MULTI-BAND LADDER-SHAPE MICROSTRIP PATCH ANTENNA.

Venkata Raviteja.K[1], Dr.K.S.N Murthy[2], I.Govardhani[3], M.Venkata Narayana[4]

Abstract: Now a day's broad-band antennas gaining importance because of their usage at high frequencies and ability to achieve high speed data communication. Microstrip patch antennas are of such type and are increasing in popularity for use in wireless applications. They are widely used because of their several advantages such as light weight, low volume, low fabrication cost and compatability with integrated circuit technology operating in multiple bands with multiple polarizations. Here we are using ladder shaped microstrip patch antenna with which it achieves dual band of frequencies. Significant reduction of antenna size can be realized when the H-shaped patch is used instead of the conventional rectangular microstrip patch antenna. By using the proposed antenna we can simulate return loss, gain, axial ratio and radiation patterns at these dual band of frequencies achieving circular polarization.

Key Terms- Microstrip patch antenna, Ladder-shape, gain, return loss

1.Introduction:

The W band of the microwave part of the electromagnetic spectrum ranges from 75 to 110 GHz. It is used for satellite communications, millimeter wave radar research, military radar targeting and tracking applications, and some non-military applications. In terms of communications capability, W-band offers high data rate throughput when used at high altitudes and in space. Microstrip or patch antennas are becoming increasingly useful because they can be printed directly onto a circuit board. This type of antennas are becoming widespread usage within the mobile phone market.

In this paper ladder shaped antenna is designed with single polarization and dual frequency using coaxial feed. Dual frequency operations can be realized by exciting the microstrip patch antenna using a single feed or dual feed. The proposed antenna works in w band ranging from 75-110 GHz. It is well suited for satellite communications and millimeter wave radar applications.

2.Antenna Design considerations:

The proposed structure of the antenna is simulated on an Rogers RT/duroid 5880(tm) substrate with dielectric constant of 2.2 and a loss tangent of 0.0009 and simulated at dual frequencies of 89 GHz and 92 GHz frequencies respectively. 'L' is the resonant length of patch which is 2cm, width of the patch is 0.5cm and height of the dielectric substrate should be in between 0.003 λ_0 and 0.05λ_0. We have taken 0.02 times of λ_0. As 50Ω coaxial cables are used normally, feed point is taken where 50Ω resistance occurs.

3.Antenna Model:

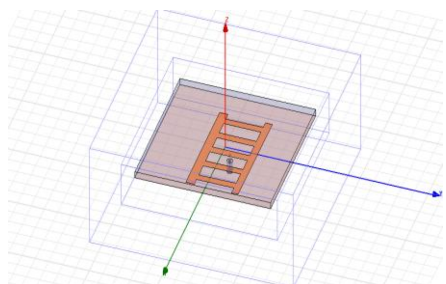

Fig1: Antenna Model.

4.HFSS:

HFSS is a high-performance full-wave electromagnetic (EM) field simulator for arbitrary 3D volumetric passive device modeling that takes advantage of the familiar Microsoft Windows graphical user interface. It integrates simulation, visualization, solid modeling, and automation in an easy-to-learn environment where solutions to your 3D EM problems are quickly and accurately obtained. Ansoft HFSS employs the Finite Element Method (FEM), adaptive meshing, and brilliant graphics to give an unparalleled performance and insight to all of our 3D EM problems. Ansoft HFSS can be used to calculate parameters such as S-Parameters, Resonant Frequency and Fields.

5. Simulation &Analysis:

5.1.Return loss:

It is a measure of the reflected energy from a transmitted signal which is commonly expressed in positive dB's. The larger the value the lesser is the energy that is reflected.

ISSN 2229-5518

The designed antenna is simulated using HFSS software. The results obtained are mentioned below.

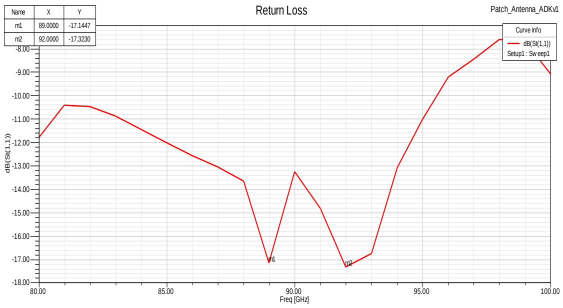

Fig2: Return loss

A return loss of -17.1447 dB at 89 GHz and -17.3230 at 92 GHz is obtained.

5.2. Gain: It is the ratio of the intensity in a given direction to the radiation intensity that would be obtained if the power accepted by the antenna were radiated isotropic ally.

5.2.1. 2-D Gain:

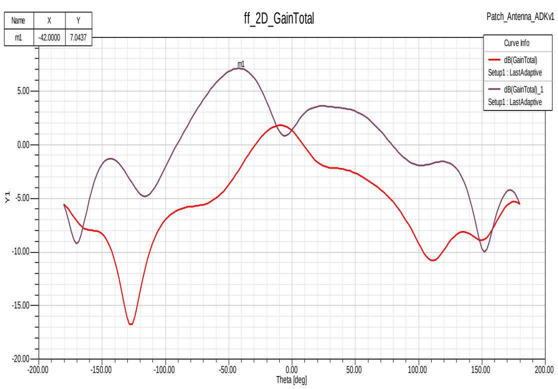

Fig3: 2-D Gain.

5.2.2. 3-D Gain:

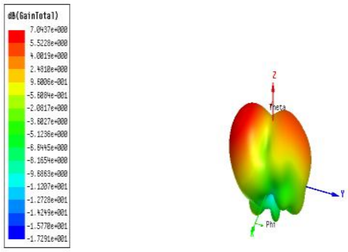

Fig4: 3-D Gain.

For the designed antenna model a 2D and 3D gain of 7.0437 dB is obtained.

5.3 E-field pattern:

An electric field can be visualized by drawing field lines, which indicates both magnitude and direction of the field. Field lines start on positive charge and end on negative charge. The direction of the field line at a point is the direction of the field at that point. The relative magnitude of the electric field is proportional to the density of the field lines.

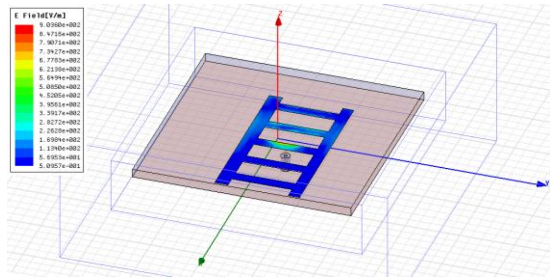

Fig5: E-Field pattern.

5.4. H-field Pattern:

In the case of linearly polarized antenna, this is the plane containing the magnetic field vector and the direction of maximum radiation. The magnetic field or "H" plane lies at a right angle to the "E" plane. For a vertically-polarized antenna, the H-plane usually coincides with the horizontal/azimuth plane. For a horizontally-polarized antenna, the H-plane usually coincides with the vertical/elevation plane.

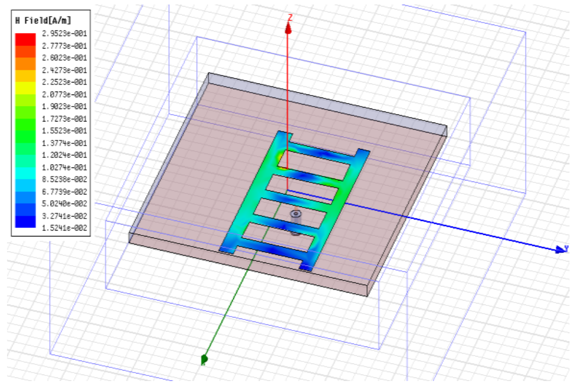

Fig6: H-Field pattern.

5.5. Vector E- Field:

ISSN 2229-5518

The field equations of Einstein Cartan Evans (ECE) are used to develop the concept of the static electric field as a vector boson with spin indices −1, 0, +1, which occur in addition to the vector character of the electric field. The existence of the electric vector boson in physics is inferred directly from Cartan geometry, using the concept of a spinning space-time that defines the electromagnetic field. When the electromagnetic field is independent of the gravitational field the spin connection is dual to the tetrad, producing a set of equations with which we can define the electric vector boson. Angular momentum theory is used to develop the basic concept.

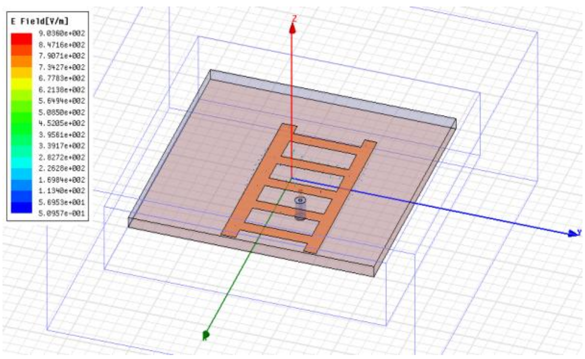

Fig7: Vector E-Field pattern.

5.6. Vector H- Field

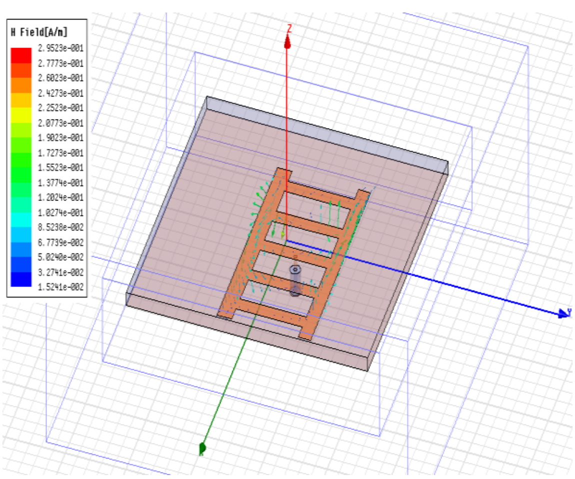

Fig8: Vector H-Field pattern.

5.7. Radiation pattern:

The radiation pattern or antenna pattern describes the relative strength of the radiated field in various directions from the antenna at a constant distance.

5.7.1.Radiation pattern of Gain total:

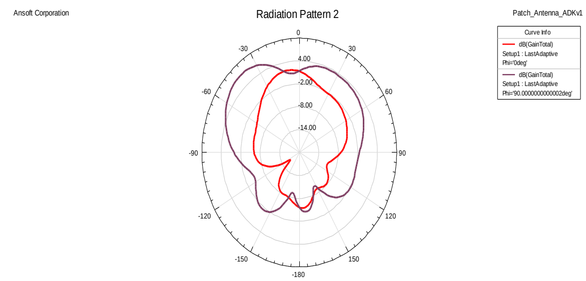

Fig9: Radiation pattern of Gain total.

5.7.2.Radiation pattern of Gain in Theta direction:

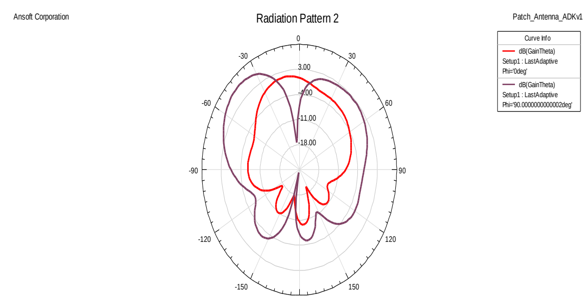

Fig10: Radiation pattern of Gain in Theta direction**.**

5.7.3.Radiation pattern of Gain in Phi direction:

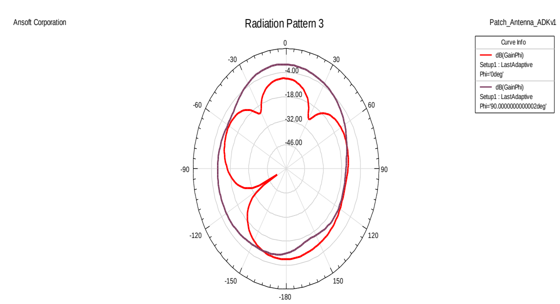

Fig11: Radiation pattern of Gain in Phi direction.

5.8.Axial Ratio:

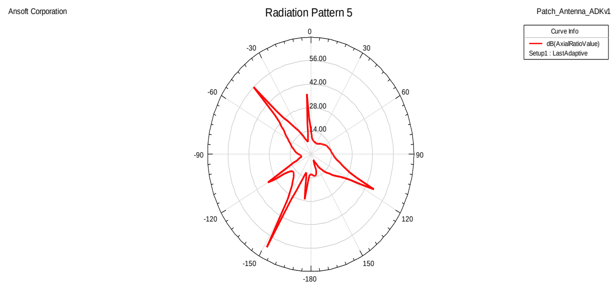

Fig12: Axial Ratio.

Axial Ratio is the ratio of peak value in the major lobe direction to peak value in the minor lobe direction.

6.Conclusion:

Thus the proposed antenna works at dual frequency bands of 89 GHz and 92 GHz which is in the W band range. It is well suited for satellite communications, millimeter wave radar applications**.**

7. Acknowledgement:

We would like to express our sincere thanks to the department of ECE and management of KL University for their continuous support and encouragement in completion of this work.

8.References:

[1] Ramesh Garg, Prakash Bartia, Inder Bhal and Apsiak Ittipiboon, "Microstrip Antenna Design Hand Book," Artech House, Norwood, MA, 200 I .

[2]Comparative Analysis of Exponentially Shaped Microstrip-Fed Planar Monopole Antenna With and Without Notch, International journal of Emerging trends in computing Vol. 2, No.11 , November 2011

M. Venkata Narayana1, I.Govadhani2, K.P.Sai Kumar, K. Pushpa Rupavathi.

[3].Design of coaxial fed Microstrip patch antenna for 2.4Ghz. International journal of Emerging trends in computing Vol. 2, No.12 , December 2011

Govardhani.Immadi,M.S.R.S.Tejaswi,M.VenkataNarayana, N.Anil Babu, G.Anupama, K.Venkata Ravi teja.

[4]. Phased Array Antenna for Millimeter Wave Radar in W-band using Liquid Crystal Substrate International journal of Emerging trends in computing Vol. 2, No.12 , December 2011

I.Govardhani,K.Rajkamal,M.VenkataNarayana, S.Venkateswarlu

[5] D.M.Pozzar "Microstrip Antenna Coupled t o Microstripline," Electron Lett., vol. 21, no.2, pp. 49-50, January 1995.

[6] K.-L. Wong and J.Y. Sze, "Dual frequency slotted rectangular microstrip antenna", Electron Lett 34 (1998). 1368-1370

[7] J.S. Row and K.W. Lin, "low profile design of dual-frequency and dual-polarised triangular microstrip antennas", Electron Lett 40 (2004), 153-154.

[8] J.s. Row, "Dual-frequency dual-polarized microstrip antenna fed by an inclined slot", Microwave Opt Technology Lett 41 (2004), 512-514

[9] J.Y. Jan, "Low-profile dual-frequency circular microstrip antenna for dual ISM bands", Electron Lett (2001), 999-1000.

[10] G.S. Binoy, CK Aanandan, P. Mohanan, K. Vasudevan, and K.G. Nair, "Single feed dual Frequency dual polarized slotted square microstrip antenna, Microwave Opt Technol Lett 25 (2000).395-397.

[11] Che-Wei Suo Jeen-Sheen Row, A single-feed dual frequecy dual polarized microstrip antenna Vol. 47, No. 2, 2005

[12] Zeland Software Inc., "IE3D Electromagnetic Simulation and optimization package, Version 14.2".

[13] J. R. James, P. S. Hall, and C. Wood, *Microstrip Antenna Theory and Design*. London, U.K.: Peregrinus, 1981.

[14]V.Palanisamy and R. Gary,Rectangular ring and H shaped microstrip antennas-alternatives to rectangular patch antennas, IEE Electron. Lett, Vol.21, no.19 , pp.874~876, 1985

[15]Dilbagh Singh, Christos Kalialakis, Peter Gardner," Small H-Shaped Antennas for MMIC Applications", IEEE Transactions on antennas and propagation, Vol.48, No,7 ,pp.1134-1141,July2000

[16]M.EI Yazidi, M. Himdi and J. P. Daniel,Transmission line analysis of nonlinear slot coupled microstrip antenna□, Electronics Letters,Vol.28 No.15,16h July 1992

[17]MITSUO MAKIMOTO and SADAHIKO YAMOSHITA,Bandpass Filters Using Parallel Coupled Stripline Stepped Impedance Resonators □ , IEEE Transactions on microwave theory and techniques, Vol, MTT-28, No.12 , December,1980

[18]Jaume Auguera□Lluis Boada□Carles Puente□Carmen Boarja□Jordi Soler□□Stacked H-Shaped Microstrip patch Antenna ,IEEE TRANSACTIONS ON ANTENNAS AND PROPAGATION,Vol.52,No,4,April,2004

[19]Y. Qin, S. Gao, A. Sambell, E. Korolkiewicz and M. Elsdon," Broadband patch antenna with ring slot coupling",
Electronics Letters,Vol.40 No.1,8th January 2004

[20] J. P. Kim, W. S. Park "Analysis and network modeling of an aperture-coupled microstrip patch antenna," *IEEE Trans. Antennas Propagat.*, vol. 49, pp. 849-854, June 2001.

[21] J. P. Kim, W. S. Park "An improved network modeling of slot-coupled microstrip lines," *IEEE Trans. Microwave Theory Tech.*, vol. 46, pp. 1484-1491, October 1998.

[22] D. G-Kurup, A. Rydberg, and M. Himdi, "Transmission line model for field distribution in microstrip line fed H-slots," *Electron. Lett.*, vol. 37, no. 14, July 2001.
1893.

9.Authors Biography:

Venkata Raviteja. K pursuing his Masters degree in KL University. He completed B.Tech in Electronics & Communication Engineering from Vignan's Engineering college, Vadlamudi affiliated to JNTU, Hyderabad in 2008. His areas of interest are Antennas, Wireless Communication & Image processing.

Dr. K.S.N Murthy working as professor in KL University. He has 25 years of teaching experience. He taught nearly 12 different electronics subjects to his credit and 8 students got M.Phil degrees in Electronics under his guidance. He obtained his Ph.D degree from Acharya Nagarjuna University in 2010. He is having 4 publications out of which 3 are international journals. His areas of interest are Antennas, Electronic Instrumentation and Glass science.

Govardhani. Immadi working as Associate professor in KL University. She Completed B.Tech in KLCE affiliated to Acharya Nagarjuna University in 2004. Received Masters degree from the Acharya nagarjuna University as a University topper in 2009. Major area of working is Microstrip Antennas, Electrically Small Antennas.

Venkatanarayana.M working as Associate professor in KLUniversity, HODSED-1(ECE). He Completed B.Tech in 2001 in Bapatla Engineering College affiliated to Acharya Nagarjuna University. Received Masters degree from the Acharya Nagarjuna University in 2009.

Major area of working is Microstrip Antennas, Electrically Small Antennas.

1. M.Tech Thesis Student, Department of ECE, KL University

2. Professor, Department of ECE, KL University.

3 & 4. Associate Professors, Department of ECE, KL University,

Email: govardhanee@gmail.com,

venkataraviteja.k2@gmail.com