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Design and Simulation of Broad Band Antenna for Rf Energy Harversting

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Abstract: The harvesting of radio frequency energy is a growing priority for providing power to electronic devices. With the aid of Inverted F antenna, this project proposes to create an energy harvesting system using RF radiation. Using the survey, we recognized that energy harvesting with RF is more effective than the other natural resources. Therefore we can further harvest enough energy that can be used for micro devices. Inverted F antenna has higher gain, simpler to feed and smaller size compared to spiral antenna, directional antenna etc. For the antenna design and simulation HFSS tool is used.

Keywords: — Broadband antenna, HFSS, Inverted F antenna, RF energy harvesting.

I. INTRODUCTION

Harvesting of energy is a process in which the energy is collected from the atmosphere and converted to electrical energy. The converted energy is used for certain electrical appliances. This is known as power generation technology, and scavenging of energy. There are a range of sources and techniques available for energy generation or storage including radio frequency (RF) energy .It centers around the accessible electromagnetic encompassing vitality from business RF transmission stations, for example Wi-Fi. RF vitality reaping holds a potential guarantee for electronic gadgets to deliver a constrained measure of electrical force. It requires an enormous cross segment (receiving wire) vitality gathering framework and is exceptionally near the transmitter. The amount of energy that is harvested is considerably low. The vitality gathering framework comprises of components collection, transferring equipments and electronics for regulating conditioning. The collected energy must be transformed to electricity and processed into a suitable type i.e used for battery storage. The reception apparatus has the obligation to receive all the signals in Wi-Fi band. Matching network is used to deliver the maximum signals acquired from the antenna and the rectifier is used to convert the RF signal into DC.

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II. PROPOSED METHOD RF ENERGY HARVESTING ANTENNA

The antenna consists of different radiators, the first (or most important) radiator, and the radiator (related to objects that gradually feed off certain items and weaken others) .The role of the parasite radiator is to couples the RF power, that hardly contributes for the performance of the main radiator because the collected signal is radiated from the 3-dB beam width of the main radiator. Therefore, with only a limited amount of variance, the main radiator will preserves its original performance level. The proposed antenna is designed to operate at a frequency band of 2.25GHz to 2.75GHz which offers a remarkable efficiency. Thus it is used for various wireless communication transceivers as an auxillary means of DC control. To prevent losses in the respective circuit, a energy network is suggested that has a connection to a rectifier. The outcome shows the energy is inadequate. When designing an electromagnetic energy harvesting device the choice of antenna is very important. To encourage the option, several requirements can be specified. The most important parameter are: Frequency of operation, antenna gain, circuit efficiency and price. The priority frequency bands correspond to the configuring patch antennas. In addition, these antennas can gather power and make simple structure. The antenna is planned to collect the frequencies of Wi-Fi band. To get to the resonating frequency with good performance, 14 different Topologies were checked for the antenna shape. The antenna component is designed to resonate at around 2.45 GHz and 5GHz. Choosing the suitable frequency band is very important to optimize the harvested DC power. The theory of RF Energy Harvesting requires an effective antenna, and as circuit that converts AC to DC voltage. The efficiency of an antenna has to do with the shape and impedance of the antenna.

III. INVERTED F ANTENNA:

An advancement of the basic ¼ wavelength monopole reception apparatus is the inverted F antenna. During the 1940s the F-type wire antenna was invented. For this antenna the feed is associated with a middle point along the reception apparatus length, instead of to the base. The establishment is based on the ground. The drawback of doing so is that receiving wire's information impedance relies upon the good ways from the grounded finish of the feed point. The piece of the radio wire between the feed point and the ground plane basically goes about as a stub of a short out.

Therefore, by setting the location of the feed point, the manufacturer must change the antenna to the impedance of the system (RF systems typically have a system impedance of 50 ranges, whereas the pi/4 monopoly has an impedance of 36.5 ranges). The inverted-L antenna is a bent monopole antenna which runs parallel to the ground plane. This has the advantage of compactness and a shorter length than the $\lambda/4$ monopoly. Inverted-F antenna blends the benefits of both of these antennas; it has inverted-L compactness and F-type impedance matching capability.

IV. BLOCK DIAGRAM:

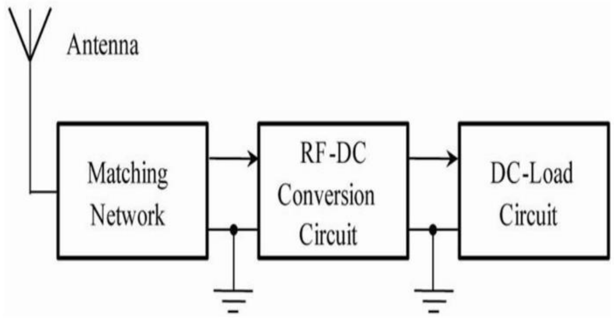

FIG 1: RF energy harvesting antenna block diagram

V. II. METHODOLOGIES:

The vitality gathering framework segments (receiving wire, coordinating system, and rectifier) are normally alluded to as a rectenna or RF/DC which can collect high-recurrence vitality in free space and convert it to DC power. Cautious plan is expected to collect encompassing RF vitality and convert the reaped capacity to usable DC power:

1. An effective antenna to maximize the reception of RF signals from the area.
2. An antenna impedance matching a complex load impedance network consisting of inductive and capacitive components to achieve the optimal power supply from antenna to rectifier.
3. Optimization of the rectifier circuit for conversion from RF to DC.

HIGH FREQUENCY SIMULATOR STRUCTURE (HFSS):

HFSS is an elite full wave electromagnetic (EM) field test system for self-assertive 3D volumetric latent framework reenactment, utilizing the famous graphical UI of Microsoft Windows. Ansoft HFSS utilizes the Finite Element Method (FEM), versatile cross section, and splendid illustrations to give you unparalleled execution and knowledge into all your 3D EM issues. We can use Ansoft HFSS to measure parameters like S-Parameters, Resonant Frequency, and Fields.

VI. RESULTS AND DISCUSSIONS:

Simulation model for the inverted F antenna using FR4 substrate is shown in the figure.

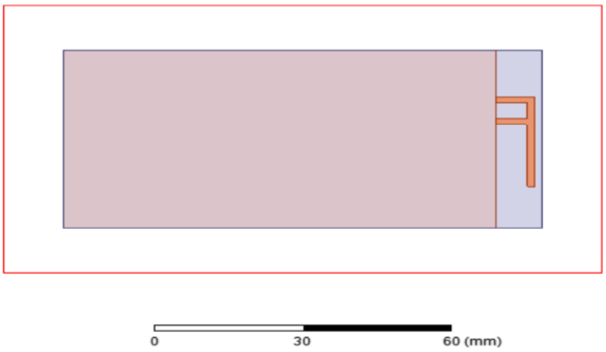

FIG 2: Simulation model of the antenna

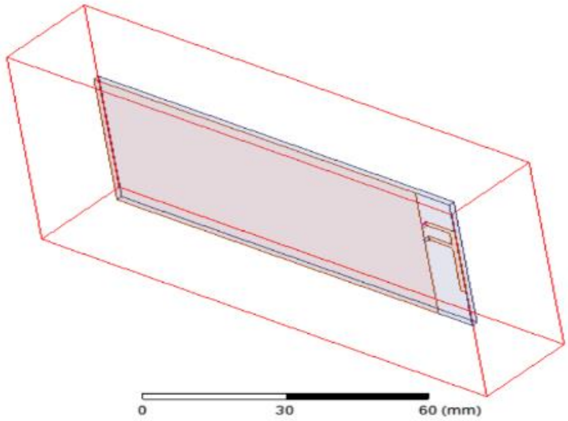

FIG 3: Antenna model in side view

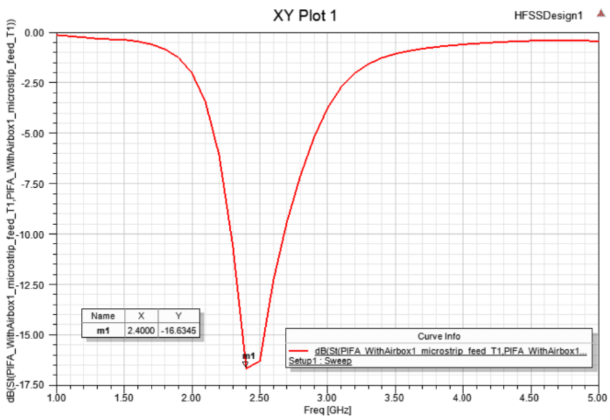

FIG 4: Return loss vs Frequency

From the response it is inferred that antenna is resonating at 2.4GHz. Simulated antenna achieves a return loss of -16.63dB at 2.4GHz. Objective of the proposed work is to design broadband antenna for the frequency range of 1GHz to 5GHz. Wide band characteristics of the antenna can be achieved by modifying the shape of the radiating element.

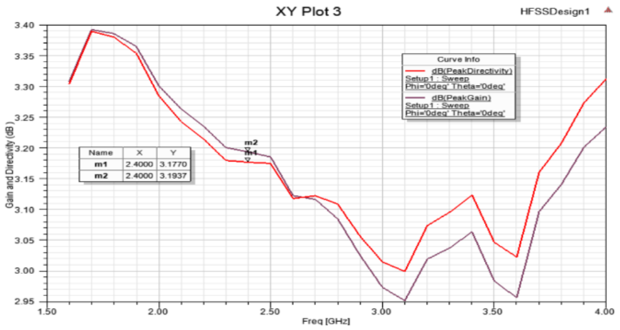

FIG 5: Gain vs Frequency

Figure 5 shows that the variation of peak gain versus frequency. From the figure it is concluded that simulated antenna achieves the peak gain of 3.38dB at 1.75 GHz.

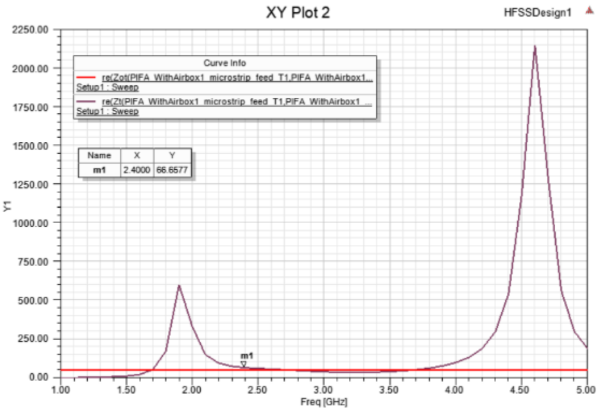

Figure 6 : Characteristic impedance vs Frequency

It shows that the simulation results of impedance. The resonant frequency is closed to 50 ohm in the desired range.

VII. CONCLUSION

Inverted F antenna using FR4 substrate to work at 2.4GHz is simulated and the performance of the antenna is evaluated in terms of return loss, gain and impedance characteristics of the antenna. Simulated results shows that the antenna can be employed to harvest the RF signal in ISM band. Based on the study presented it is proposed to design broad band antenna for the frequency range of 1GHz to 5 GHz with suitable matching network for harvesting RF signal in the proposed frequency band. Future work is also extended to design rectifier circuit to convert RF signal into DC energy. In this study, inverted F antenna using FR4 substrate is designed for the following specifications: substrate length=99mm, substrate width=49mm, ground length=89.6mm , substrate thickness= 1.6mm. Length and Width of the patch is determined using TL model. Simulated result shows that antenna can be employed for the frequency of 2.25GHz to 2.75GHz in UHF band.

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