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Miniaturized Circularly Polarized Implantable Antenna for Bio Medical Application

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ABSTRACT: The research on implantable antennas has received much growing attention in recent years. An implantable antenna needs to be broadband to reduce the effect of frequency shift in inhomogeneous human tissues. However, implantable antennas, which are electrically small in size, are intrinsically characterized by very narrow bandwidth. Generally Linear Polarized (LP) implantable antenna suffers from the polarization mismatch resulting from indoor multipath distortion and different body postures. It is well understood that circular polarization (CP) has the distinct merit of being insensitive to the orientation between the transmitter and receiver, and thus provides better mobility, lower bit-error-rates, and link stability enhancement than LP .In this project, the design and the analysis of miniaturized CP implantable patch antenna for biomedical applications. To obtain this we are using Defective Ground Structure(DGS) has been gained popularity among all the techniques reported for enhancing the parameters due to its simple structural design. Etched slots or defects on the ground plane of microstrip circuits are referred to as Defected Ground Structure. It increases the gain of the antenna and maintains the axial ratio as less than 3db to get better performance of the antenna.

I. INTRODUCTION

Patch antenna is one of the basic types of antenna used to transmit and receive information through no physical connection. It's operation in the external environment is different from its operation inside the body of a living medium (such as animals, birds, human beings). As the composition of body varies from external environment , it involves blood flow, tissue , bone, muscles, etc. Each layer of the body has various characteristics. Thus the device in such complicated environment has strong reliability, low profile, harmless to the subject at which it is inserted. On consideration of all the above aspects the patch antenna for biomedical application as its own importance in both the improvement of the wireless technology and the technology used for medical applications. The major characteristics of the antenna that are considered during designing of the antenna for medical applications are radiation pattern, return loss, VSWR, axial ratio, etc. The size of the patch antenna is the most important thing to be considered. The dimensions of the antenna varies based on its purpose.

With the growing concern of human health and the convenience of medical care, the idea of biomedical devices that can be implemented into human bodies has been brought up and widely studied. However implantable antenna is commonly needed to communicate with the equipment outside a human body wirelessly. Now a days with the contribution of implantable antennas , patients can be monitored remotely even if they are not physically touched. The implantable devices also suffer from polarization mismatch resulting from indoor multipath distortion. The circular polarization has better mobility, lower bit error rates and link stability enhancement than LP. Hence, it is significant to carry out the study on CP antennas operating in human body. The CP implantable patch antennas operating in Industrial, Scientific &Medical band (ISM 2.4-2.48GHZ). However, the 3db axial ratio(AR) & bandwidth is 1.63% .This cannot be directly treated on human skin so we are using phantom. This phantom is a mixture of chemicals which is been used. The antenna is been placed inside the skin. In this antenna the size is been reduced and the thickness is been reduced. The gain and the bandwidth of this antenna are hence increased further. The antenna is manufactured on Rogers 5880 and the thickness is about 0.8mm. The Rogers is been used as a substrate and also as a superstrate. The superstrate is considered as a layer of a substrate.

The objectives of antenna analysis are to predict the radiation characteristics such as radiation patterns, gain and polarization as well as input impedance, bandwidth, mutual coupling, and antenna efficiency. Instead, the dominant mode of propagation would be the quasi-TEM mode. Hence, an effective dielectric constant must be obtained in order to account for the fringing and the wave propagation in the line. The value of effective dielectric constant is slightly less than dielectric constant of substrate, because the fringing fields around the periphery of the patch are not confined in the dielectric substrate but are also spread in the air.

The analysis of micro strip patch antenna is complicated by the presence of in homogeneity of dielectric and boundary condition, narrow frequency band characteristics, and a wide variety of feed, patch shape, and substrate configuration.

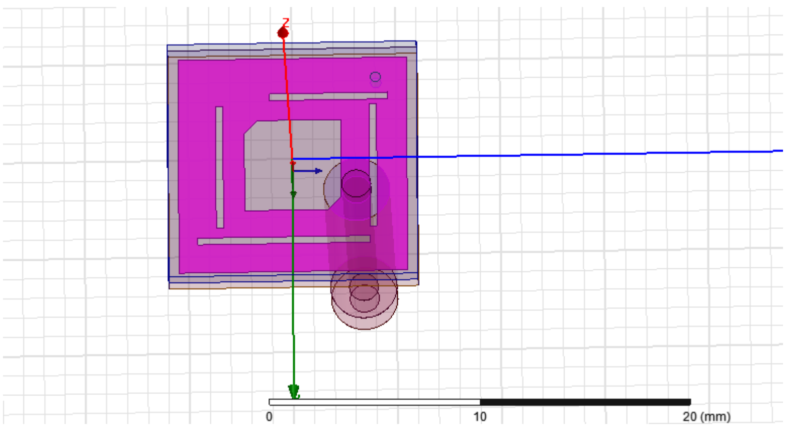
The good model has the following basic characteristics:

- It can be used to calculate all impedance and radiation characteristics of the antenna
- It lends itself to interpretation in terms of known physical phenomena.
- Its results are accurate enough for the intended purpose
- It is simple and possible ,while providing the proposed accuracy for the impedence and radiation properties

In common practice, micro strip antennas are evaluated using one of three analysis methods: the transmission line model, the cavity model, and the full-wave model. The transmission line model is the easiest of all, it gives good physical insight. But it is less accurate and more difficult to model coupling effect of antenna.

II. SYSTEM MODEL

In this proposed model we have changed the dimension of antenna from 10mm*10mm*1.27mm to 12mm*12mm*1.6mm. The substrate material has been changed from Rogor6010 of relative permittivity 10.2 and thickness 0.635mm to rogors5880 of relative permittivity 2.2 and thickness 0.8mm. Changed the substrate material, this is because the dielectric rogors5880 is the most available material in market than that of rogor6010.As the dielectric constant changes the overall dimension of the antenna also changes. Also increased the width of the four slits given in the existing model that is from 0.1mm to 0.36mm. In these short pins also removed (i.e.) we are using only one short pin out of three pins . In this coaxial feed is provided to get better performance in the stimulation output ant those are shown below:



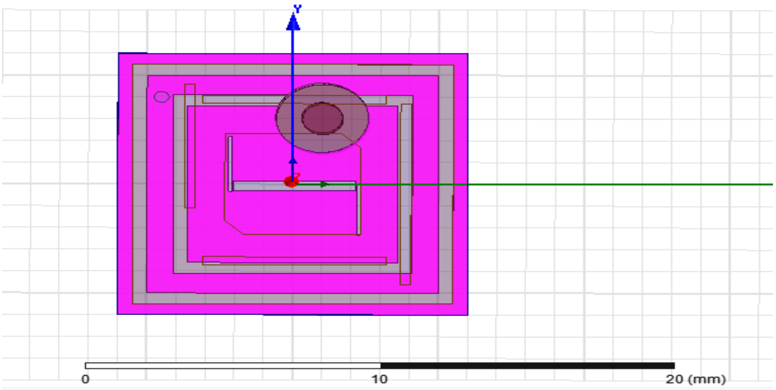
The proposed antenna design

PROPOSED CIRCULARLY POLARIZED ANTENNA WITH DGS:

In this we have introduced a new concept of Defective Ground Structure (DGS).It increases the gain of the antenna and axial ratio is <3db is obtained

Defected Ground Structure (DGS) has been gained popularity among all the techniques reported for nhancing the parameters due to its simple structural design. Etched slots or defects on the ground plane of microstrip circuits are referred to as Defected Ground Structure. Single or multiple defects on the ground plane may be considered as DGS. Initially DGS was reported for filters underneath the microstrip line. DGS has been used underneath the microstrip line to achieve band-stop characteristics and to suppress higher mode harmonics.

Design of the antenna:The rectangular patch antenna design with z shape slot in truncated patch antenna is a multilayer antenna that is composed of four layers. The ground plane
is at the base of the antenna whose size is chosen as (12 × 12) mm. The substrate, which is a dielectric, is placed above the ground plane. It is made up of Rogers RT/Duroid 5880 material and it has a dimension of (12×12) mm. A height of 0.8mm is given to the substrate. The patch is fixed above the substrate whose length is 12mm and width is 12mm with a height of 1.8mm.Along with substrate , The superstrate is placed above the substrate which is similar to thesubstrate. It is having the exact copy of substrate. It is used to enhance the features of antenna and increases the gain of antenna .The superstrate is also the same dimension of proposed antenna. In these coaxial feed probe is used to provide feed. The patch is truncated using plotline of 1mm at both the truncated areas, along this four slit is used whose dimensions are varied from each other .When we change the **substrate** material and the thickness of **substrate** of a microstrip **antenna**, it changes the system performance.



Proposed antenna design with DGS

DIMENSION FOR PROPOSED ANTENNA:

SI.NO	CATEGORY	CENTER POSITION	LENGTH	WIDTH	HEIGHT
1	PATCH	-5.5,-5.5,0.8	11	11	Z
2	GROUND	6,6,0	-12	-12	Z
3	SUPERSTRATE	-6,-6,0	12	12	0.8
4	TRUNCATION	-4.65/2,-4.65/2,0.8	4.65	4.65	Z
5	SLIT1	3.7 ,-4.6 ,0.8	0.36	8.3	Z
6	SLIT2	3.7 ,-4.6 ,0.8	6.3	0.36	Z
7	SLIT3	-3.7 ,4.6 ,0.8	0.36	-5.7	Z
8	SLIT4	-3.1 ,-3.7 ,0.8	6.3	0.36	Z
9	SLOT1	2.325,-2.325,0	-0.125	2.325	Z
10	SLOT2	2.15,0.3,0	-4.2	0.45	Z
11	SLOT3	-2.2,-0.325,0	0.125	2.5	Z
12	RADIATIONBOX	-90/2 ,-90/2 ,-25.27/2	90	90	25.27

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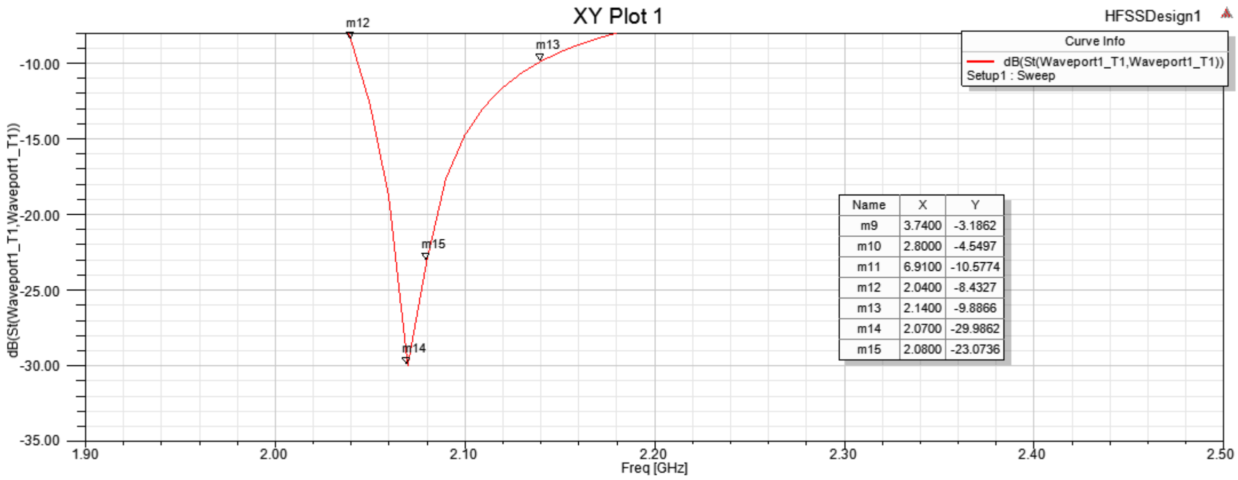
III. RESULTS AND DISCUSSION

- Return loss is defined as the ratio between input energy to antenna and reflected energy form antenna. Return loss is a measure of the effectiveness of power delivery from a transmission line to a load such as an antenna.

$$RL\ (db) = -10\log\frac{Pi}{Pr}$$

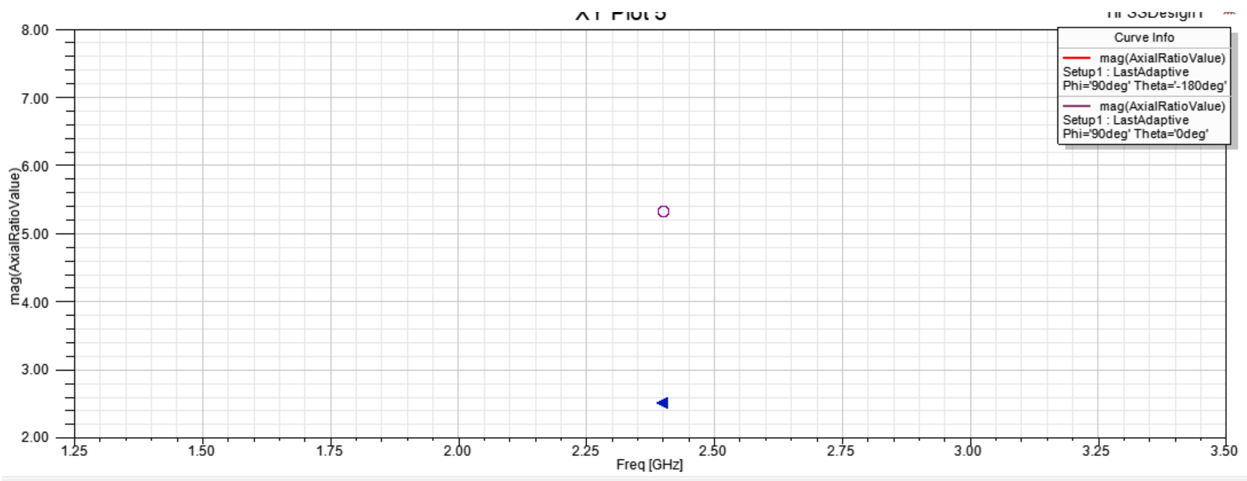
The simulation result for return loss in the frequency of 2.4GHz The return loss for this antenna is obtained as



less than -10db and the gain is increased.

Return loss for proposed antenna with DGS

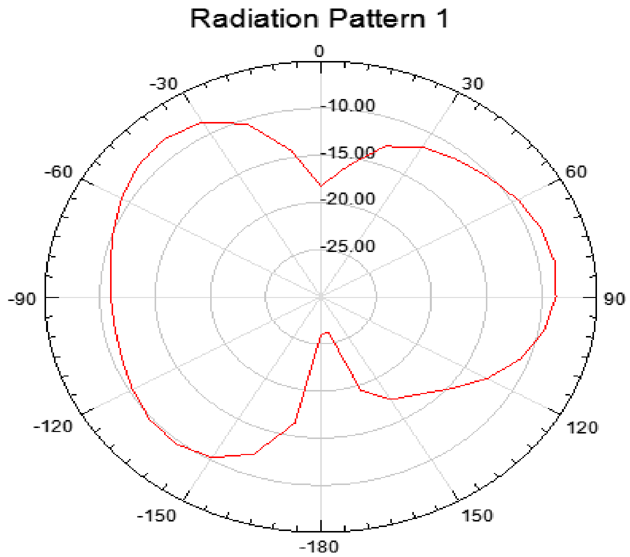
- The axial ratio is obtained as less than 3db ,so good performance can be achieved by using defective ground structure.



Axial ratio for proposed antenna with DGS

- The antenna pattern is graphical representation in three dimensional of the radiation of the antenna as the function of direction. The radiation pattern is the locus of points with the same electrical field. The radiation pattern is a graphical depiction of the relative field strength transmitted from or received by the antenna.

Antenna radiation patterns are taken at one frequency, one polarization, and one plane cut. The patterns are usually presented in polar or rectilinear form with a dB strength scale.



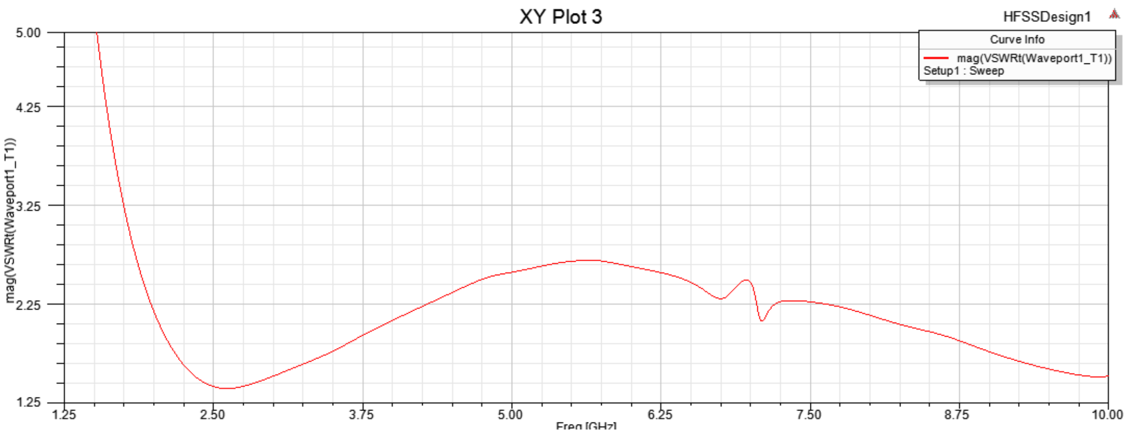
Radiation pattern for proposed antenna with DGS

- The ratio of the maximum to minimum voltage is known as VSWR, or Voltage Standing Wave Ratio. VSWR define as the ratio between maximum voltage and minimum voltage.

$$VSWR=\frac{Emax}{Emin}=\frac{Ei+Er}{Ei-Er}$$

$$S=\frac{(1+Reflectioncoefficient)}{(1-Reflection\ coefficient)}$$

The most common case for measuring and examining VSWR is when installing and tuning transmitting antenna. VSWR value given by s=1.003.Ideally, the VSWR must lie in the range of 1-2 which is achieved in fig.4.3 for 2.4 GHZ frequency range.



VSWR plot for proposed antenna

IV. CONCLUSION

The purpose of this thesis is successfully completed as the study and design has been made with the circularly polarized antenna. This way, we can make efficient and useful devices that can help in medical field development as well as wireless communication field development . The reduced sized devices are used to handle the cases by deep analysis as help to diagnosis of the tissues clearly. It also makes the devices more reliable and comfortable for the users. Thus we have designed a circularly polarized antenna which is used for biomedical applications. In this size of an antenna has been decreased and hence to increase bandwidth .

REFERENCES

[1] C. Liu, S. Xiao, Y. X. Guo, Y.-Y. Bai, M.-C. Tang and B.-Z. Wang, "Compact Circularly-Polarized Microstrip Antenna with Symmetric-slit, " Electronics Lett., vol.48,noA, pp. 195-196, Feb. 2012

[2] Z. Duan, Y.X. Guo, R.F. Xue, M. Je, and D.L. Kwong, “Differentially-fed dual-band implantable antenna for biomedical applications,” *IEEE Trans.on Antennas and Propagat*., vol. 60, no.12, pp. 5587-5595, Dec 2012.

[3] P. Soontornpipit, C. M. Furse, and Y. C. Chung, “Design of implantable Microstrip antenna for communication with medical implants,” *IEEE Trans. Microw. Theory Tech.*, vol. 52, no. 8, pp. 1944–1951, Aug. 2004.

[4] C. R. Liu, Y. -X. Guo and S. Q. Xiao, “Capacitively loaded circularly polarized implantable patch antenna for ISM band biomedical applications,” *IEEE Trans. Antennas Propag*., vol. 62, no. 5, pp. 2407-2417, May. 2014

[5] Li-Jie Xu, Y. X. Guo, and W. Wu, “Miniaturized Circularly Polarized Loop Antenna for Biomedical Applications*,” IEEE Trans. Antennas Propag*., vol. 63, no.3, pp.922–930. March 2015.

[6] Changrong Liu1,2, Yong-Xin Guo and Shaoqiu Xiao(2013) “ Small Circularly Polarized Implantable Antennas” IEEE Transaction Antennas Propagation, volume 60, pp. 36–43.

[7] Yong-Xin Guo1,2 and Changrong Liu1 “Miniaturized Implantable Circularly PolarizedPatch Antenna” IEEE Transaction Antennas Propagation, volume 60, pp. 36–43.

[8] Changrong Liu, Student Member, IEEE, Yong-Xin Guo, Senior Member, IEEE, and Shaoqiu Xiao, Member “Capacitively Loaded Circularly Polarized Implantable Patch Antenna for ISM Band Biomedical Applications” IEEE Transaction Antennas Propagation, volume 60, pp. 36–43.

[9] Wen Lei, Hui Chu and Yong-Xin Guo “Design of a Circularly Polarized Ground Radiation Antenna for Biomedical Applications” IEEE Antennas And Wireless Propagation LETTERS, VOL. 14, 2015 783.

[10] Changrong Liu*,* Student Member*,* Rangarajan Jegadeesan, and Shaoqiu Xiao*,* Member*, IEEE*, Yong-Xin Guo*,* Senior Member*," In Vivo* Testing of Circularly Polarized Implantable Antennas in Rats “

[11] F. AbuTarboush (2012) “A reconfigurable wideband and multiband antenna using dual-patch elements for compact wireless devices”, IEEE Transaction Antennas Propagation, volume 60, pp. 36–43.

[12] M. Abdallah, L.Lecoq, F.Colombel, G.Le Ray and M.Himdi (2009) “Frequency tunable monopole coupled loop antenna with broad side radiation pattern”, Electron. volume 45, pp. 1149–1151.