STACKED MICROSTRIP PATCH ANTENNA FOR BANDWIDTH ENHANCEMENT

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***Abstract*- Stacked microstrip patch antenna is used for enhance the bandwidth of standard antenna is explain in this paper. The design of stacked antenna is used for WLAN application. The suggested stacked antenna has been checked out the antenna performance such as return loss, gain, directivity using coaxial feed technique. The Stacked antenna are provide greater band width compare to conventional antenna. The suggested antenna provide the estimate result a broad frequency from 1.66 GHz to 3 GHz . The finally band width achieved is 1.34 GHz or 57.51%. By this conventional antenna got return loss -25.016 at 2.12 GHz resonant frequency. When using parasitic patch then found return loss -47.088 at 2.35 GHz resonant frequency. The antenna imitated by IE3D simulation technique and feeding by coaxial feed line.**

***IndexTerms* – Stacked microstrip antenna, coaxial feed, IE3D software, slot patch.**

I. INTRODUCTION

The growing of satellite and wireless application gradually and this reason increases the demand of suggested antenna because of suggested antenna have the merits of low light weight, small size, low capacity, fabrication cost very low, carry the both circular and linear polarization, have the ability to dual and triple frequency performance[1]. Microstrip patch antenna are operate to many application such as aircraft and missile application, spacecraft, mobile radio, cellular phone, pagers, satellite and wireless application due to ease of fabrication, low profile, low cost [2].

The basic element of stacked antenna is patch, substrate, ground and feeding line. Microstrip antenna contain the sandwich of two collateral layers which is divide by a lone thin dielectric substrate. In antenna has used metal strip at upper side of substrate and ground plane at bottom side . There are Glass epoxy (FR4), Teflon used in substrate [3]. The patch could be elliptical, triangular, square, rectangular, circular or other structure. There are different technique such as coaxial probe, microstrip line, proximity coupling and aperture coupling are used for feeding the microstrip antenna.

In probe feed, outmost conductor of the coax feed is joined to the bottom plane while the inmost conductor is linked to the patch.

The standard patch antenna have the many disadvantages just as poor polarization, tapered bandwidth, small efficiency, Low gain, capacity of handling power is low. Many technique such as Shorted stacked patches, coax fed to stacked patch antenna, electrified thick substrate has been used for minimize the disadvantages of low bandwidth and low gain. Volume of antenna is equivalent to the patch antenna bandwidth[4].

The drawback of standard patch antenna is overcome by induce the stacking . In Stacked antenna two layer are vertically stacked and builted such a several layer that reason It is know as dual patch and multilayer antenna. The lower or upper patch are treat as the feeding and radiating patch respectively [5]. However stacked antenna in which used multi layer for enhances the bandwidth of standard antenna. Stacked antenna achieved the broad bandwidth with two tuned resonance which are prompted by radiators on different layers. Shape of radiators are slotted rectangular. The prefer antenna are simulated for unidirectional radiation in the aside . The microstrip antenna are analyzed using software which is IE3D on substrate and do the experimental validation [6].

II. ANTENNA DESIGN

The shape of the stacked patch antenna is instance in the fig 1 (a). The antenna is invented using glass epoxy (FR4) material and contains of two layers, two patch, two substrates and a coaxial feed linked to the bottom patch. The ground is having length (Lg) and width (Wg) with size of 39.68 mm x 48.44 mm is used for proposed antenna. The length and width of parasitic patch and lower patch with slot cut is Lp And Wp respectively with size of 30.08 mm x 38.84 mm and is deposit on the substrate using dielectric constant 4.4 and breadth of substrate (h1) 1.6 , loss tangent (δ) 0.012 and 2.35 GHz .An airframe which has the dielectric constant 1 and depth (h2) 25 is deposit in between the substrate of parasitic patch and feeding patch. Coaxial feed is direct linked to the lower patch feed is placed at coordinates (-7.575, 10.42) . Gain of antenna has been increased by using Stacked technique. Gain of stacked antenna is 3.16 dBi achieved at 2.35 GHz. The airframe prompt in the antenna will extend physical rigidness to the antenna without any interference in the performance of antenna. The 3D geometry is instance in fig 1(b)

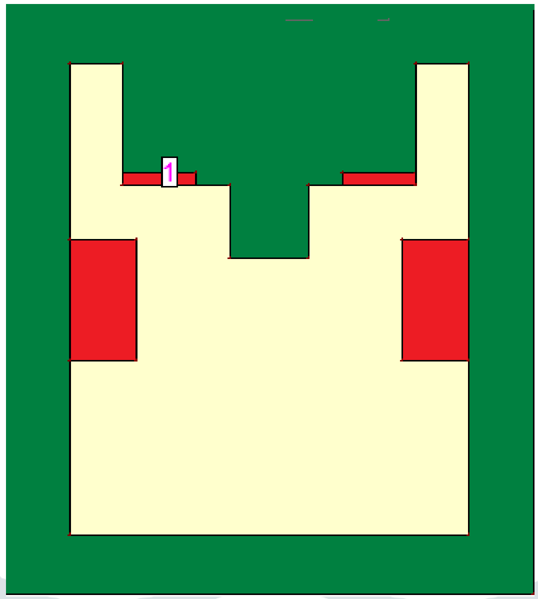

Fig 1 (a) Geometry of stacked antenna

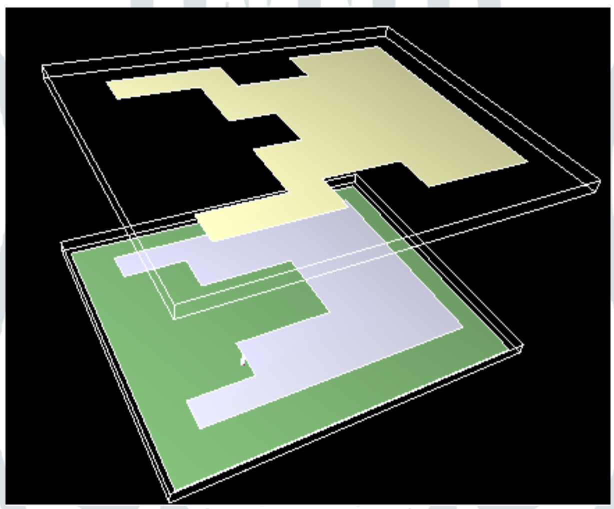

Fig 1 (b) 3 Dimensional geometry of suggest antenna

Dimension of prefer antenna (Length and width) are determined by these equations (1-6)

The patch antenna width can be expressed as

$$W = \frac{C}{2fr}\sqrt{\frac{2}{\varepsilon r+1}} \quad (1)$$

C = light velocity (3x10^8 m/s)

fr = Resonant frequency

εr= Dielectric constant

The effective dielectric (εrref) constant is defined in equation

$$\varepsilon rref = \frac{\varepsilon r+1}{2} + \frac{\varepsilon r-1}{2}\sqrt{1+\frac{12h}{w}} \quad (2)$$

h = height of the substrate

w = Patch width

The extension Length ΔL can be expressed as

$$\Delta L = 0.412\, h \frac{(\varepsilon re+0.3)(W+0.26\, h)}{(\varepsilon re-0.258)(W+0.8h)} \quad (3)$$

Antenna length is express by

$$L = \frac{c}{2fr\sqrt{\varepsilon ref}} - 2\Delta L \quad (4)$$

The Dimension of ground (bottom) plane can be expressed as

$$Lg = L + 6h \quad (5)$$

$$Wg = W + 6h \quad (6)$$

III. ANTENNA GEOMETRY

GEOMETRY I : The configuration of standard antenna is instance in the fig 2 (a) and In the fig 2 (b) is a return loss graph. Conventional antenna is feeding by coaxial feed technique. The return loss occurs is -21dB at 1.5 GHz resonant frequency which is far away from 2.35 GHz.

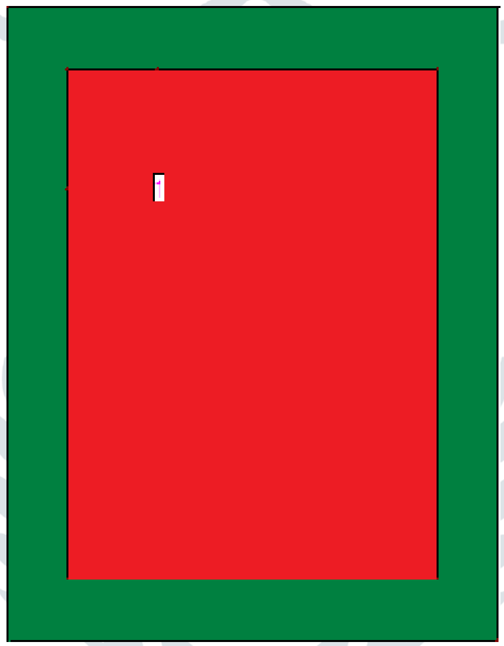

Fig 2(a) standard patch antenna

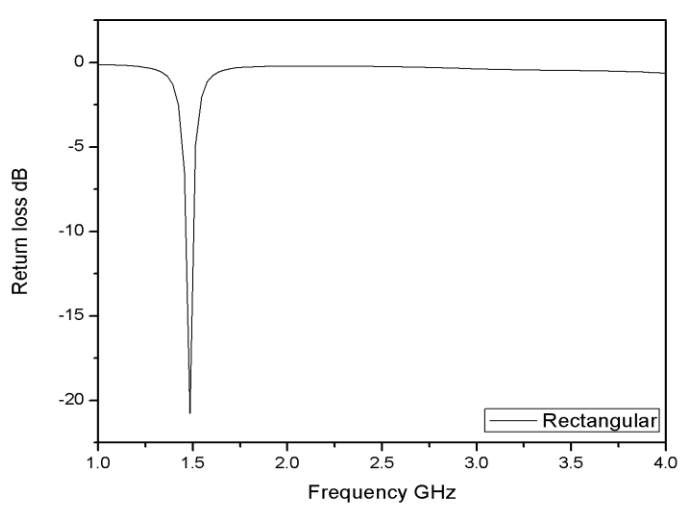

Fig 2(b) Return loss graph of patch antenna

GEOMETRY II : The configuration of one slot cut at upper side of patch with the dimension (22 mm x 9 mm) where slot length 22 mm and depth 9 mm is instance in the fig 3 (a) and return loss graph is instance in the fig 3(b). In this get return loss -36.975 at 1.66 GHz resonant frequency. A broad band get from 1.54 GHz to 2.03 GHz and bandwidth percentage is 27.45%.

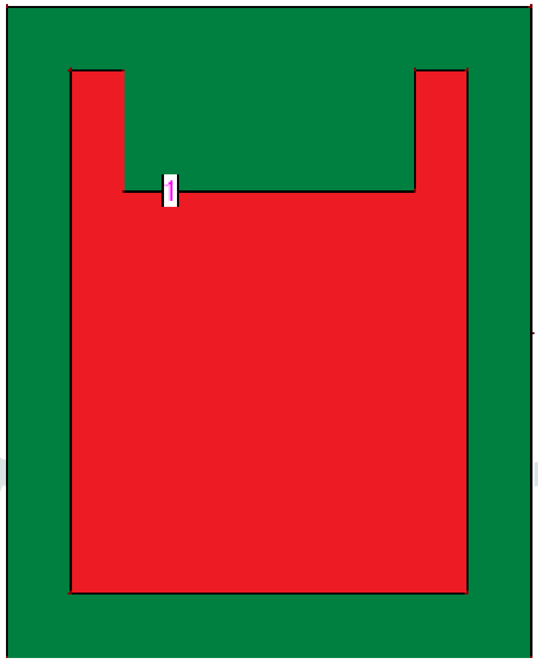

Fig 3(a) First slot cut in patch antenna

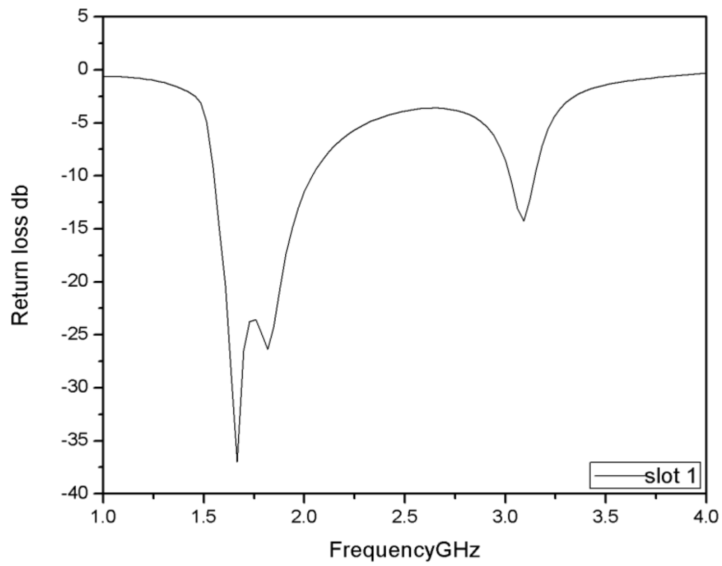

Fig 3(b) Return loss graph of patch antenna due to first slot cut

GEOMETRY III : This configuration get after cutting again slot cut within the side of slot s1 with the dimension 6 mm x 6mm which is instance in the fig 4 (a). With increase in depth return loss peak shifted to high frequency. A broad band get from 1.66 GHz to 2.87 GHz and bandwidth percentage 53.42% which is increase compare to the previous slot cut 27.45%. The peak of return loss becomes sharp of antenna is -25.016 at 2.12 GHz resonant frequency which is show in fig 4(b). This slot reduces the return loss of conventional patch.

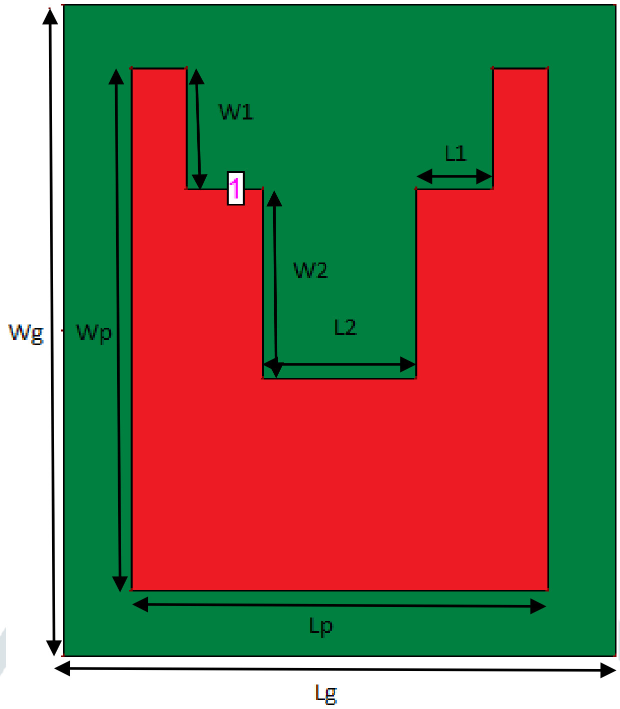

Fig 4(a) second slot cut in patch antenna

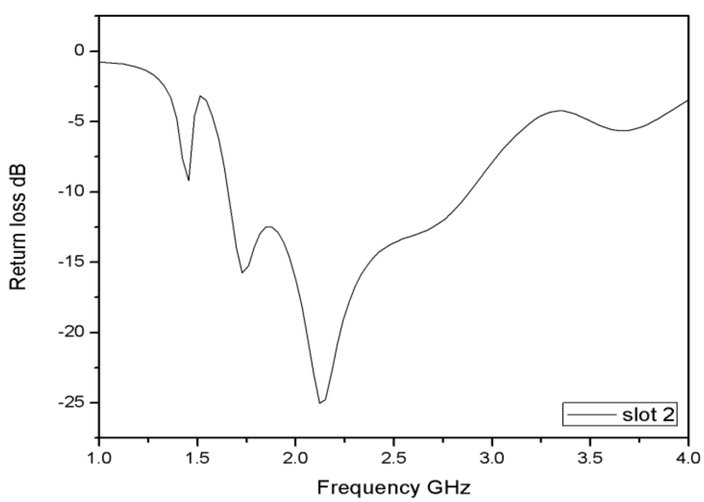

Fig 4 (b) Return loss of patch antenna due to second slot

GEOMETRY IV : This is a final geometry of stacked antenna which is achieve by induce a parasitic patch which is instance in the fig 5(a). In this, first slot is cut at top side of the parasitic patch with the dimension (22 mm x 10 mm) where slot length 22 mm and depth 10 mm. Then second slot is cut at the upper side of first slot and length of slot 6 mm, width of slot 6 mm. After that cut the third slot at the right edge of patch with 5 mm slot length and slot width 10mm. Lastly cut the fourth slot at the left side edge of patch with 5 mm slot length and slot width 10mm. By induce the parasitic patch obtained the bandwidth percentage is 57.51% which is 4.09% greater than conventional antenna and frequency range is 1.66 GHz to 3 GHz. . The return loss of antenna is -47.088 which is shown in fig 5(b).

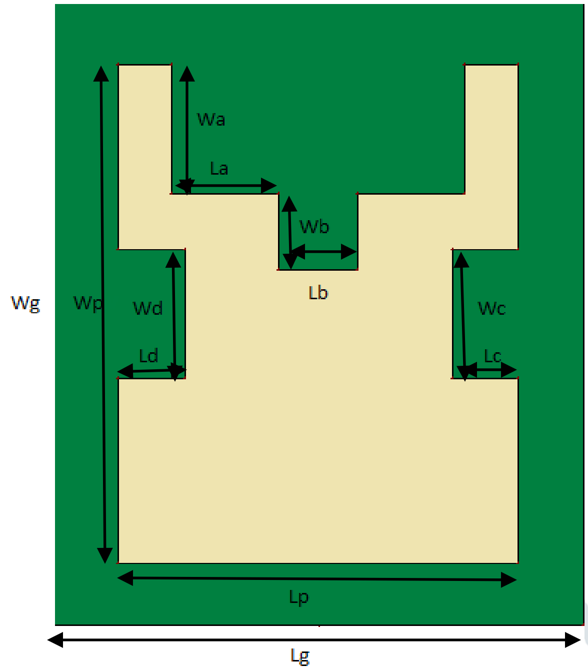

Fig 5(a) Final geometry of stacked antenna

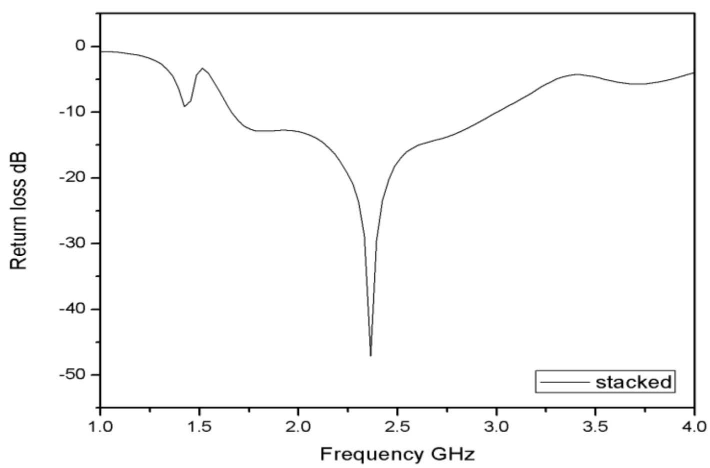

Fig 5(b) Return loss graph of stacked antenna

TABLE I. DIMENSIONS OF STACKED ANTENNA

Parameters	Dimension (mm)
Lg	39.68
Wg	48.44
Lp	30.08
Wp	38.84
L1	5.5
W1	9
L2	11
W2	14
La	5.5
Wa	10
Lb	6
Wb	6
Lc, Ld	5
Wc, Wd	10

Comparison of different variable of suggest antenna such as bandwidth, return loss is instance in table 2.

TABLE II. Comparison of different parameter of antenna

Design	Bandwidth	Return loss
Geometry I	Below the 10%	-21
Geometry II	27.45	-37.975
Geometry III	53.42	-25.016
Geometry IV	57.51	-47.088

Camparison of different variable of suggest antenna S11 parameter which is obtain after slot cutting is analyzed by IE3D software shown in the fig 6

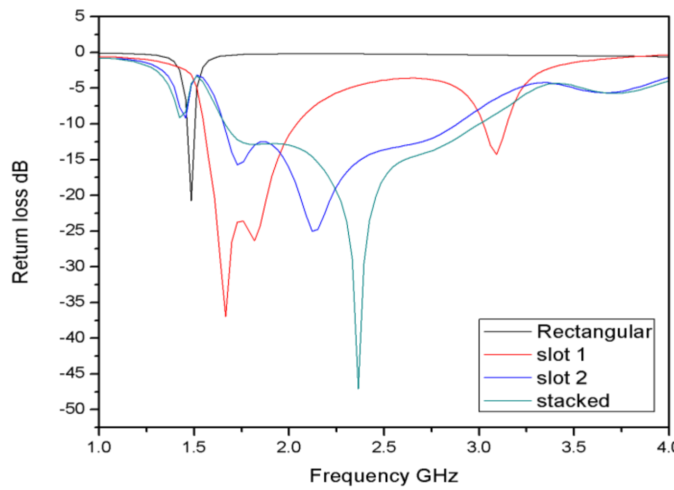

Fig 6 comparison of S11 parameter of different configuration

IV. RESULT

Zeeland IE3D simulator is provide the simulation of stacked antenna and having large bandwidth. Network analyzer of stacked antenna is instance in the fig 15 and Hardware of stacked antenna is instance in the fig 16. Frequency ranging of suggested antenna between 2.75 GHz to 3.75 GHz. The return loss of antenna is -47.088 at 2.35 resonant frequency. According to analysis of return loss graph lower cut off frequency is 1.66 GHz and upper cut of frequency is 3 GHz. Large bandwidth has been obtained By using stacked antenna is calculated as 57.51% at 2.35 GHz resonant frequency which is instance in fig 5(b) . Bandwidth percentage increase 4.09% compare to conventional patch antenna. Gain of suggested antenna has been obtained 3.16 dBi and directivity 4.47 dBi which is instance in the fig 7 and 8. Antenna efficiency and radiation efficiency get 73.92% and 73.94% respectively by IE3D software which is display in fig 9 and 10. Graph of smith chart is instance in fig 11. VSWR (dB) of stacked antenna is instance in fig 12. Radiation pattern of stacked antenna is illustrate in fig 13. Return loss graph of experimental fabricated stacked antenna is display in fig 14. The simulated and measured return loss of the standard antenna and suggested antenna is instance in fig 17.

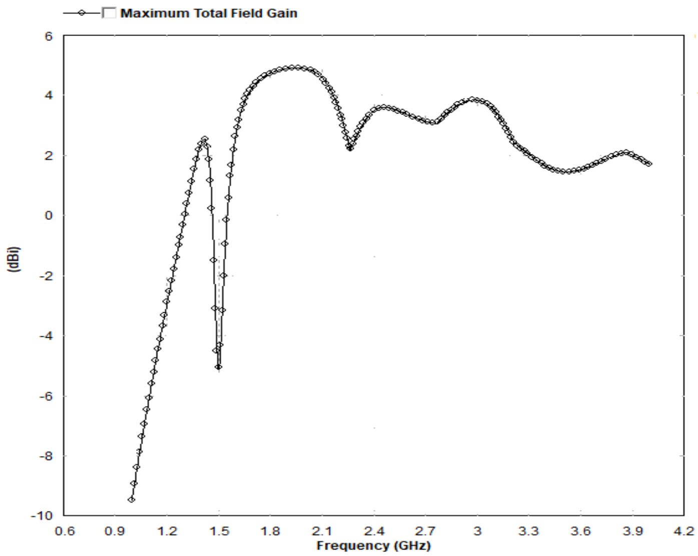

Fig 7 Gain graph of stacked antenna

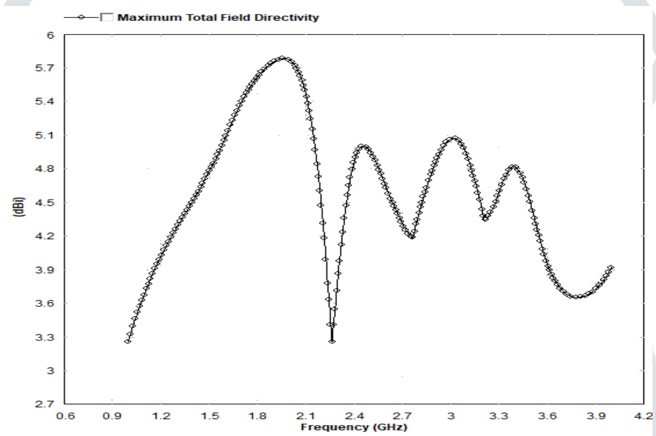

Fig 8 Total Field Directivity of stacked antenna

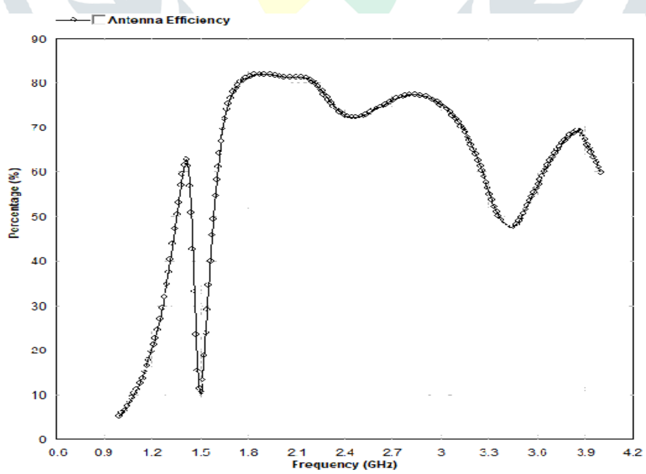

Fig 9 Antenna Efficiency of stacked antenna

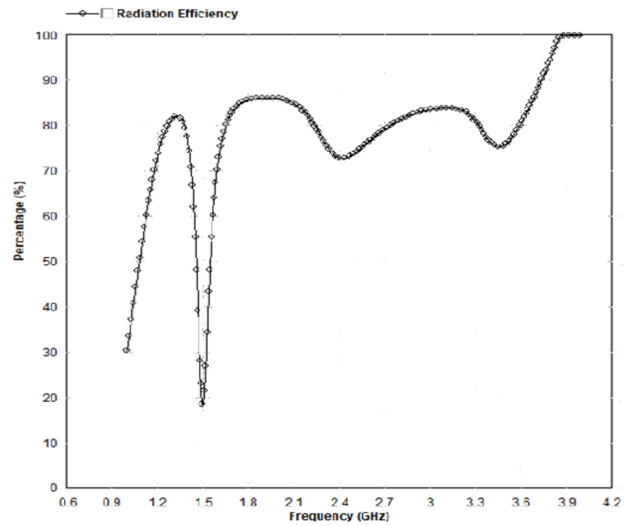

Fig 10 Radiation Efficiency of stacked antenna

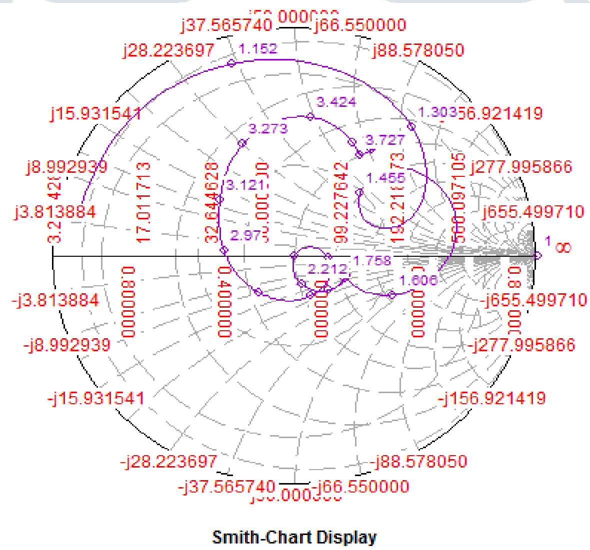

Fig 11 Smith chart graph of antenna

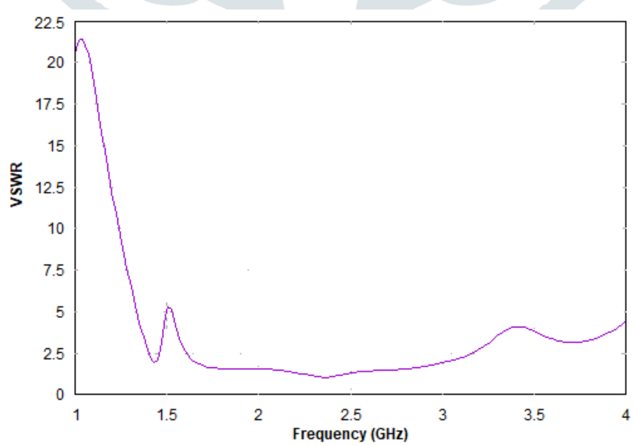

Fig 12 VSWR (dB) of stacked antenna

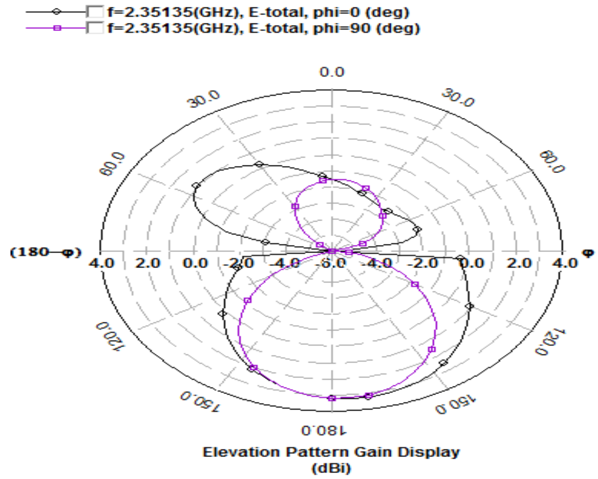

Fig 13 Radiation pattern of stacked antenna

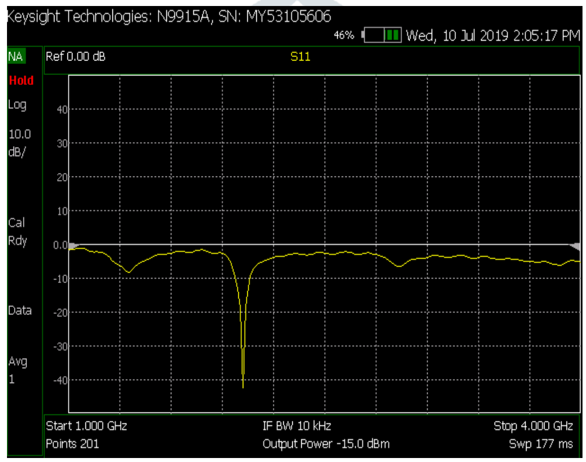

Fig 14 Experimental return loss of fabricated stacked antenna

Fig 15 Network analyser of stackec antenna

Fig 16 Hardware of stacked antenna

Table Comparison between simulated and measured result

	Resonant frequency GHz	Bandwidth (%)	Return loss
Simulated	2.35	57.51	-47.088
Measured	2.02	Below 10%	-42.46

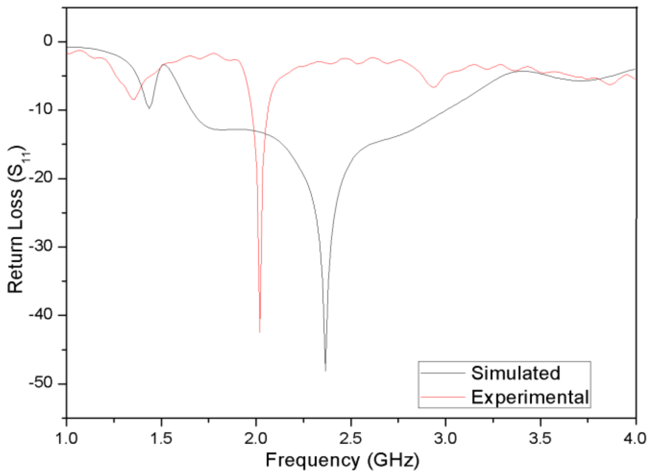

Fig 17 Return loss of measured and simulated antenna

V. CONCLUSION

The suggested antenna has been simulated in IE3D simulator. The stacked antenna fed by coaxial probe has been presented. The glass epoxy (FR4) substrate is apply to fabricate the proposed antenna. The bandwidth of antenna has been enhanced by using parasitic patch . The Stacked antenna is used the airframe between ground patch and parasitic patch. Bandwidth percentage of antenna is increased by 4.09% compare to the standard patch antenna. The stacked antenna achieved the gain 3.16 dBi. The suggested antenna is used for wireless application, WLAN, IMT, Bluetooth.

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