International Journal of Scientific Research in Science, Engineering and Technology

Print ISSN - 2395-1990
Online ISSN : 2394-4099

OPEN ACCESS

Available Online at : www.ijsrset.com
doi : https://doi.org/10.32628/IJSRSET

A Novel E-Shapped DGS Incorporated Implantable Antenna for Biomedical Applications

G. Shankara Bhaskara Rao[1], P. K. R. Bhagya Lakshmi[2], V. Pradeep Reddy[3], P. Priyanka[4], N. Maruthi[5], S.B.S.S. Raja[6]

[1*]Associate Professor, Department of Electronics and Communication Engineering, Sri Vasavi Engineering College, Tadepalligudem, Andhra Pradesh, India.

[2,3,4,5,6*]U.G Student, Department of Electronics and Communication Engineering, Sri Vasavi Engineering College, Tadepalligudem, Andhra Pradesh, India.

ARTICLEINFO

Article History:

Accepted: 15 March 2024
Published: 04 April 2024

Publication Issue :
Volume 11, Issue 2
March-April-2024
Page Number :
155-160

ABSTRACT

This paper represents designing & analysis of E-shape microstrip patch antenna for wireless communication. Low volume, low profile configuration, easily mounted, light weight,,low fabrication cost is the advantages of this antenna. The operating frequencies of antenna are 2.4 GHz the substrate RT DUROID 5880 is used for proposed antenna with dielectric constant (2.2) and thickness of (1.0mm). Two slots are cut to form the E-shape , which provides a bandwidth of 400 mhz . The E-shape has return loss of -15.49dB and gain of 7.1dB at operating frequencies 2.4 GHz respectively. Designing and simulation of this antenna has been done by the help of HFSS Software. This antenna is fed by a co-axial probe feeding.In this paper, the effects of different types of antenna parameters studied.

Keywords: Co-Axial Feed Antenna, Compact Wireless Antenna, Microstrip Patch Antenna, Patch Antenna, E-Shaped Antenna, HFSS

I. INTRODUCTION

In the recent world, the demand for low weight, cheap, low profile and efficient antennas is increasing microstrip patch antenna and are more popular for meeting these requirements in several applications. The main problem encountered with these such kind of patch antennas is high value of return loss and smaller impedance bandwidth, but theses problem can be solved by using some new designing approaches. The microstrip patch antenna offers the advantages of low profile, case of fabrication, and compatibility with integrated circuit technology. They can be designed to operate over a large range of frequencies (1-40 GHz) and easily combine to form linear or planar arrays. A microstrip patch antenna is types of antennas that offers a low profile. i.c., thin and easily manufacture ability, size reduction, increasing gain, wide bandwidth, multiple functionality and system-level integration. Significant research work has been reported on increasing the gain and bandwidth of microstrip antennas. In this

paper, an attempt has been made to design a single band microstrip antenna without any geometrical complexities. An E-shaped patch antenna is easily formed by cutting two slots from a rectangular shape. By cutting the slots from a patch, gain, return loss and bandwidth of microstrip antenna can be improved. The increased development of wireless communications, the urgency to design low volume, compact, low profile planar configuration and wideband multi-frequency planar antennas become highly desirable Narrow bandwidth is a serious The growing interest in wireless in-body communications is demanding more and more compact and high performance antennas. Wireless medical applications constitute one of these fields of interest. In particular, leadless pacemakers constitute a case where miniaturized implantable antennas are needed to keep the heart at an adequate rate. Then, the need for trusty and wireless communications is essential in keeping the patient in a state as safe as possible. In this sense, implantable antennas play a fundamental role in the wireless communication between the implanted device within the body and the circuitry outside it. Conventional implantable antennas face numerous challenges, including limited bandwidth, reduced efficiency, and susceptibility to electromagnetic interference (EMI). To address these issues, innovative antenna designs are continually being explored. In this context, the integration of Defected Ground Structures (DGS) has emerged as a promising approach to enhance antenna performance.

This paper presents a novel E-shaped DGS-incorporated implantable antenna designed specifically for biomedical applications. The proposed antenna leverages the benefits of both the E-shaped radiating element and the DGS structure to achieve improved performance metrics, including enhanced bandwidth, increased efficiency, and reduced sensitivity to surrounding biological tissues

Overall, the development of novel implantable antennas holds significant promise for advancing the capabilities of implantable medical devices, paving the way for improved patient care and enhanced healthcare outcomes.

II. METHODOLOGY

In this proposed antenna the size of the patch is 42x50mm. The top view of the proposed antenna as shown in the figure1.

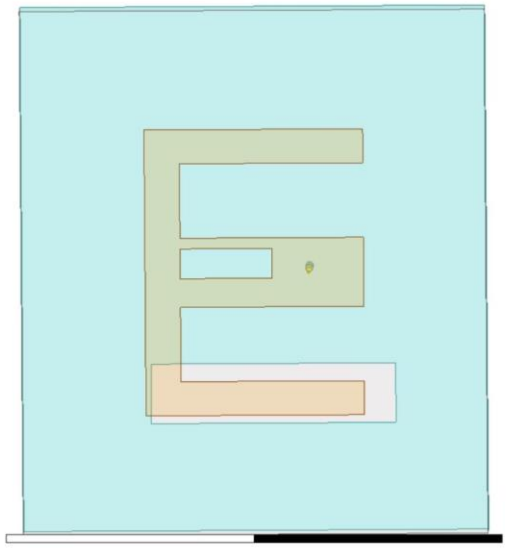

Fig 1. Top View of Proposed Antenna

Table 1: Dimensions of the proposed antenna

S. No	Name of the parameter	Unit(mm)
1	Length of the substrate	48mm
2	Width of the substrate	56mm
3	Height of the substrate	6.7mm
4	Length of the slot	32mm
5	Width of the slot	41mm
6	Height of the patch	40mm
7	Width of the patch	36mm

III. DESIGN STAGES OF PROPOSED ANTENNA

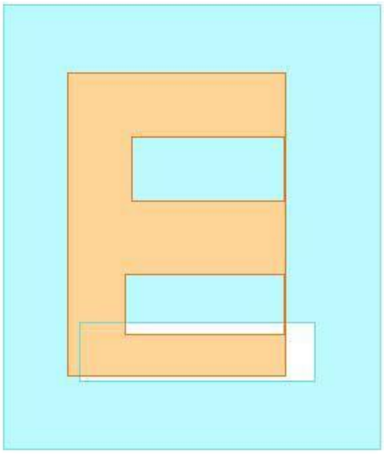

Fig 2: 1st iteration of proposed antenna

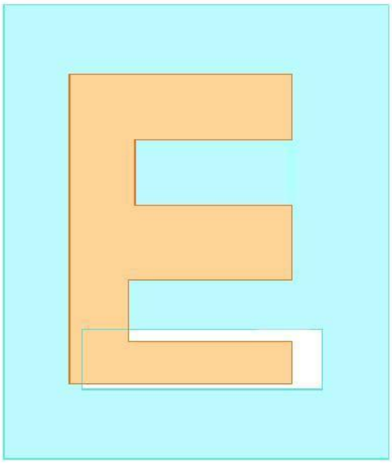

Fig 3: 2nd iteration of proposed antenna

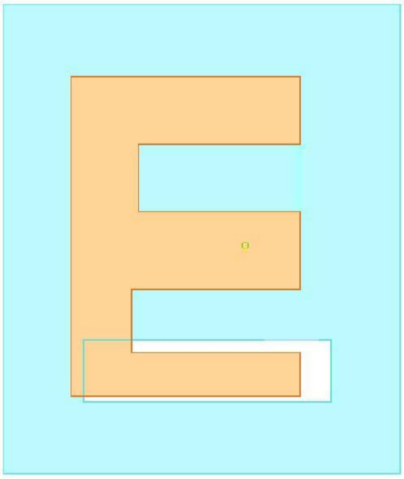

Fig 4: 3rd iteration of proposed antenna

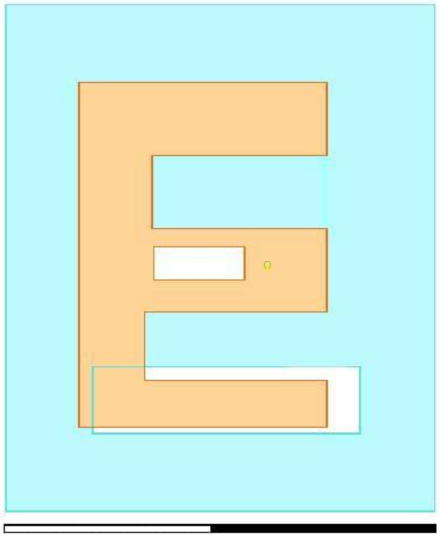

Fig 5: 4th iteration of proposed antenna

IV. RESULTS

The proposed antenna is designed with the resonant frequency 2.4 GHz using RT-Duroid as a dielectric substrate.

Return Loss or S11 (S-Parameters):

An antenna's Return Loss is a figure that indicates the proportion of radio waves arriving at the antenna input that are rejected as a ratio against those that are accepted.

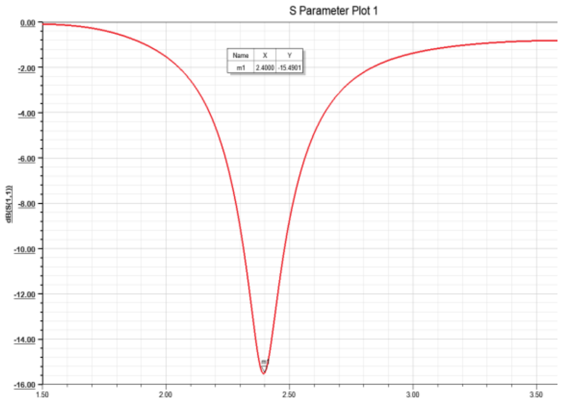

Fig 6: S-Parameter iteration

The figure 6 shows the S-parameters of the proposed antenna. It shows the S11 parameter the iteration is -15.49dB.

GAIN:

It states that the ratio of output power radiated in a particular direction to the total input power given to the antenna.

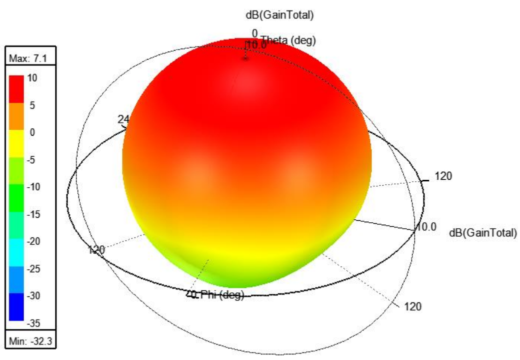

Fig 7: Gain iteration

The figure 7 shows the gain shows the gain of the proposed antenna. It shows that the gain of the iteration is 7.1dB.

VSWR:

VSWR stands for Voltage Standing Wave Ratio. It states that the power reflected from the antenna. The range of VSWR varies between 1 to ∞. VSWR value under 2 is most suitable for Ultra-wide band applications.

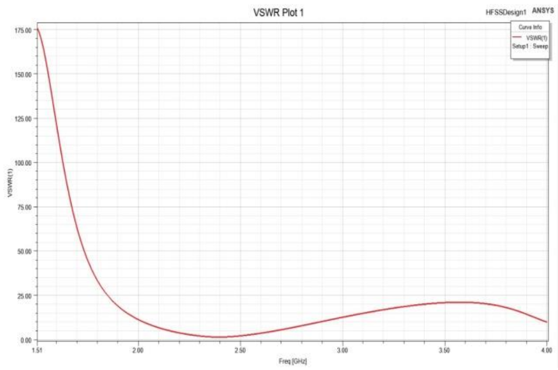

Fig 8: VSWR iteration

The figure 8 shows the VSWR of the proposed antenna. It shows that VSWR iteration is 1.407.

ELECTRIC FIELD DISTRIBUTION:

The surface currents are showing perfectly at the edges than at the middle and the middle is not that much radiated. Hence, the field is perfectly distributed.

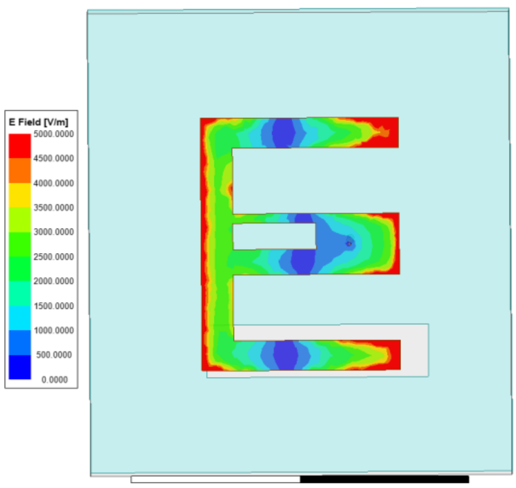

Fig 9: Field Distribution iteration

CURRENT DISTRIBUTION:

Current radiated maximum at the center when compared to the edges. The less current radiated at the edges.

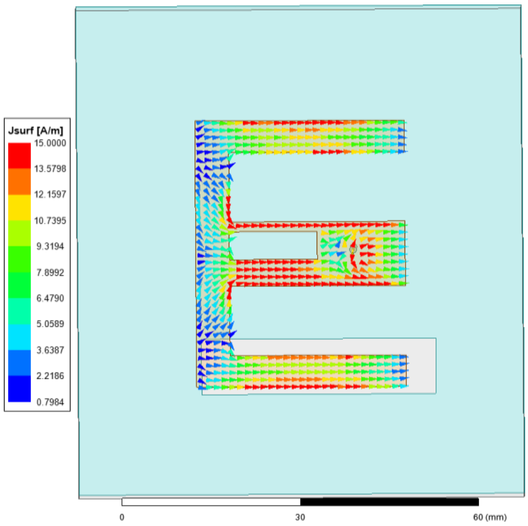

Fig10: Current Distribution iteration

RADIATION PATTERN:

The radiation pattern for E shapped patch antenna at 2.4Ghz is shown as

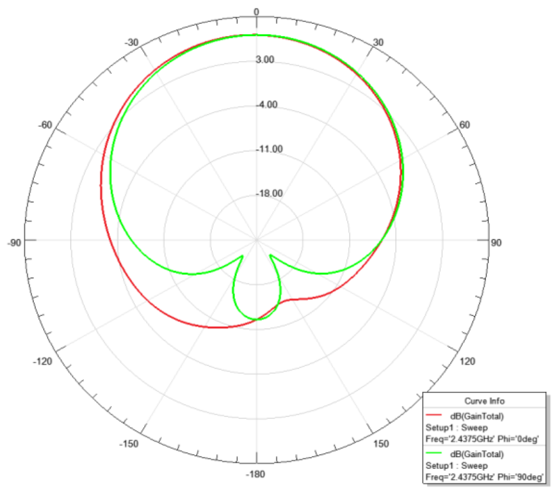

Fig 11: Radiation Pattern iteration

COMPARISION TABLE:

Frequency	parameter	Output(dB)
2.4Ghz	S11	-15.49
2.4Ghz	Gain	7.1
2.4Ghz	VSWR	1.407

Table 2: Comparison Table

The above table shows the comparison among the iterations of the proposed antenna. We can notice that the S11 parameter iteration is below -17dB.The gain is enhanced in the iteration and the VSWR iteration is above 1.

V. CONCLUSION

The main aim of this paper is to enhance the gain for every iteration of the proposed antenna. It was observed that the S11 parameter iteration is -15.49dB, the gain iteration is 7.1dB and the VSWR iteration is 1.407. The proposed antenna will be operated in S, C frequency band range.

VI. REFERENCES

[1]. B. Biswas, A. Karmakar, and V. Chandra, “Miniaturised wideband ingestible antenna for wireless capsule endoscopy,” IET Microwaves, Antennas & Propagation, 2019.

[2]. K. Zhang, C. Liu, X. Liu, H. Cao, Y. Zhang, X. Yang, and H. Guo, “A conformal differentially fed antenna for ingestible capsule system,” IEEE Transactions on Antennas and Propagation, 2018.

[3]. A. Lamkaddem, A. E. Yousfi, L. E. G. Munoz, and D. Segovia- ˜ Vargas, “A compact wideband circularly polarized implantable antenna for cardiac pacemaker devices,” in 2021 International Conference on Electromagnetics in Advanced Applications (ICEAA), 2021.

[4]. C. Liu and Y. Guo and S. Xiao, “Capacitively loaded circularly polarized implantable patch antenna for ism band biomedical applications,” IEEE Transactions on Antennas and Propagation, 2014.

[5]. C. Liu, Y. Guo, and S. Xiao, “Circularly polarized helical antenna for ism-band ingestible capsule endoscope systems,” IEEE Transactions on Antennas and Propagation, vol.2014.

[6]. G. Lippi and F. Sanchis-Gomar, "Global epidemiology and future trends of heart failure", AME Medical Journal, vol. 5, 2020.

[7]. M. Zada, I. A. Shah, A. Basir and H. Yoo, "Ultra-compact implantable antenna with enhanced performance for leadless cardiac pacemaker system", IEEE Transactions on Antennas and Propagation, vol. 69, no. 2, pp. 1152-1157, 2021.

[8]. A. Lamkaddem, A. El Yousfi, K. A. Abdalmalak, V. G. Posadas, L. E. García-Muñoz and D. Segovia-Vargas, "A compact design for dual-band implantable antenna applications", 2021 15th European Conference on Antennas and Propagation (EuCAP), 2021.

[9]. X. Y. Liu, Z. T. Wu, Y. Fan, and E. M. Tentzeris, “A miniaturized csrr loaded wide-beamwidth circularly polarized implantable antenna for subcutaneous real-time glucose monitoring,” IEEE Antennas and Wireless Propagation Letters, vol. 16, pp. 577–580, 2017.

[10]. R. Li, Y. Guo, B. Zhang, and G. Du, “A miniaturized circularly polarized implantable annular-ring antenna,” IEEE Antennas and Wireless Propagation Letters, vol. 16, pp. 2566–2569, 2017.

[11]. L. Xu, Y. Bo, W. Lu, L. Zhu, and C. Guo, “Circularly polarized annular ring antenna with wide axial-ratio bandwidth for biomedical applications,” IEEE Access, vol. 7, pp. 59 999–60 009, 2019.