between the frequency that is equal to bandwidth. Bandwidth for our GSM antenna is 90 MHz and of Wi-Fi antenna is 160MHz. The question is how much we need?

As we have designed our antenna fro GSM 1800 MHz and Wi-Fi 2.4 GHz, so we should look at the standards.The standardized bandwidth for GSM band of 1800 MHz is shown in figure below:

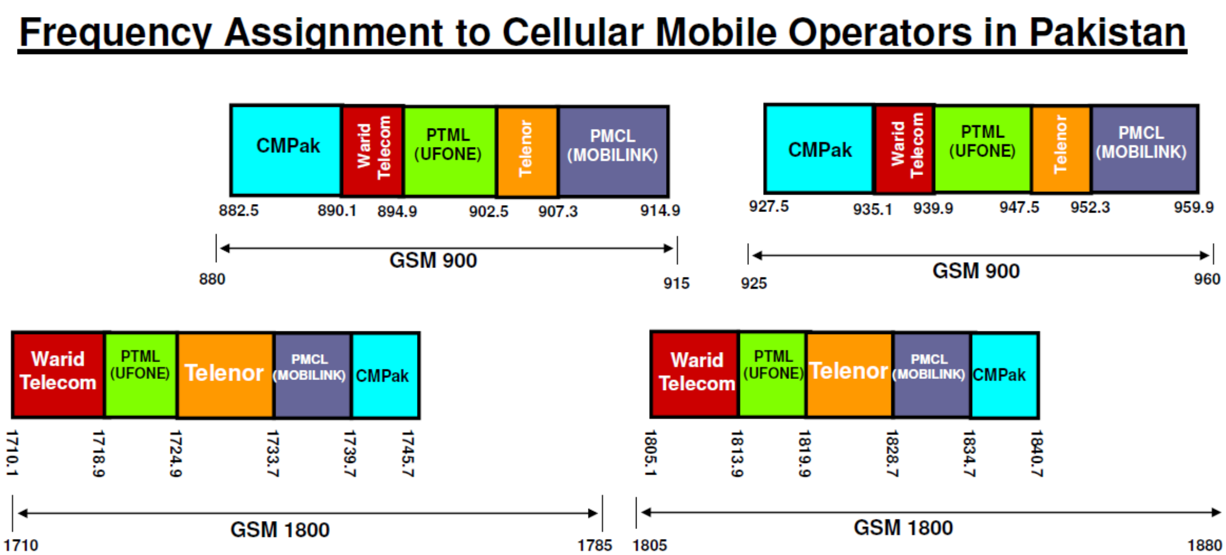


Figure 3.9: GSM Band Standardization and Frequency Allocation

From the GSM assembly of 1805-1880 we can find that the required bandwidth should be the difference between 1880 and 1805.

1880 MHz - 1805 MHz = 75 MHz

As a convention we all need to have a bandwidth of 75 MHz, and we gain a lot more when the required amount is equal to 90 MHz.

3.5.3 Gain:

The antenna gain is a key operation that combines antenna direction and electrical efficiency.

As a transmission antenna, the advantage explains how the antenna effectively converts its input power into radio waves in a certain direction.

As an receiving antenna, the advantage means that the antenna will convert radio waves from a specific location to electrical power.

The figure given below describes what amount of profit applies to broadcasting:

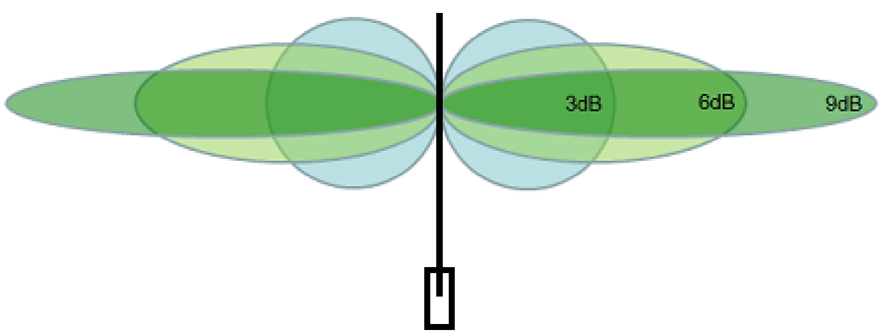


Figure 3.10: Value of Gain along with the area of coverage

It shows that the gain of 3dBi is providing low coverage as compare to the gain og 9dBi.

Hence for the achievements of good results the gain of our antenna should be as more as possible.

Following figure is going to describe the gain of our proposed antenna:

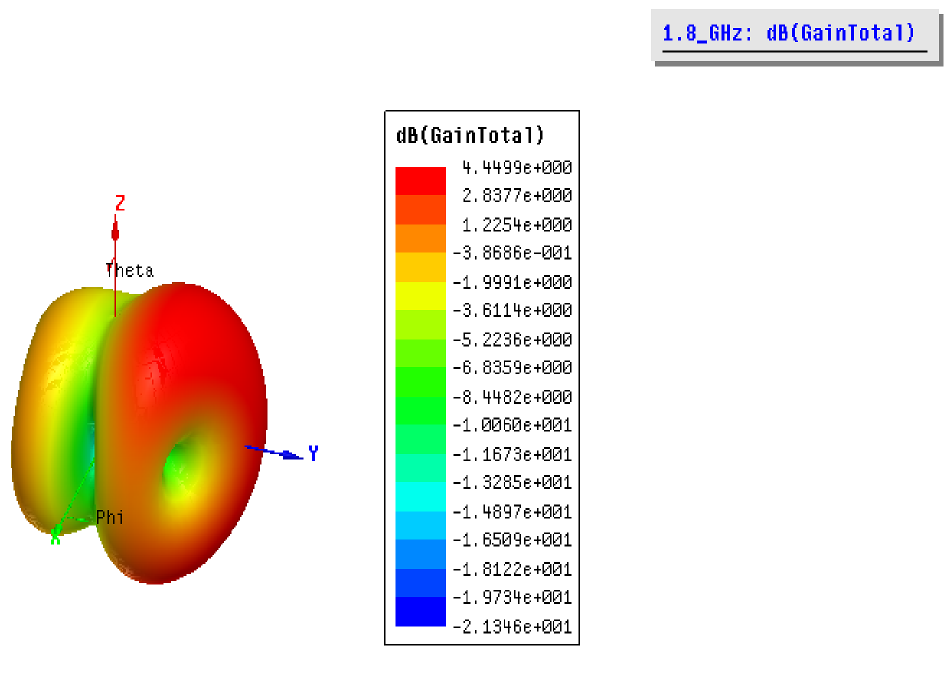


Figure 3.11: Total Gain of Proposed GSM antenna

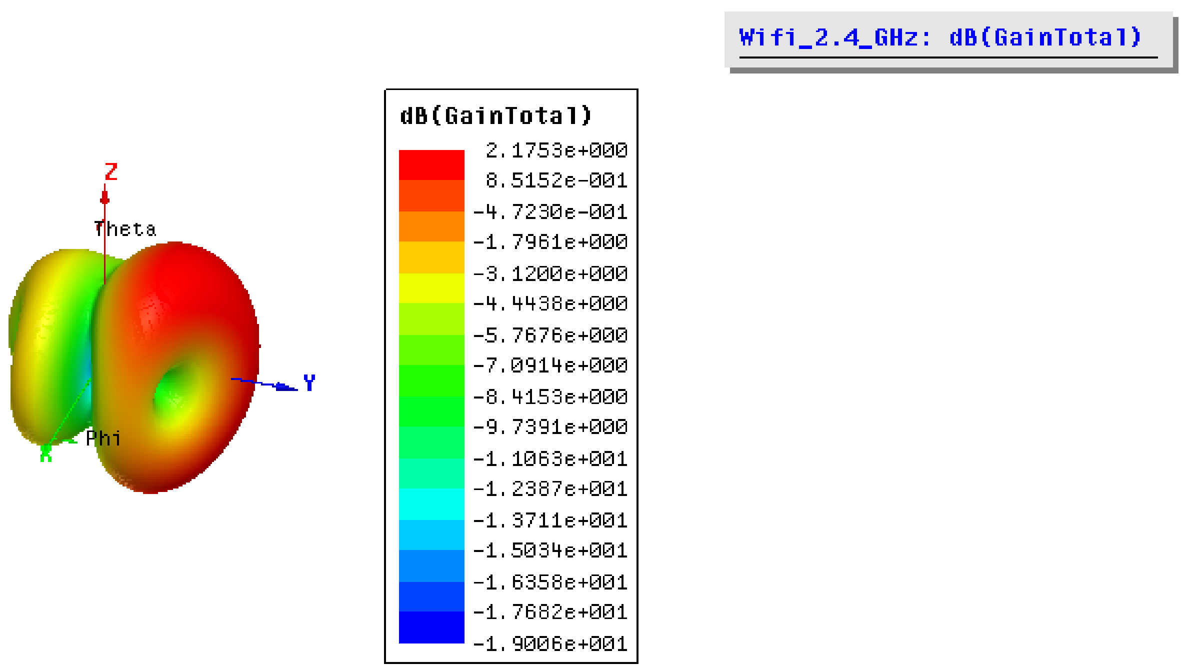


Figure 3.12: Total Gain of Proposed Wi-Fi antenna

We are achieving good gain from our proposed antenna.

3.5.4 Axial Ratio:

The ratio between a small axis and a large axis of a solar flare is known as the axial ratio. It looks as if a small, large axis of sunlight is about to turn into a circle. And we can say that it is divided by a circle. In this case the axial ratio will be equal to zero.

Axial measurements are usually quoted by an antenna where the desired polarization should be circular. If we look at the ideal value of the axial measurement of a circular antenna, it should be 0 (zero) dB. In addition, the axial axis tends to deteriorate away from the main shaft of this particular thread. As an axial measurement of a circular antenna for best results should be less than 3 dB and close to zero. As long as it tends to malfunction the antenna will work fine. This indicates that according to the specified range of deviation from the internal combustion should be less than 3 dB.

The following figure can show the results of the axial measurement of our proposed antenna.

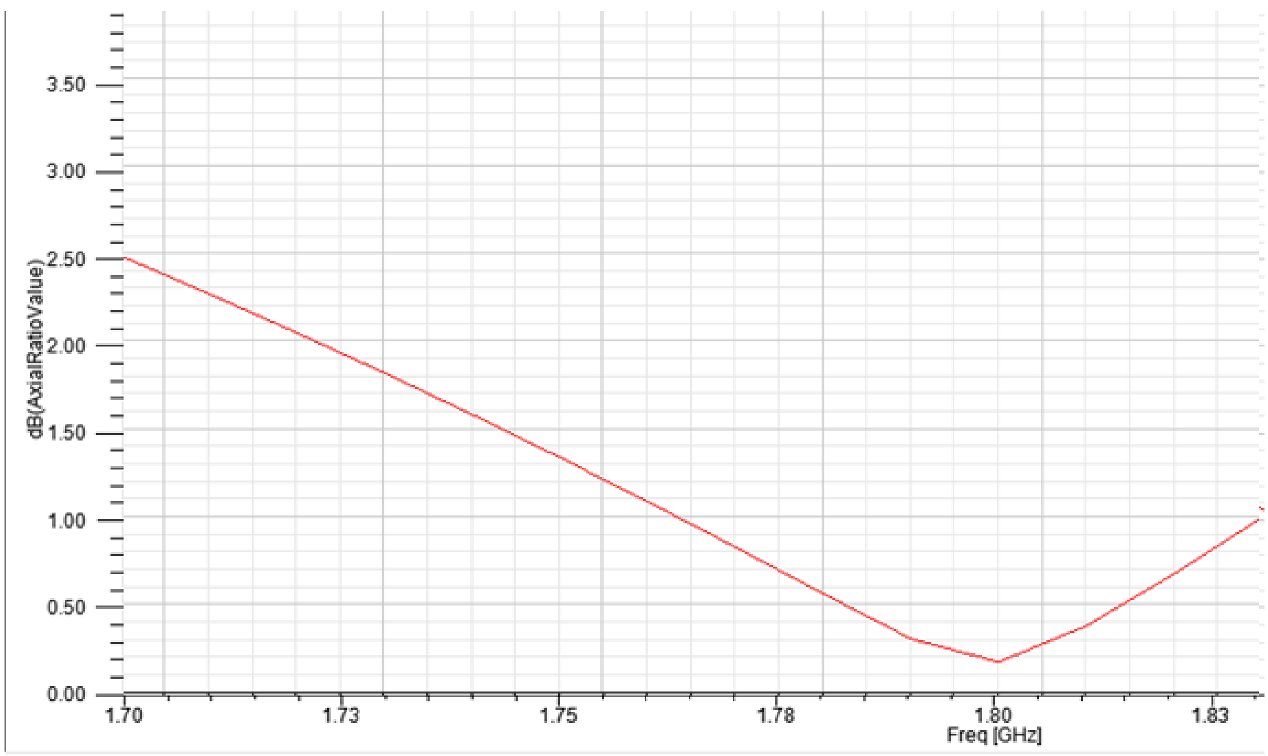


Figure 3.13: Axial Ratio of Proposed GSM-Antenna

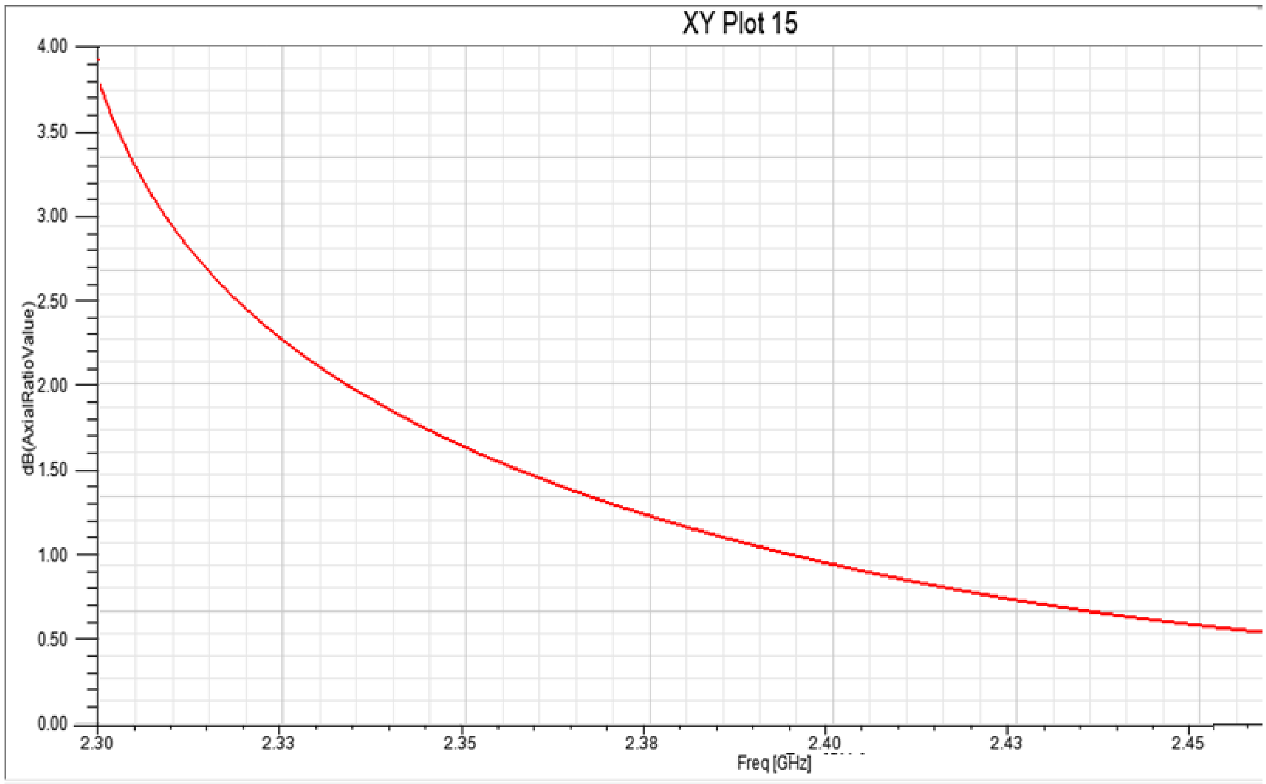


Figure 3.14: Axial Ratio of Proposed GSM-Antenna

3.5.5 Radiation Pattern:

The way the antenna distributes its energy in space is the pattern of the antenna radiation. It is a function of angles and can be expressed as a field or pattern of energy. The pattern can be specified on two planes, in relation to each other, plane E and plane H. There are several existing limitations related to the antenna radiation pattern e.g. radiation power, antenna gain, direction, horn bending, and efficiency.

There are two types of medal wrappers.

LHCP: Circular left polarization of the left hand

RHCP: Circular polarization of the right hand

RHCP is also known as circular antennae with a well-inserted hand. Similarly LHCP is also known as complete circular antennae tied to the left. Sometimes they are both known as round horns. Due to this type of polarization it will blossom into a multi-layered process. Like a suitable circular antenna designed for 360 rays. But the only proper view of a reference is that we can access positive or isotropic antennae. We have therefore tried our best to achieve a virtually circulating loan pattern.

The following figure shows the radiation pattern in the remote field of our proposed antenna.

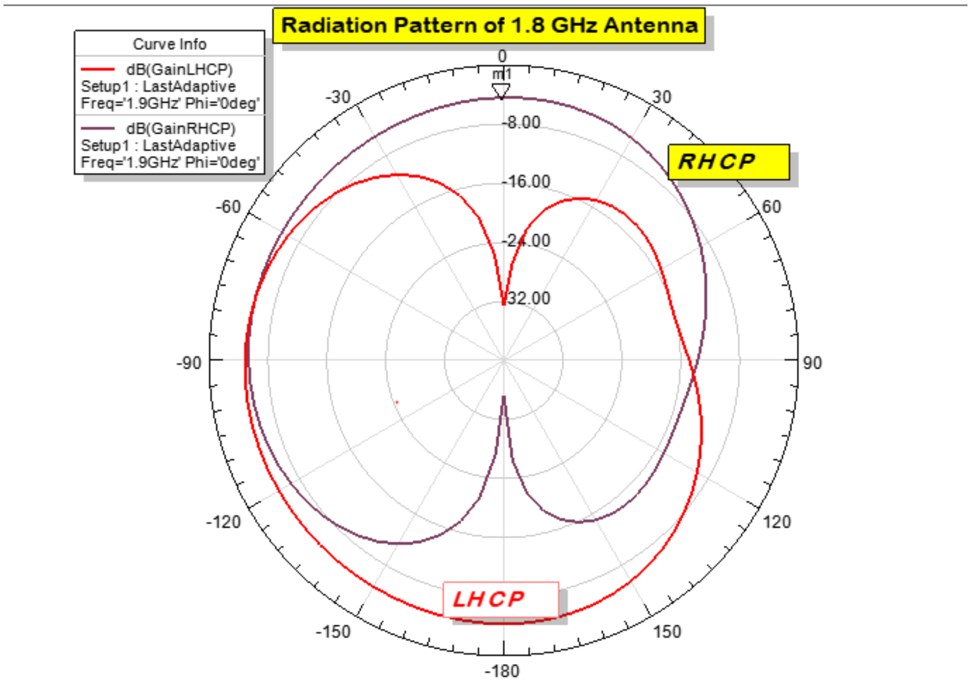


Figure 3.15: Radiation Pattern output of Proposed GSM-Antenna (RHCP & LHCP)

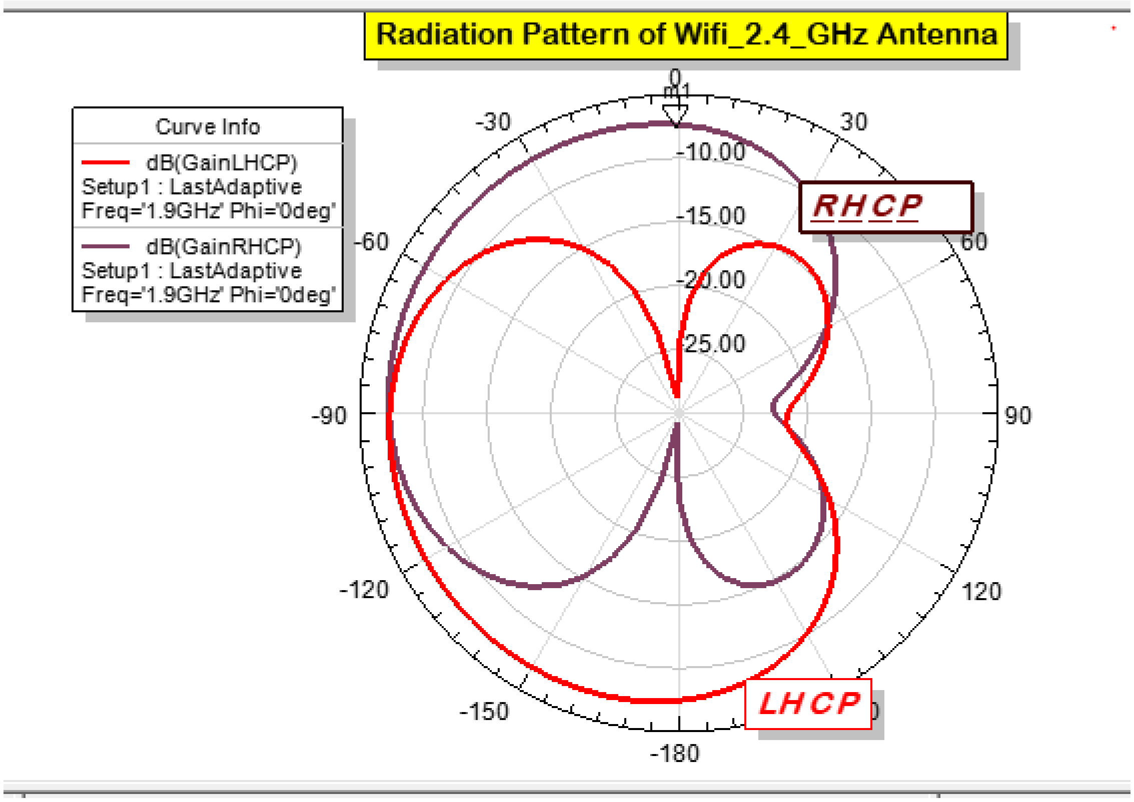


Figure 3.16: Radiation Pattern output of Proposed Wi-Fi-Antenna (RHCP & LHCP)

An animated view of circular polarization is shown as in the figure given below:

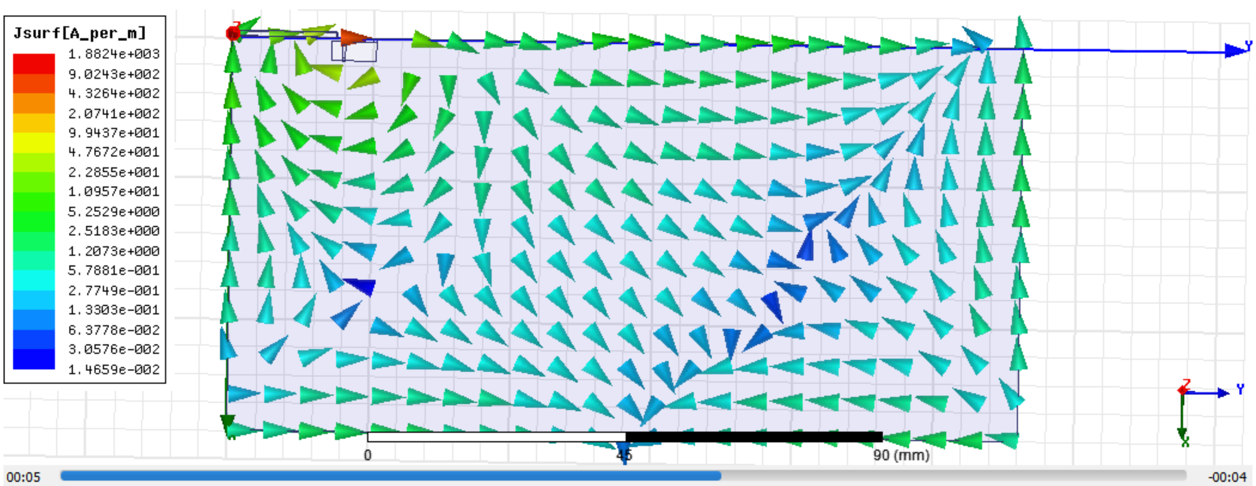


Figure 3.17: Animation of Proposed antennae (Same for both GSM & Wi-Fi)

CHAPTER IV

THEORY OF ELECTRONICS AND DESIGN OF ELECTRONIC BOOST RECTIFIER CIRCUIT

4.1. Diode:

The electronic semiconductor component with two channels provides flow in only one location. It shows very low resistance in one area and very high resistance in the other.

There are many types of diodes but the type of diode we will use in our project is the schottky diode.

Diode is an active electronic utility.

4.2. Schottky Diode:

In this type of diode, the junction is formed by contacting the semiconductor material with the metal. For this reason the power outage goes on for a minute. The semiconductor material is N-silicon, which acts as an anode and as a metal cathode with its components of crystalline, platinum and tungsten.

These diodes have a high carrying capacity current due to the metal, which reduces the switching time. Therefore, Shotkey has a lot of use in changing apps. The voltage drop is low due to the meticonductor metal, which increases diode performance and reduces power loss. Therefore, these are used in high frequency applications. The diode data sheet we used in our renewable energy circuit is provided in the APPENDIX The Shotkey Diode indicator is as shown below.

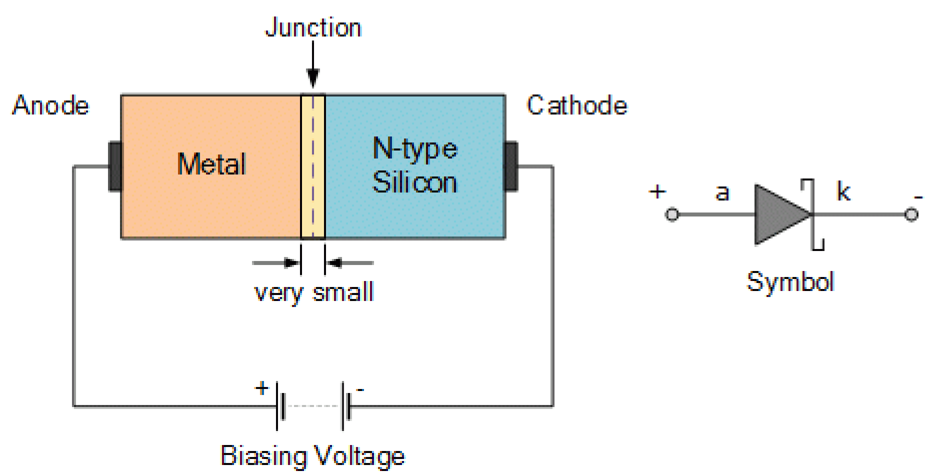


Figure 4.1: Schottky Diode Diagram with symbol

4.3. Capacitor, Inductor & Resistance:

The part of electricity that can be used to store electrical energy such as an electric field built between two hidden metal sheets is called plates and each plate has a different power (or Voltage). This is a deadly electronic component.

An electrical component that can be used to store electrical energy as a magnetic field around an element. It is also a last-minute technology tool.

It is the opposite of what is provided by the flow of electricity. Represented by top letter R. SI resistance unit ohm. Influenced by the Greek book omega. Resistance is part of appreciation.

The figure given below shows these three inputs.

A block diagram of our proposed electronic circuit (Energy Harvest) as shown in the figure:

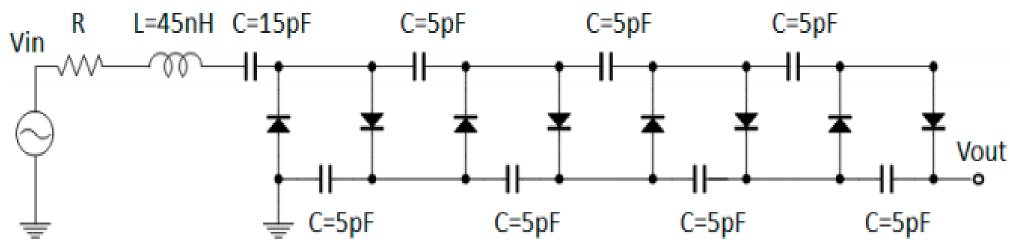
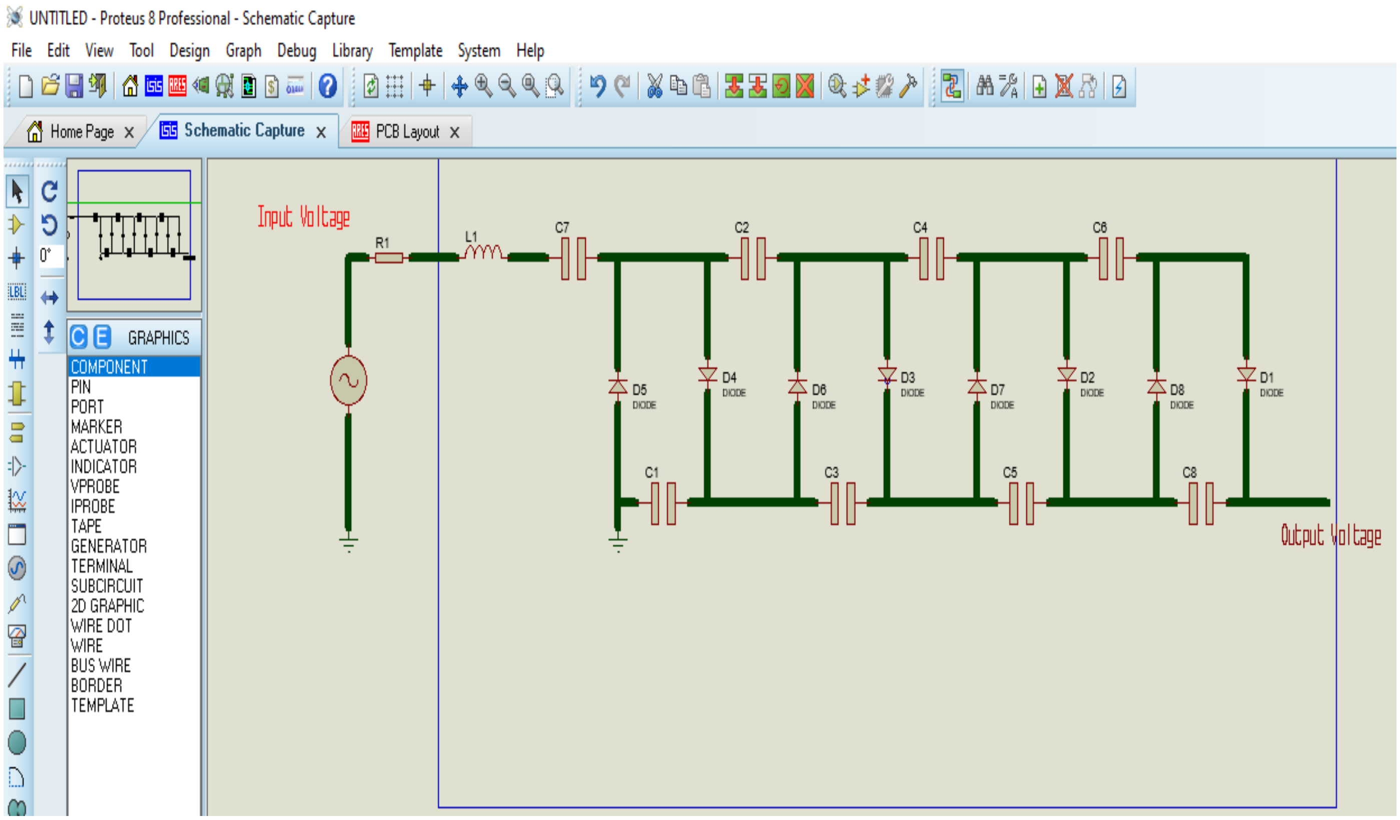


Figure 4.2: Schematic of Proposed Boost Rectifier Circuit

Schematic of our proposed design circuit designed by us is shown in the figure below:

Figure 4.3: Self designed Boost Rectifier Circuit



4.4 CONCLUSION

The main objective of the project was to design a power output using a mobile antenna and to expand the renewal circuit to increase the capacity of the portable antenna to solve low battery time problem, as well as to design a circular antenna shaped with portable antennae size and design layout easily.

This paper is designed to produce the most efficient energy yield using a circular antenna and a recurring cycle. The low-interference antenna is successfully designed for the standard GSM band 1800 GHz and the Wi-Fi band 2.4 GHz. In addition we learned to set up a circular antenna with the help of a resonance capacitor that we used to find the antenna. With the random movement of a portable handset for optimal circular polarization we proposed an antenna-element-element composed of two elements called the M-element and the L-element as a flexible method. In the design of the proposed antenna project the difference in the distance of the remote components of the compass depends on the critical features of the underground areas with the help of the antenna material changes which can be controlled. This is why the antenna design is equally exciting in two orthogonal areas of radiation by receiving two connecting elements. With the help of changing the frequency of the elements of the cleaning elements and you can achieve your favorite phase difference between the two parts of the orthogonal field. In addition, the comprehensive ARBW can be achieved by compensating for the internal phase inequality compensation of the earth's paths on a round rectangular planet, where the concept of unity is determined by the earth's plane. Therefore, the proposed antenna method can be installed on mobile devices of the CP application.

4.5 References

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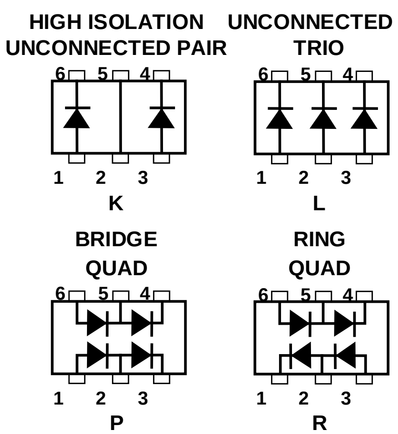
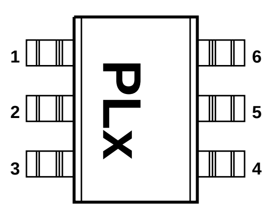
APPENDIX

Data Sheet

SOT-363 Package Lead Code Identification (top view)



Pin Connections and Package Marking



Notes:

1. Package marking provides orientation and identification.
2. The first two characters are thepackage marking code. The third character is the date code.

SOT-23/SOT-143 DC Electrical Specifications, T_C = +25°C, Single Diode

Part Number HSMS-	Package Marking Code[1]	Lead Code	Configuration	Forward Voltage V_F (mV)		Typical Capacitance C_T (pF)
2860	T0	0	Single	250 Min.	350 Max.	0.30

2862	T2	2	Series Pair[2,3]			
2863	T3	3	Common Anode[2,3]			
2864	T4	4	Common Cathode[2,3]			
2865	T5	5	Unconnected Pair [2,3]			
Test Conditions				I_F = 1.0 mA		V_R = 0 V, f = 1 MHz

Notes:

1. Package marking code is in white.
2. ΔV_F for diodes in pairs is 15.0 mV maximum at 1.0 mA.
3. ΔC_T for diodes in pairs is 0.05 pF maximum at –0.5V.

SOT-323/SOT-363 DC Electrical Specifications, T_C = +25°C, Single Diode

Part Number HSMS-	Package Marking Code[1]	Lead Code	Configuration	Forward Voltage V_F (mV)		Typical Capacitance C_T (pF)
286B	T0	B	Single	250 Min.	350 Max.	0.25
286C	T2	C	Series Pair[2,3]			
286E	T3	E	Common Anode[2,3]			
286F	T4	F	Common Cathode[2,3]			
286K	TK	K	High Isolation Unconnected Pair			
286L	TL	L	Unconnected Trio			
286P	TP	P	Bridge Quad			
286R	ZZ	R	Ring Quad			
Test Conditions				I_F = 1.0 mA		V_R = 0 V, f = 1 MHz

Notes:

1. Package marking code is laser marked.
2. ΔV_F for diodes in trios and quads is 15.0 mV maximum at 1.0 mA.
3. ΔC_T for diodes in trios and quads is 0.05 pF maximum at –0.5V.

RF Electrical Specifications, T_C = +25°C, Single Diode

Part Number HSMS-	Typical Tangential Sensitivity TSS (dBm) @ f =			Typical Voltage Sensitivity γ (mV/μW) @ f =			Typical Video Resistance RV (KΩ)
	915 MHz	2.45 GHz	5.8 GHz	915 MHz	2.45 GHz	5.8 GHz	
2860 2862 2863 2864 2865 286B 286C 286E 286F 286K 286L 286P 286R	–57	–56	–55	50	35	25	5.0
Test Conditions	Video Bandwidth = 2 MHz I_b = 5 μA			Power in = –40 dBm R_L = 100 KΩ, I_b = 5 μA			I_b = 5 μA

Absolute Maximum Ratings, T_C = +25°C, Single Diode

Symbol	Parameter	Unit	Absolute Maximum[1]	
			SOT-23/143	SOT-323/363
P_{IV}	Peak Inverse Voltage	V	4.0	4.0
T_J	Junction Temperature	°C	150	150
T_{STG}	Storage Temperature	°C	-65 to 150	-65 to 150
T_{OP}	Operating Temperature	°C	-65 to 150	-65 to 150
θ_{jc}	Thermal Resistance[2]	°C/W	500	150

ESD WARNING: Handling Precautions Should Be Taken To Avoid Static Discharge.

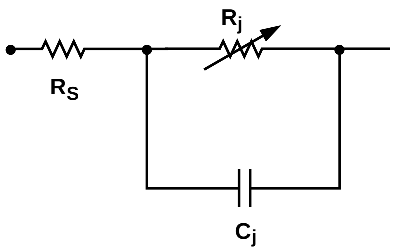
Notes:

1. Operation in excess of any one of these conditions may result inpermanent damage to the device.
2. T_C = +25°C, where T_C is defined to be the temperature at the package pins where contact is made to the circuit board.

Equivalent Linear Circuit Model,

SPICE Parameters

Parameter	Units	Value



Diode chip

R_S = series resistance (see Table of SPICE parameters)

C_j = junction capacitance (see Table of SPICE parameters)

$$R_j = \frac{8.33 \times 10^{-5}\ nT}{I_b + I_s}$$

where

I_b = externally applied bias current in amps

I_s = saturation current (see table of SPICE parameters)

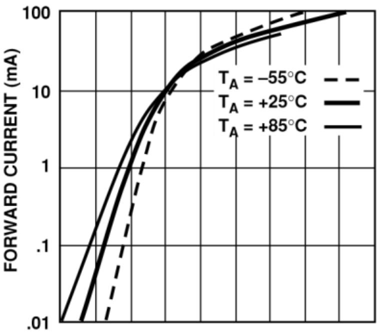
T = temperature, °K

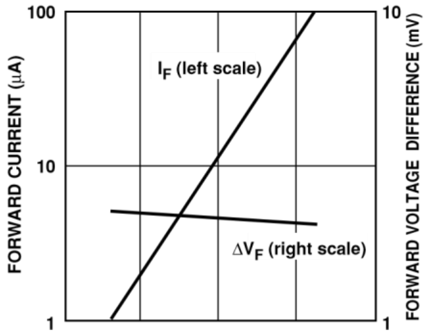
n = ideality factor (see table of SPICE parameters)

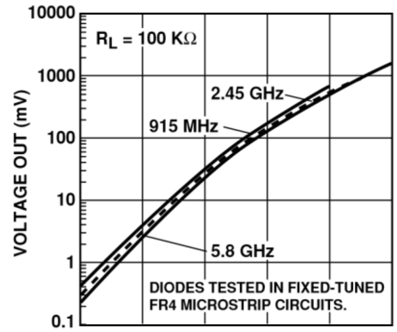
Note:

To effectively model the packaged HSMS-286x product, please refer to Application Note AN1124.

B_V	V	7.0
C_{J0}	pF	0.18
E_G	eV	0.69
I_{BV}	A	E - 5
I_S	A	E -8
N		1.08
R_S	Ω	6.0
P_B (VJ)	V	0.65
P_T (XTI)		2
M		0.5







Typical Parameters, Single Diode

0.1 0.20.3 0.4 0.60.7 0.80.90.5 1.0

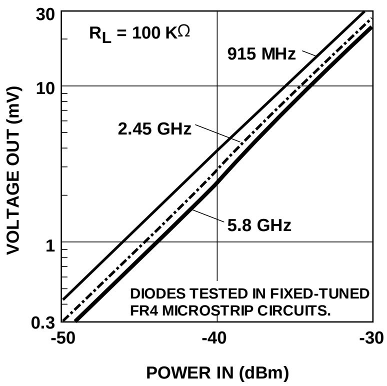
FORWARD VOLTAGE (V)

0.05 0.10 0.15 0.20 0.25

FORWARD VOLTAGE (V)

Figure 1. Forward Current vs. Forward Voltage at Temperature.

Figure 2. Forward Voltage Match.



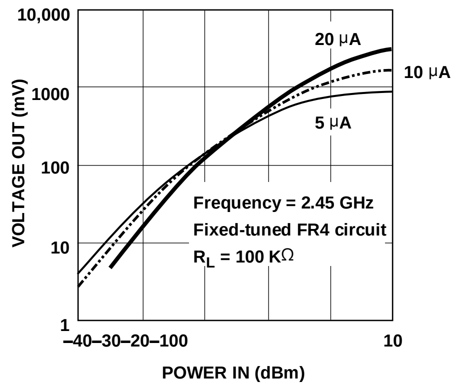


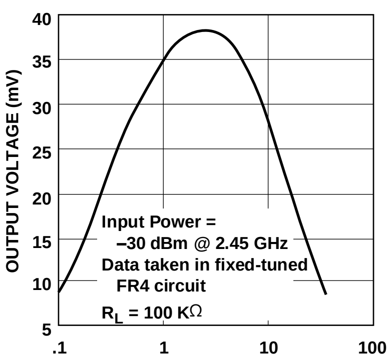
Figure 4. +25°C Expanded Output Characteristic as a Function of DC Bias.

Figure 5. Dynamic Transfer Voltage vs. Input Power. See Figure 3.

-50 -40 -30 -20 -10 0

POWER IN (dBm)

Figure 3. +25°C Output Voltage vs. Input Power, 3 μA Bias.



BIAS CURRENT (μA)

Figure 6. Voltage Sensitivity as a Function of DC Bias Current.

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GENERAL COMMENTS

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

PAGE 21

PAGE 22

PAGE 23

PAGE 24

PAGE 25

PAGE 26

PAGE 27

PAGE 28

PAGE 29

PAGE 30

PAGE 31

PAGE 32

PAGE 33

PAGE 34

PAGE 35

PAGE 36

PAGE 37

PAGE 38

PAGE 39