



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 4, April 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

 9940 572 462

 6381 907 438

 ijirset@gmail.com

 www.ijirset.com

Design and Simulation of Meander Line Antenna using Defected Ground Structure for LTE Communications

Sri. A. Rajasekhar, M. Anvitha, Y. Manasa, P. Anusha, P. Sarath Chandra

Assistant Professor, Department of Electronics and Communication Engineering, N.B.K.R, Institute of Science and Technology, Vidyanagar, Andhra Pradesh, India

U.G. Students, Department of Electronics and Communication Engineering, N.B.K.R. Institute of Science and Technology, Vidyanagar, Andhra Pradesh, India

ABSTRACT: Wireless communications performance depends on the efficiency of the antenna design in any wireless device. Achieving long term evolution frequency bands using a small-size antenna in a compact device remains a major technical challenge. This paper demonstrates the design and simulation of meander line antenna for a wireless local area network application using defected ground structure. The performance of the proposed design has been analyzed using various parameters like bandwidth, directivity, radiation pattern, return loss, etc. The performance is optimized by introducing defective ground structure in back plane of antenna. Finally, antenna can operate at less than -10 dB with 2.4GHz. The proposed antenna has great potential to be implemented for Wireless devices such as mobile phones, tabs etc.

I. INTRODUCTION

It is indisputable that antenna plays a significant part in communication system. Therefore, an increasingly number of technicians begin to do some research and development of antenna. However, with rapid development of the communication industry, the requirement of antenna will be achieved with high quality. Nowadays, there are different kinds of antennas in the market such as dipole antenna, patch antenna, loop antenna, meander-line antenna and so on. In order to meet the demand of developing communication equipment the research of antennas focuses on some particular aspect, for instance, how to reduce the size of antennas while maintaining higher radiation efficiency. Meanwhile, with the improvement of Small-Scale Integrated circuits, the size of communications equipment is also getting smaller and smaller. Clearly compared with communication equipment, the dimension of antenna is too large. Therefore, the reduction of antenna size will be our research topic. In our thesis, we are trying to find a good antenna design solution on the reduction of the antenna size while maintaining higher efficiency.

II. RELATED WORK

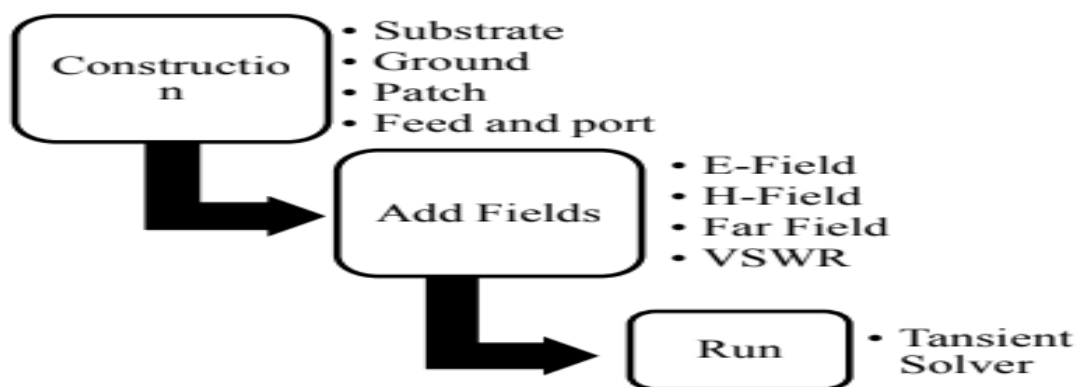
CST MICROWAVE STUDIO is a full-featured software package for Electromagnetic analysis and design in the high frequency range. It simplifies the process of inputting the structure by providing a powerful solid 3D modeling front end. Strong graphic feedback simplifies the definition of your device even further. After the component has been modelled, a fully automatic meshing procedure is applied before a simulation engine is started.

CST MICROWAVE STUDIO is part of the CST DESIGN STUDIO suite and offers a number of different solvers for different types of application. Since no method works equally well in all application domains, the software contains four different simulation Techniques (transient solver, frequency domain solver, integral equation solver, Eigen mode solver) to best fit their particular applications. The most flexible tool is the transient solver, which can obtain the entire broadband frequency behavior of the simulated device from only one calculation run (in contrast to the frequency step approach of many other simulators). It is based on the Finite Integration Technique (FIT) introduced in electrodynamics more than three decades ago. This solver is efficient for most kinds of high frequency applications such as connectors, transmission lines, filters, antennas and more.

III. METHODOLOGY

In addition to the port impedance and S-parameters which are calculated automatically for each port, field quantities such as electric or magnetic currents, power flow, equivalent currents density or radiated far field may be calculated. To invoke the calculation of these output data, use the command Solve Field Monitors. Start the Simulation after defining all necessary parameters. Start the simulation from the transient solver control dialogue box: Solve Transient Solver. In this dialogue box, you can specify which column of the S-matrix should be calculated. Therefore, select the Source type port for which the couplings to all other ports will then be calculated during a single simulation run.

Figure : Design flow



IV. EXPERIMENTAL RESULTS

EXPERIMENTAL SET UP

The figure shown below shows the simulation setup where the antenna is designed and a port is connected to the feed to energize the antenna so that the antenna starts radiating. The antenna parameters like reflection coefficient, Bandwidth, VSWR, Gain, Directivity and radiation pattern were analysed.

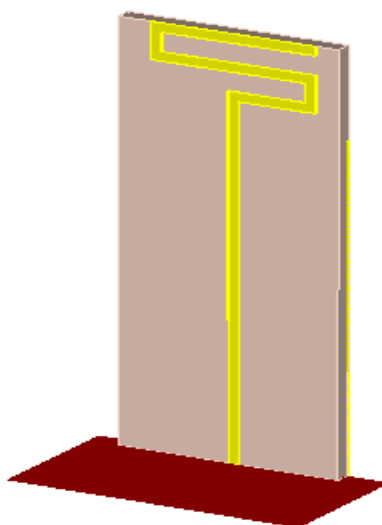


Fig 4.1 Simulation setup in CST Studio

4.1 Reflection Coefficient (S11)

The S11 for the proposed antenna is illustrated in fig 6.2. The proposed antenna has a resonant frequency at $F= 2.38$ GHz. The proposed antenna produces a bandwidth from 1.79 GHz to 2.54 GHz. The return loss obtained for the resonant frequency is around -25.10 dB.

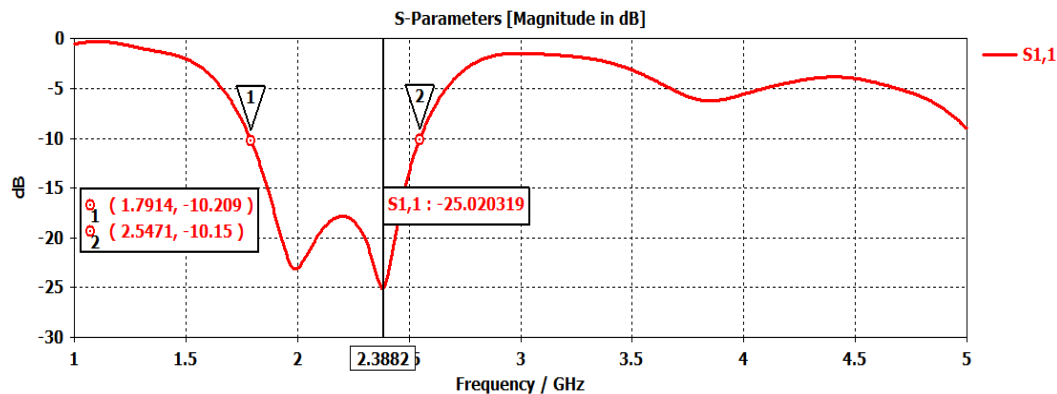


Fig : 4.2 S11 for proposed antenna

4.2 VOLTAGE STANDING WAVE RATIO (VSWR)

VSWR (Voltage Standing Wave Ratio), is a measure of how efficiently radio-frequency power is transmitted from a power source, through a transmission line, into a load (for example, from a power amplifier through a transmission line, to an antenna). In an ideal system, 100% of the energy is transmitted. The VSWR is always a real and positive number for antennas. The smaller the VSWR is, the better the antenna is matched to the transmission line and the more power is delivered to the antenna. The minimum VSWR is 1.0. In this case, no power is reflected from the antenna, which is ideal.

Often antennas must satisfy a bandwidth requirement that is given in terms of VSWR. For instance, an antenna might claim to operate from 100-200 MHz with $VSWR < 3$. This implies that the VSWR is less than 3.0 over the specified frequency range. This VSWR specifications also implies that the reflection coefficient is less than 0.5.

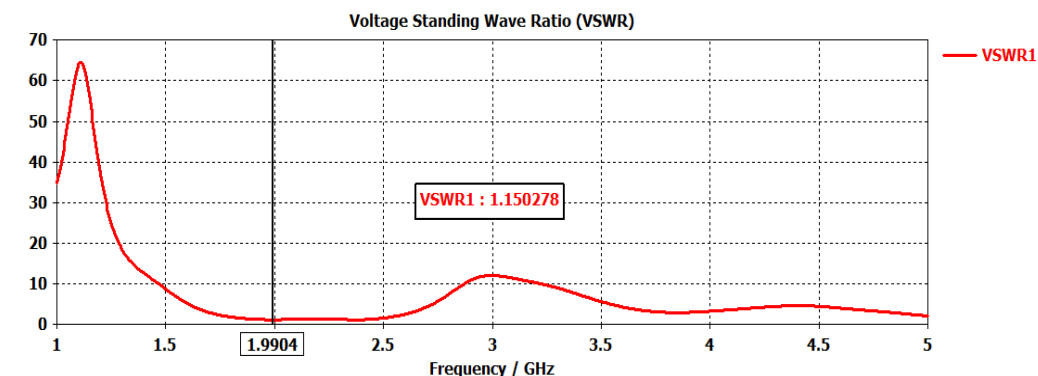


Fig 4.3 VSWR for proposed antenna

4.3 GAIN OF PROPOSED ANTENNA DESIGN

The obtained gain for the proposed antenna design is around 1.839 dBi. The 3d view of the antenna gain is shown in fig. 6.4. The gain is calculated for the resonant frequency $f=2.38$ GHz.

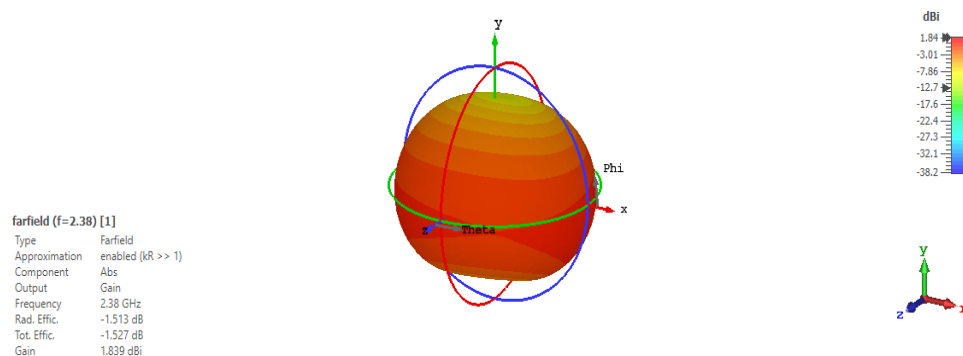


Fig 4.4 Obtained Gain for proposed antenna

4.4 DIRECTIVITY OF PROPOSED ANTENNA DESIGN

The obtained directivity for the proposed antenna design is around 3.35 dBi. The 3d view of the antenna directivity is shown in fig. 6.5. The directivity is calculated for the resonant frequency $f=2.38$ GHz.

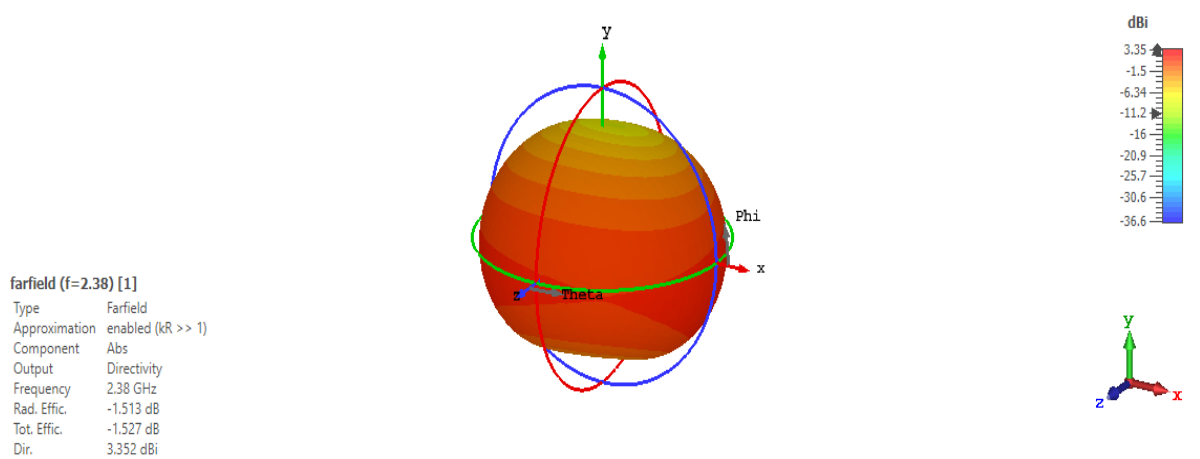


Fig Obtained Directivity for proposed antenna

4.5 RADIATION PATTERN OF PROPOSED ANTENNA

The energy radiated by an antenna is represented by the Radiation pattern of the antenna. Radiation Patterns are diagrammatical representations of the distribution of radiated energy into space, as a function of direction. The radiation patterns can be field patterns or power patterns. The field patterns are plotted as a function of electric and magnetic fields. They are plotted on logarithmic scale. The power patterns are plotted as a function of square of the magnitude of electric and magnetic fields. They are plotted on logarithmic or commonly on dB scale. The major part of the radiated field, which covers a larger area, is the main lobe or major lobe. This is the portion where maximum radiated energy exists. The direction of this lobe indicates the directivity of the antenna. The other parts of the pattern where the radiation is distributed side wards are known as side lobes or minor lobes. These are the areas where the power is wasted.

4.5.1 H-PLANE RADIATION PATTERN OF PROPOSED ANTENNA DESIGN

The H-plane radiation pattern is generated by selecting ($\phi=90$) and the corresponding graph is shown in fig 6.6. In this radiation pattern the shape is in donut shape and the main lobe is directed towards 154° at frequency $f=2.38$ GHz.

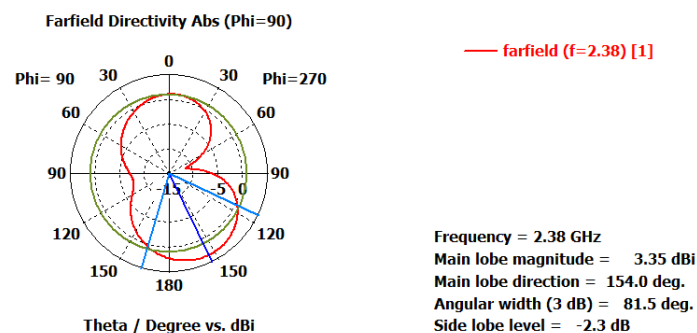


Fig : H-plane radiation pattern of Proposed Antenna

4.5.2 E-plane radiation pattern of Proposed Antenna

The E-plane radiation pattern is generated by selecting (phi=0) and the corresponding graph is shown in fig 6.7. In this radiation pattern the shape is in donut shape and the main lobe is directed towards 176° at frequency f=2.38GHz.

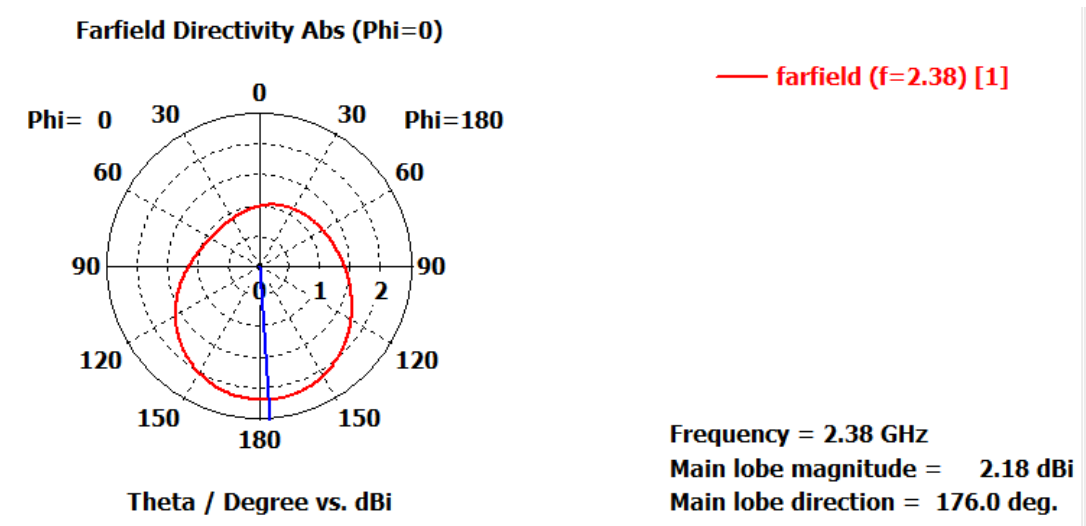


Fig : E-plane radiation pattern of Proposed Antenna

V. CONCLUSION

A novel circular microstrip patch antenna was designed and simulated in CST studio software tool for microwave applications. The designed antenna is 45X20mm dimension which is very compact in size. The designed antenna is able to resonate at 1.8 GHz frequency and produce a gain and directivity of 1.89 and 3.352 dBi respectively. The performance of the antenna is obtained by introducing partial ground. Because of the introduction of partial ground, the ability to provide better gain is reduced. Since a full ground will act as reflector. The return loss value obtained for the resonant frequency of 2.38 GHz is -25.10 dB with bandwidth of 0.75GHz. Currently in INDIA, 4G LTE band-40 having 2300 to 2400 MHz (TD-LTE) frequency range is active (online) and offered by the operators in Indian territory. The other LTE band in 1800 MHz (FDD-LTE) frequency is also auctioned by the INDIA government. The proposed antenna is suitable for the above mentioned 4G LTE frequency band

REFERENCES

1. Jais, Mohd Ilman et al. "Design Analysis of 2.45 GHz Meander Line Antenna (MLA)." 2012 Third International Conference on Intelligent Systems Modelling and Simulation (2012): 628-631.
2. Islam, Syed Md. Anwarul et al. "Design and Simulation of Triangular Shaped Meander-Line Antenna." (2019).
3. Mufti, Saad Ehsan et al. "Design and fabrication of meander line antenna on glass substrate." 2013 Loughborough Antennas & Propagation Conference (LAPC) (2013): 559-562.
4. Jais, Mohd Ilman et al. "High gain 2.45 GHz 2x2 patch array stacked antenna." 2015 International Conference on Computer, Communications, and Control Technology (I4CT) (2015): 589-592.
5. Nej, Sanjukta and Anumoy Ghosh. "Design of Meander Line Triple Band Antenna for Wireless Applications." 2020 Fourth International Conference on Computing Methodologies and Communication (ICCMC) (2020): 690-693.
6. Rahman, C. Abdul and H. Umma Habiba. "Design and Fabrication of Microstrip Planar Antenna with Meander – Line Structure in GSM Band." (2019).
7. M. Jusoh, M. F. Jamlos, T. Sabapathy, M. I. Jais and M. R. Kamarudin, "A simple design of compact patch antenna with high directional beam", *Antennas and Propagation Society International Symposium (APSURSI) 2013 IEEE*, pp. 1838-1839, 2013.
8. T. Sabapathy, M. F. Jamlos, M. Jusoh, M. I. Jais and M. R. Kamarudin, "Gain enhancement of circular patch antenna using parasitic ring", *Antennas and Propagation Society International Symposium (APSURSI) 2013 IEEE*, pp. 1836-1837, 2013.
9. M. F. Ismail, M. K. A. Rahim, M. R. Hamid and H. A. Majid, "Dual-fed circular polarization compact array antenna", *Applied Electromagnetics (APACE) 2012 IEEE Asia-Pacific Conference on*, pp. 116-119, 2012.
10. H. Chih-Yu, W. Jian-Yi and W. Kin-Lu, "Cross-slot-coupled microstrip antenna and dielectric resonator antenna for circular polarization", *Antennas and Propagation IEEE Transactions on*, vol. 47, pp. 605-609, 1999.
11. H. Iwasaki, "A circularly polarized small-size microstrip antenna with a cross slot", *Antennas and Propagation IEEE Transactions on*, vol. 44, pp. 1399-1401, 1996.
12. N. Minh Tuan, K. Byoungchul, C. Hosung and P. Ikmo, "Effects of ground plane size on a square microstrip patch antenna designed on a low-permittivity substrate with an air gap", *Antenna Technology (iWAT) 2010 International Workshop on*, pp. 1-4, 2010.
13. M. I. Jais, M. F. Jamlos, M. F. Malek, M. Jusoh, I. Adam, N. I. Iliyes et al., "Design Analysis of 2.45 GHz Meander Line Antenna (MLA)", *Intelligent Systems Modelling and Simulation (ISMS) 2012 Third International Conference on*, pp. 628-631, 2012.
14. Seahee Hwangbo, Hae Yong Yang and Yong-Kyu Yoon, "Mutual coupling reduction using micromachined complementary meander line slots for a patch array antenna", *IEEE Antenna Wireless Propag. Lett.*, Feb 2017.
15. Pooja Gupta, G.S. Tripathi and Sudhanshu Verma, "A compact MIMO antenna of meander-line structure for Wi-Fi application", *International Conference on Emerging Trends in Electrical Electronics and Sustainable Energy Systems (ICETESES-16)*, pp. 95-98, 2016.
16. Yishan Liang, Yuan Yao, Junsheng Yu and Xiaodong Chen, "Design of a novel meander line reader antenna for UHF near-field RFID", *Int. Symposium on Ant. Propag and EM Theory*, pp. 19-21, 2016.



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details