International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

COMPARISON BETWEEN COAXIAL PROBE FEED RECTANGULAR MICROSTRIP PATCH ANTENNA AND PROXIMITY COUPLED FEED RECTANGULAR MICROSTRIP PATCH ANTENNA FOR WIRELESS APPLICATION

Mahesh Narayan[1], Prof. K.K.Verma[2], Himanshu Bhusan Baskey[3]

[1]Research scholar, Department of Physics and Electronics Dr. Rammanohar Lohia Avadh University Ayodhya.U.P, India
[2]Prof. K.K.Verma Professor, Department of Physics and Electronics Dr. Rammanohar Lohia Avadh University Ayodhya. U.P, India
[3]Himanshu Bhusan Baskey DMSRDE (DRDO), Kanpur U.P, India

Abstract - *This paper presents a comparative study of coaxial probe feed rectangular microstrip patch antenna and proximity coupled feed rectangular microstri patch antenna. The operation (resonant) frequency (f_o) for the both is 2.4GHz which is suitable for short range wireless application .Coaxial probe feed rectangular microstrip patch antenna is designed on FR-4 substrate (lossy) of dielectric constant 4.3 having height of 1.6mm. Whereas proximity coupled feed rectangular patch antenna is designed on substrate FR-4(lossy) and Rogers R03003 (lossy) having dielectric constants 4.3 and 3.0 respectively and height 1.6mm each. An impedance of both the antennas is matched with 50 Ω.The CSTMW Studio 2018 is used for designing and simulation. The proposed antennas have shown return loss -29.098189 dB and -25.106887 dB respectively for coaxial probe feed rectangular microstrip patch antenna and proximity coupled feed rectangular microstrip patch antenna. Obtained band width at -10 dB is 30.4 % for coaxial probe feed rectangular microstip patch antenna and 33.2 % for proximity coupled feed rectangular patch antenna. The antenna performance parameters like Return loss, VSWR, Bandwidth, Gain and Radiation pattern at the resonant frequency for both the antennas are analyzed on the basis of results obtained after simulation.*

Key Words: Proximity Coupled Feed, Coaxial Probe Feed, Fr-4, Rogers R03003, Gain, VSWR And CST.

1. INTRODUCTION

An antenna is one type of transducer that converts electrical energy into (electromagnetic energy) radio wave. According to the IEEE standard, "Antenna is considered as the means of transmission and reception of radio waves" [1]. Antenna is a key component of all kinds of wireless networking. Microstrip patch antennas used on large scale due to their simplicity and compatibility in various microwave frequency spectrum to cater the commercial as well as scientific purposes[1-6] .Coaxial probe fed antenna consist of a patch of conducting material on one side of a substrate and a ground plane of conducting material on the other side of the substrate. Feeding is achieved with the help of co-axial line with an inner conductor that terminates on the patch. Whereas Proximity coupled fed antenna consist of a patch on one side of two different kinds of substrates placed in parallel to each other and a ground plane of a conducting material to the other free side of compiled substrates. Feed line is sandwiched between the two different substrates [7-8]. The microstrip patch antenna has more advantages over other microwave antennas in the area of portability because of its low profile, low cost fabrication, light weight, easy to install and integrate with feed networks. But with these quantum merits it has a serious demerit of narrow band width, low gain and low efficiency. These antennas have very narrow band width characteristics as it limits the frequency range over which the antenna can perform [1].Both the impedance bandwidth and return loss are important parameters of any antenna. The impedance band width depends upon parameters related to the patch antenna element and feed used. The prime object of this paper is comparison and analysis of band width characteristics under -10 dB return loss with resonant frequency 2.4GHz and others characteristics such as voltage standing wave ratio (VSWR),directivity, gain , efficiency etc. of the proposed antennas which have been fed through quietly two different methods.

2. ANTENNA GEOMETRY AND DESIGN:

For Coaxial probe fed rectangular microstrip patch antenna , the height of substrate FR-4 is 1.6mm and relative permittivity ε_r is 4.3.The length and width of patch are L=29.16 mm. and W =37.61mm.respectively.The length and width of substrate FR-4 are L_{s1}=58.32mm and W_{s1}=75.22mm respectively. For proximity coupled fed rectangular microstrip patch antenna, the height of substrate F.R-4 is 1.6mm and relative permittivity ε_r is 4.3 whereas height of substrate Rogers R 03003 is 1.6mm and relative permittivity ε_r is 3.0.The length and width of substrate FR-4 are L_{s1}=58.32mm and W_{s1}=75.22mm respectively whereas length and width of substrate Rogers R03003 are L_{s2}=43.74.mm and W_{s2} =56.42mm respectively. The length and width of patch are L=29.16mm and W=37.61mm respectively.

Perspective views of Coaxial probe feed patch antenna and proximity coupled feed patch antenna have been shown in fig-1 and fig-2

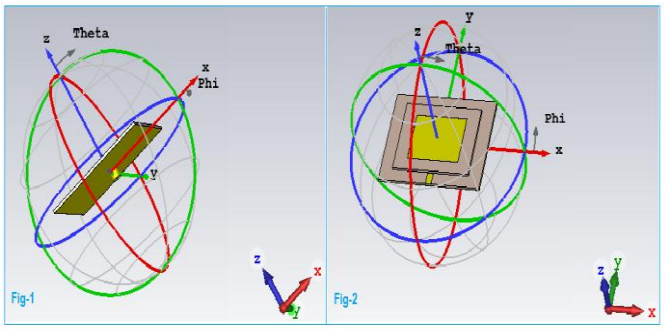

Fig1: Coaxial probe fed patch antenna
Fig 2: Proximity coupled fed patch antenna

Table -1: Design specifications for the proposed antennas.

Antenna	Dimensions	Value	Material
1.Probe	Patch width	W= 37.61mm	Copper
Fed	Patch length	L=29.16mm	Copper
patch antenna	Patch thickness	t =0.036mm	Copper
	Substrate height	h =1.6mm	FR-4
	Substrate width	2W =75.22mm	FR-4
	Substrate length	2L =58.32mm	FR-4
	Ground width	2W=75.22mm	Copper
	Ground length	2L=58.32mm	Copper
	Ground thickness	t= 0.036mm	Copper
	Pin radius	r_i = 0.5mm	Copper
	Pin height	(t+4*h)=6.436mm	Copper
	Coat outer radius	r_o =2.818mm	Teflon
	Coat inner radius	r_i =0.5mm	Teflon
	Coat height	3*h =4.8mm	Teflon
	Cover inner radius	r_0 =2.818mm	Copper
	Cover outer adius	(ro +t)=2.854mm	Copper
	Cover height	3*h = 4.8mm	Copper
2 . Proximity	Patch width	W =37.61mm	Copper
coupled	Patch length	L =29.16mm	Copper
fed patch	Patch thickness	t = 0.036mm	Copper
Antenna	Substrate	1.5W=56.42	Roger
	width(ii)	mm	
	Substrate length(ii)	1.5L=43.74mm	Roger
	Substrate height(ii)	h = 1.6mm	Roger
	Substrate width (i)	2W =75.22mm	FR-4
	Substrate length(i)	2L = 58.32mm	FR-4
	Substrate height(i)	h = 1.6mm	FR-4
	Feed length	lf =14.58mm	Copper
	Feed width	wf =4.193mm	Copper
	Ground width	2W =75.22mm	Copper
	Ground length	2L =58.32mm	Copper
	Ground thickness	t = 0.036mm	Copper

3. SIMULATIONS AND RESULTS

(A) RETURN LOSS: After designing the antenna by CSTMWS 2018, simulation function has been carried out.Plots for simulated return loss of coaxial probe feed patch antenna and that of proximity coupled fed patch antenna have been shown in fig. 3 and in fig.4 respectively.Magnitude of reflection coefficient have been found to be -29.098189 dB at 2.41GHz (approx 2.4 GHz) of probe feed patch antenna and -25.10687 dB at 2.4341GHz (approx 2.4GHz) of proximity coupled feed patch antenna. At -10 dB the bandwidth has been found to be 73.3 MHz which covers 30.41 % bandwidth at resonant frequency 2.41 GHz for probe feed patch antenna whereas at -10 dB the bandwidth has been found to be 80.6 MHz which covers 33.2 % bandwidth at resonant frequency 2.4341GHz for proximity coupled feed patch antenna.

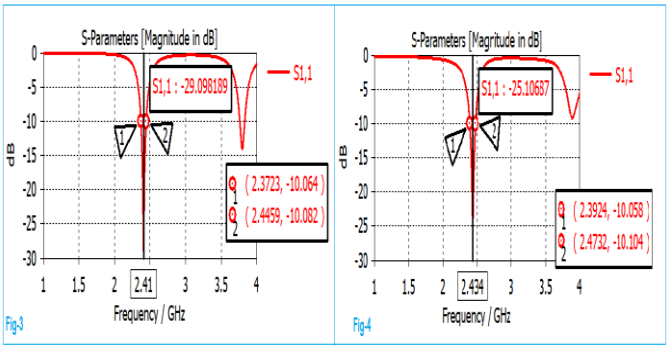

Fig 3: Return loss of coaxial Probe fed microstrip patch antenna
Fig 4: Return loss of Proximity coupled fed microstrip patch antenna

(B) VSWR: Plots for VSWR of probe feed patch antenna and proximity coupled feed patch antenna have been shown in Fig -5 and fig-6 respectively. Magnitude of VSWR for coaxial probe fed patch antenna is found as 1.0727161 at resonant frequency 2.41GHz(approx 2.4 GHz) which is in good agreement and very close to an ideal value of 1 for an impedance matching.Whereas for proximity coupled fed patch antenna it has been found to be 1.12 at resonant frequency 2.434GHz(approx 2.4GH) which is in good agreement and close to an ideal value of 1 for impedance matching also.

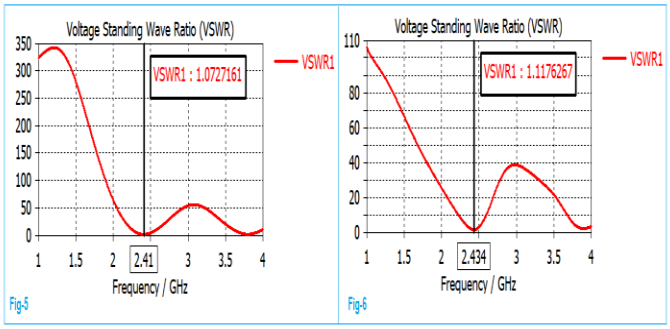

Fig 5: VSWR plot for coaxial probe fed patch antenna

Fig 6: VSWR plot for proximity coupled fed patch antenna

(C) FARFIELD DIRECTIVITY : Polar plots for farfield directivity of probe feed patch antenna and proximity coupled feed patch antenna are shown in fig-7 and fig-8 respectively.For coaxial probe feed microstrip patch antenna, Main lobe magnitude is around 2.58 dBi and Angular width is obtained as 149.5 degree whereas for proximity coupled feed microstrip patch antenna ,Main lobe magnitude is 7.17 dBi and Angular width is obtained as 91.1degree.

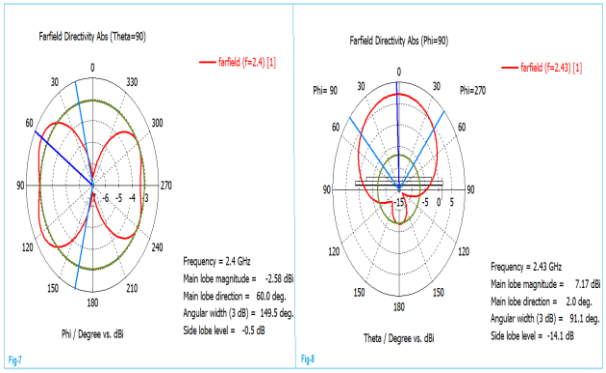

Fig7: Polar plot for farfield directivity of proximity probe fed patch antenna

Fig 8: Polar plot for farfield directivity of coupled fed patch antenna

(D) RADIATION PATTERN: The 3D –plots for radiation pattern of gain for probe feeed patch antenna andproximity coupled feed patch antenna have been shown by fig-9 and fig- 10 respevtively. For coaxial probe feed microstrip patch antenna, gain is 3.476dB and radiation efficiency is obtained as 98.92% and at an operation freqency of 2.4 GHz whereas for proximity coupled feed microstrip patch antenna , gain is obtained as 6.010 dB and radiation efficiency is obtained as 88.35 % .

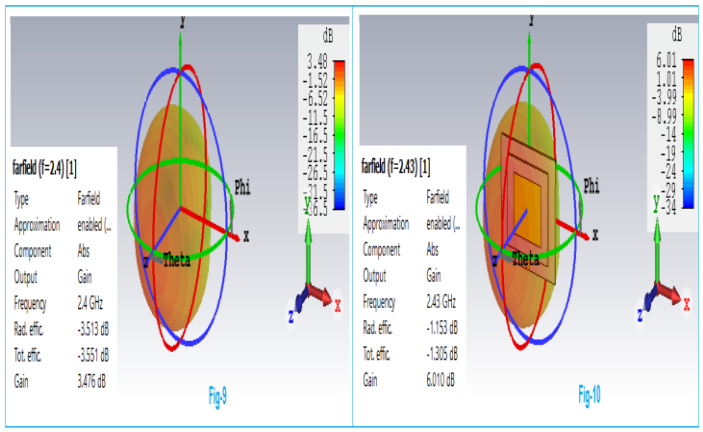

Fig -9. 3D plot of radiation radiation pattern gain of probe fed patch antenna

Fig -10. 3D plot of radiation pattern for gain of for proximity coupled fed patch antenna

Table 2: Summery of simulated results

Parameter	Coaxial probe fed microstrip patch antenna	Proximity coupled fed microstrip patch antenna
Operation frequency	2.4GHz	2.4 GHz
Return Loss	-29.098189dB	-25.10687dB
Bandwidth at -10dB	73.6MHz	80.8MHz
Bandwidth %	30.41%	33.2%
VSWR	1.0727161	1.1176262
Gain	3.476dB	6.010dB
Directivity	2.51dBi	7.17dBi
Radiation efficiency	98.92%	88.35%
Main Lobe Direction	60.0 degree	2.0 degree
Main Lobe Magnitude	2.51dBi	7.17dBi

From the table 2 , coaxial probe fed antenna has overall better results than proximity coupled fed antenna. More negative value of Return loss gives the better results, hence coaxial Probe feed antenna has better result in comparision to proximity coupled feed antenna.Closer the

value to 1,better is the VSWR, and hence coaxial probe fed antenna has better VSWR. Coaxial probe fed antenna has lesser directivity than proximity coupled fed antenna therefore it should show more gain but more gain is being exhibitted by proximity coupled fed antenna.More the main lobe direction,better is the radiation pattern, hence coaxial probe fed antenna shows better radiation pattern.

4. CONCLUSION

The comparison between coaxial probe fed microstrip patch antenna and proximity coupled fed microstrip patch antenna, using the simulation results obtained from CSTMW studio has been carried out. It therefore concluded that both the antenna configurations show good results on perspective of Return loss, VSWR, Gain and Radiation efficiency for s - band application. However, in view of return loss, VSWR and radiation pattern coaxial probe fed microstrip patch antenna configuration shows better performance, while the proximity coupled fed microstrip patch antenna shows better results on bandwidth, gain and main lobe levels

REFERENCES

[1] Constantine A .Balanis," Antenna Theory: Analysis and Design, "John Wiley & Sons, 3rd Edition,2005
[2]M.James, J.R. and Hall P.S.,"Handbook of Microstrip antennas," Peter Peregrinus, Vol.2, 1989.
[3] Garg R., P.Bahartia, and A. Ittipiboon,"Microstrip Antenna Design Handbook,"Artech House, Boston, London, 2001
[4] Indrasen Singh et al," Microstrip Patch Antenna and its Application: a Survey,"Int. J. Comp.Tech.Appl., Vol.2 pp.1595-1599, 2011
[5] Garg, Ramesh, "An improved formula for the resonant frequencies of the triangular microstrip patch antenna, "Antennas and Propagation, IEEE Transactions, Vol.36, Issue: 4, 1988
[6] Mohammad Tareq, Zeenat Afroze,Razin Ahmad ,"Design and Performance Analysis of Compact Microstrip –fed Multiple Edge Slotted Monopole Antenna for Wideband Application," International Journal of Science and Research Publications, Volume 4,Issue 98,September 2014
[7] Wentworth M. Stuart, "Fundamentals of Electromagnetic with Engineering Applications, "John Wiley & Sons,Pp442-445,2005.
[8] Kin-Lu- Wong "Compact and Broadband Microstrip Antennas",Inc.ISBNs:0-471-41717-3(Hardback);0-471-22111-2(Electronics)

ABOUT THE AUTHOR

Mr. Mahesh Narayan born in 2 july 1963. He obtain his Master's Degree in Physics (solid state physics) from Banaras Hindu University (BHU), Varanasi, U.P, India. He is also graduate in PCM. He has more then 29 years of experience in teaching different subjects of applied science and specially in physics. Presently he working as a senior Lecturer of Physics in SSV inter college, Faizabad U.P, India. He is author of several book of physics. By dint of hard work and devotion to duty, he has earn many award/honours.