International Journal of Engineering and Technology, 1 (3) (2012) 250-255

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Design & Investigation of Five Element Liquid Yagi Uda Antenna at L-Band(1 GHz) Applications

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Abstract

The purpose of this paper is to design a liquid yagi uda antenna at 1 GHz for L-band Application. The designing formulas and structure were discussed. The antenna characteristics like return loss with different liquids are filled in the all the yagi elements were also discussed in this paper.

Keywords: *Liquid Yagi-uda antenna, Return loss*

1 Introduction

The yagi-uda antenna is basically an arrangement of dipoles in such a way that the whole system provides a directional antenna beam in desired direction. That's why some times it is called a directional antenna system. The yagi antenna's overall basic design consists of a "resonant" fed dipole [1] (the fed dipole is the driven element).

1.1 The elements of Yagi:

The driven element: The driven element of a yagi is the feed point where the feed line is attached from the transmitter to the yagi to perform the transfer the power from the transmitter to the antenna. A dipole driven element will be "resonant" when its electrical length is ½ of the wavelength of the frequency applied to its feed point [2]. The feed point is on the center of the driven element.

The directors- The directors are the shortest of the parasitic element and this end of the yagi is aimed at the receiving station. It is resonant slightly higher in frequency than the driven element, and its length will be about 5% shorter, progressively than the driven element. The length of directors can vary depending upon the director spacing. The numbers of directors that can (length) of the supporting boom needed by the used are determined by the physical size design. The directors are used to provide the antenna directional pattern with gain. The amount of gain is directly proportional to the length of the antenna array not by the number of directors used. The spacing of the directors can range from 0.1 to 0.5wavelengths or more and will depend largely up on the design specification of the antenna [3].

The reflector: The reflector is the element that is placed at the rear of the driven element (The dipole). Its resonant frequency is lower, and its length is approximately 5% longer than the driven element. Its length will vary depending on the spacing and the element diameter. The spacing of the reflector will be between 0.1 wavelengths and 0.25 wavelengths [4]. Its spacing will depend upon the gain, bandwidth forward/backward ratio, and side lobe pattern requirements of the final antenna design. The length and spacing between the elements which we are taken to design the antenna are shown in the table 1.

Table 1: The length and spacing between the elements in terms of wavelength

Element	Length	Separation
Reflector	0.55λ	0.1λ
Driven	0.50λ or λ/2	0.1λ
Directors	0.45λ, 0.40λ, 0.35λ	0.1λ

2 Antenna Design

Basically, a yagi-uda antenna is the structure of dipoles in such a way that the whole system provides a directional antenna beam in desired direction. That’s why it is called a directional antenna system. The gain of yagi antenna is depend on the number of dipoles used in the antenna system and for high gain there should be more number of elements is used and kept low separation between the element For this research, aluminum hollow tube of 10 mm diameter is used as antenna element and by using the formula λ=c/f the length of the dipoles is calculated and create the separation between the dipoles is 0.1λ which is equals to 3cm. All the physical design consideration at 1GHz is shown in the Fig. 1.

Figure1**.** Proposed antenna at 1 GHz

3 Measurement and Result

The measurements are taken by the FS-315 spectrum analyzer connected by SWR Bridge and designed yagi antenna. The typical measurement set up is shown in the fig. 2. We put the reference level 75 in the spectrum analyzer and all these values are taken in the minimum hold condition to create low difference between actual and measured value.

Figure2**.** Measurement set up to measure return loss of designed yagi-uda antenna

The variation of antenna return loss -17 dB in air is shown in Fig. 3. Than after hollow element of antenna filled with water and return loss shifted to – 21 dBwhich is shown in Fig. 4. Then salty water filled in element and return loss becomes to -32 dB shown in Fig. 5. In case of mustured oil retun loss becomes -38 dB is shown in Fig. 6. Finally elements filled with disel then return loss shiftrd to -40 dB which shown in Fig.7.

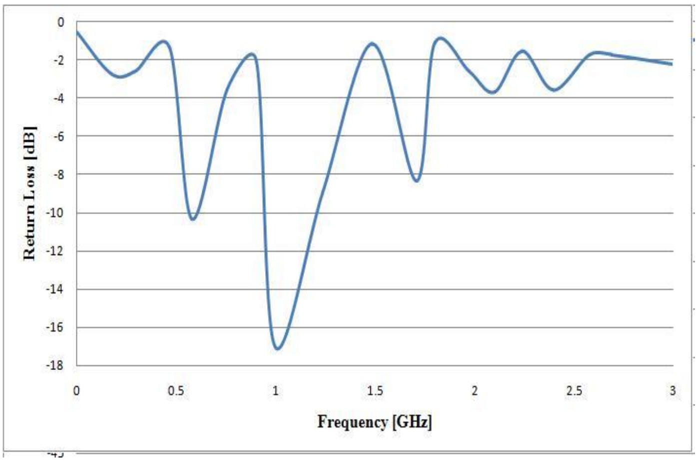

Figure3. Return loss Vs frequency graph of designed liquid yagi -uda antenna

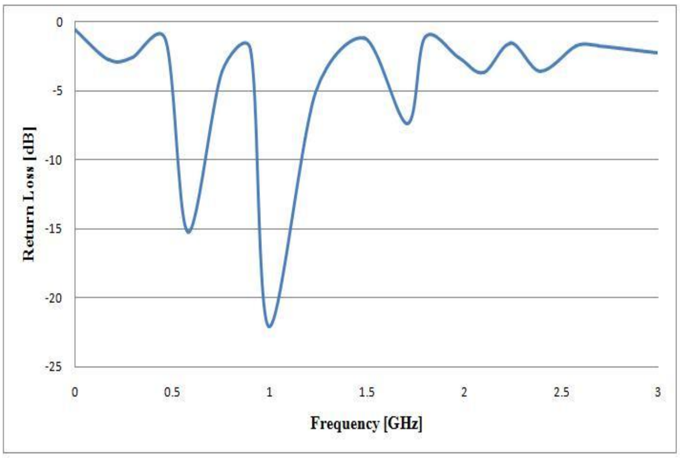

Figure4. Return loss Vs frequency graph filled with water

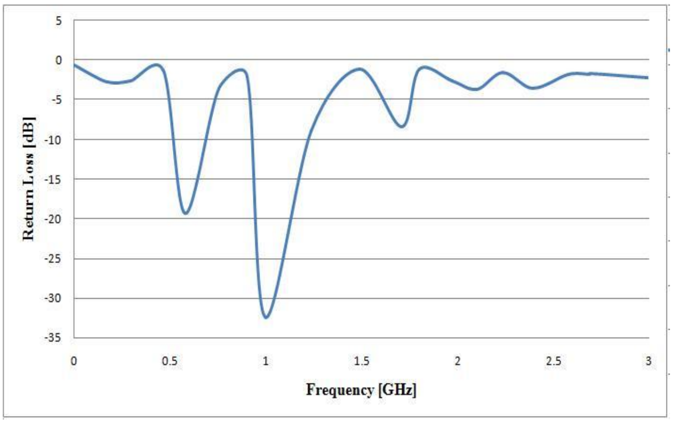

Figure5. Return loss Vs frequency graph   filled with salty water

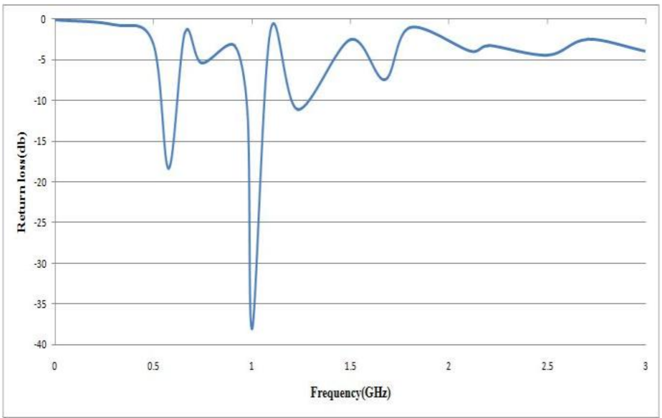

Figure6. Return loss Vs frequency graph filled with mustered oil

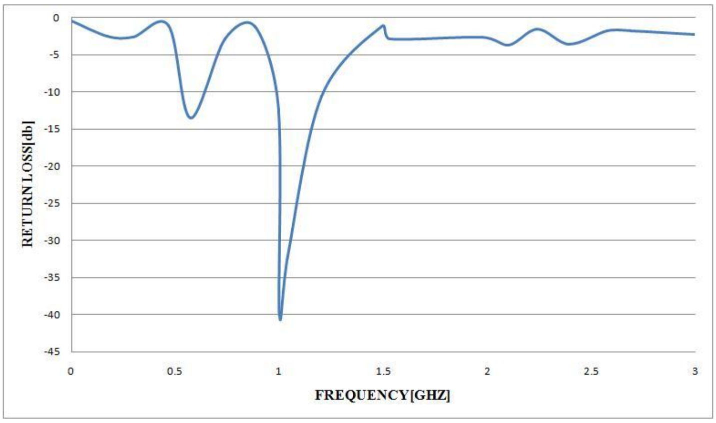

Figure7. Return loss Vs frequency graph filled with diesel

4 Conclusion

After the whole process examined, it can be concluded that, when the yagi-uda antenna placed with simple air less power transmitted compared to it filled with different liquids transmitted much power. Return loss is greater when it is empty compared to yagi-uda liquid antenna filled with different liquids. We can say that our antenna goes desired results when it is contact with different type of liquids.

References

[1] John D. Kraus,“Yagi-uda Antennas” in Antennas second edition, pp. 621, 1997.
[2] Sun, B.H., S.G Zhou, Y.Fwei, and Q.-Z Liu, “Modified two elements” and Yagi-uda-“antenna with tunable beams with tunable beams progress”,Progress electromagnetic research, Vol. 16, pp.406-419, 2009.
[3] Balanis, C.A.,“Antenna Theory, Analysis and Design”, 2nd edition, John Wiley & Sons, Inc.,pp. 468, 1997.
[4] H. Yagi,“Beam Transmission of ultra short waves” proceeding of the IRE vol. 16, pp. 715-740, June 1928.
[5] Pozar. D .M.,“Microwave engineering”, pp. 68- 70, second edition, Wiley, New York, 1991.
[6] Tran, A. and M. C. E. Yagoub, “Intertwined two- section dual-polarize log periodic dipole antenna," PIERS Proceedings, 30-33,Prague, Czech Republic, Aug. 27-30, 2007.
[7] Densmore, A. and J. Huang, “Microstrip Yagi antenna for mobile satellite service," IEEE Antennas and Propagation Society Int.Symp., Vol. 2, 616{619, Jun. 1991.
[8] Zhang, X. C., J. G. Liang, and J. W. Xie, “The Quasi-Yagi antenna subarrat fed by an orthogonal T junction," Progress In Electromagnetics Research Letters, Vol. 4, 109-112, 2008.
[9] Chen, C. A. and D. K Cheng, “Optimum element lengths for Yagi-Uda arrays," IEEE Trans. Antennas and Propagation, Vol. 23, Jan. 1975.
[10] [10]Haneishi, M., et al ,” Beam-shaping of microstrip antenna by parasitic elements having coaxial stub," Trans. IECE of Japan, Vol. 69-B, 1160-1161, 1986.
[11] Huang, J., Planar microstrip Yagi array antenna,"IEEE Antennas and Propagation Society Int. Symp., Vol. 2, 894-897,Jun. 1989.
[12] Gray, D., J. Lu, and D. Thiel, “Electronically steerable Yagi-Uda microstrip patch antenna array," IEEE Trans. Antennas and Propagation, Vol. 46, No. 5, 605-608, May 1998.
[13] Padhi, S. and M. Bialkowski, “Investigations of an aperture coupled microstrip Yagi antenna using PBG structure," IEEE Antennas and Propagation Society Int. Symp., Vol. 3, 752-755, Jun. 2002.