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Design of a Micro Strip Patch Antenna for Wireless Communication

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Abstract: *Wireless Technologies is one of the main and very vast areas of research in the world of communication system. The study of communication is incomplete without understanding of the operation and fabrication of antenna. For which we are proposed a simple micro strip patch antenna using micro strip feeding technique at low frequency 2.9 GHz, 3.1 GHz, 2.7 GHz and 2.8 GHz. This is obtained by embedding a rectangular metal patch antenna in the square slot. This paper shows the design analysis of square micro strip patch antenna. The MPA is designed by using low cost FR-4 substrate with dielectric constant of 4.4, and a loss tangent of 0.019 and with a thickness (h) of 1.6mm. We are using CST Studio for simulation and the performance such as Radiation pattern, Radiation efficiency, Directivity, VSWR, Gain, Return loss are obtained. In our proposed antenna design has a good return loss of -24 dB, -14 dB, -24.5 dB and -15.5 dB, VSWR 1.4, 1, 1.12 and 1.4 and Directivity of 4.1, 1.8, 3.7 and 3.2 at interest of frequency 2.9 GHz, 3.1 GHz, 2.7 GHz and 2.8 GHz respectively for wireless communication.*

Keywords: Return loss, directivity, dielectric constant, Voltage standing rati (VSWR), wireless.

1. Introduction:

Wireless Technologies is one of the main and a very vast areas of research in the world of communication system. In today's world the study of communication is incomplete without understanding of the operation and fabrication of antenna. That time was passed when the communication means wired and a lot of wire mesh but now in today's world is moving toward wireless things as most of the things now a days are in wireless mode around us because the main reason is that wireless communication. There is rapid growing demand for a multiband antenna by different wireless technology networks. It was dedicated by many publications; most design is for dual band operations.

Kin-Lu Wong presented a low-profile multiband antenna the proposed antenna is very compact in size (12x30 mm^2).The antenna contains a planar rectangular patch a folded slit is implanted at the patch's bottom edge. The slit separates the page into two sub patch's ,one in a patch encircled by the outer one. The antenna is suitable for the Global System For Mobile Communication (GSM) (890 MHz- 960 MHz), Personal Communication Systems (PCS)(1850 MHz-1990 MHz), Digital Communication Systems(DCS)(1800 MHz) and universal Mobile telecommunication system (UMTS)(1920 MHz-2170 MHz) cellular system.[1]

Kunpeng Wei reported a dual band micro strip patch antenna design for GPS and intelligent transport system application. The antenna structure is divided into two parts one is a square ring patch antenna which directly coupling and second is centre fed square ring loaded patch antenna. The first part produces reason in frequency of 1.227 GHz and other part produces 5.1 GHz resonant frequency. The reported impedance bandwidth and 29 MHz and 1020 MHz respectively. [2]

The prospect of it is tremendous on account of its ability to prevent accidents and to improve safety and comfort.

2. ANTENNA DESIGN AND DEVELOPMENT PROCEDURES

The structure of our proposed antenna is shown in the figure 1 for easy explanation and understanding of all the measurement in the proposed antenna in this paper are mentioned in the same figure. Here we have FR4 substrate with a dielectric constant (Er) of 4.4 attendant loss of 0.019 and the thickness of (h) 1.6 mm.

SBR designing square micro strip patch antenna so the length of the substrate is G which is coated with thin copper on one side with as square slaughtered in the center of it with a side length of L.

TABLE1

TABLE 1 IMPORTANTMEASUREMENTS

G	H	L	g1	Wf	Wp	Lp	L4	L1	L2	S1	L3
60mm	1.6mm	36mm	0.3mm	3mm	13.8mm	27.6mm	13.2mm	15.9mm	1mm	0.6mm	10.8mm

Where , G is length of ground and substrate, His height, L is length of patch g1 SI is gap, Wf is width of coplanar waveguide, Wp is width of patch 2, Lp is length of patch2, L4 length of a patch, L1 is length of a patch, L2 is length of a patch , L3 is length of a patch.

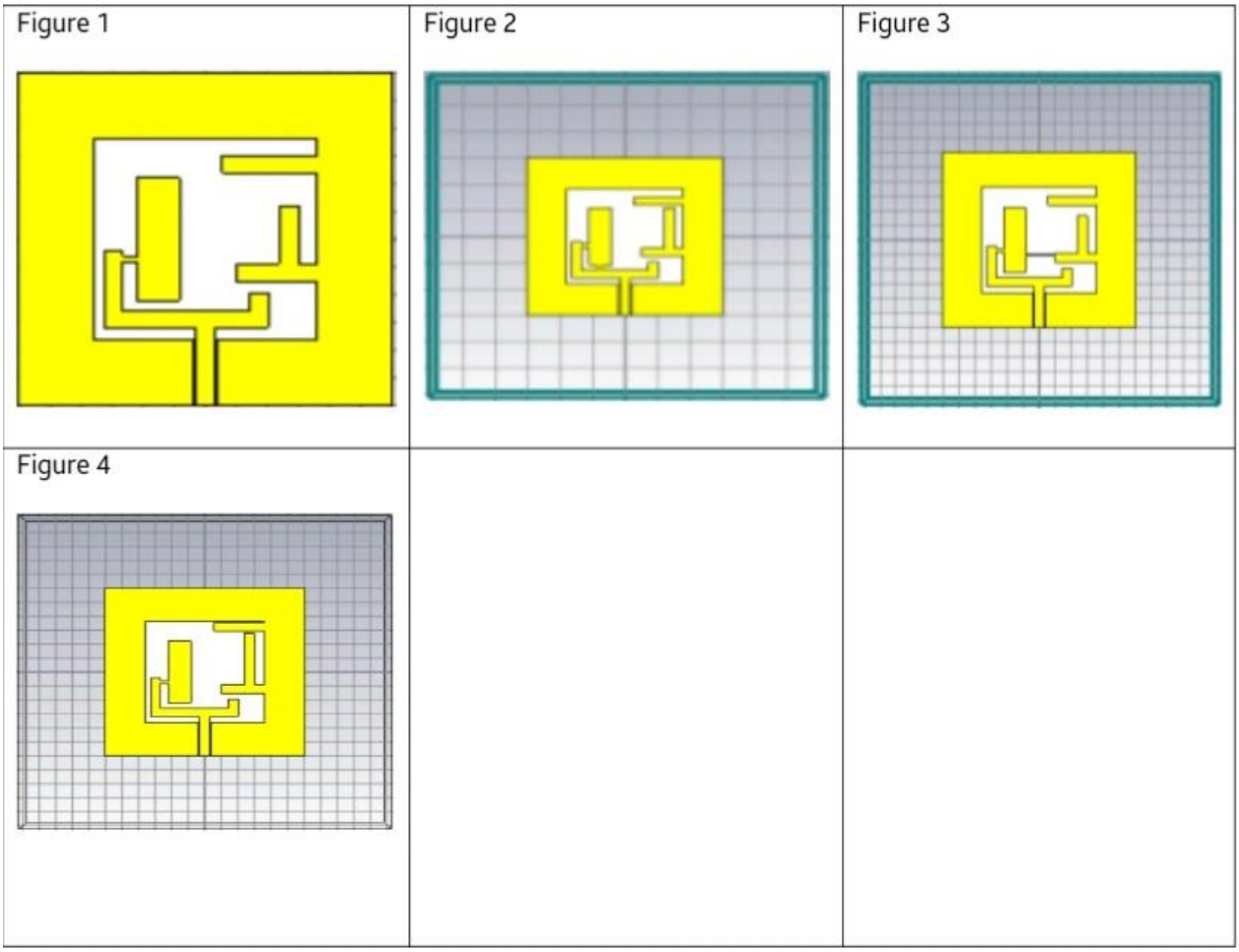
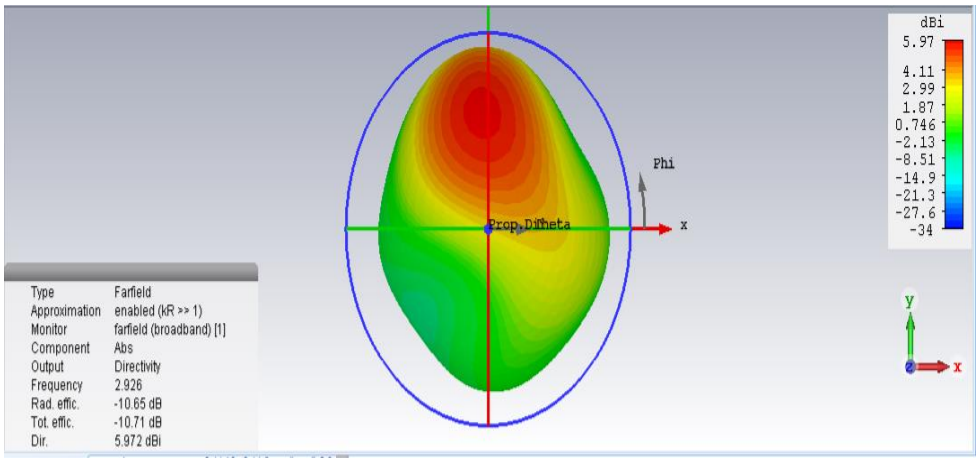


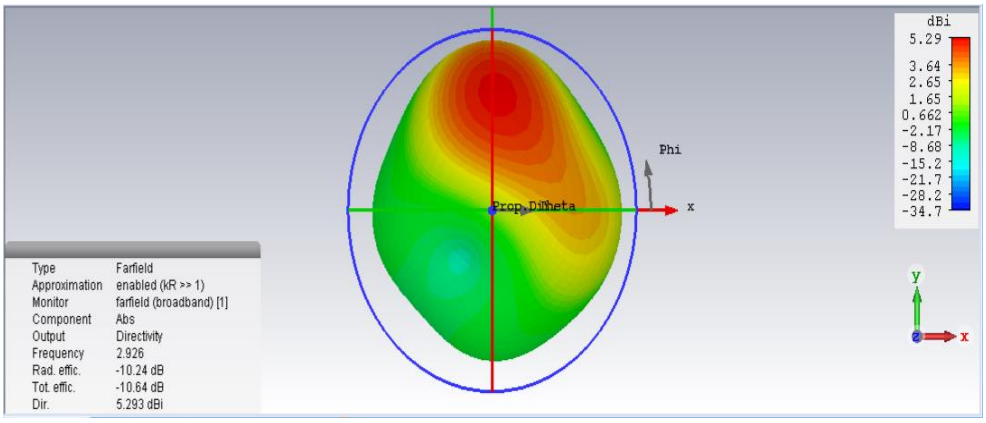
FIGURE 1. Antenna structure

3. ANALYSIS OF 3D RADIATION PATTERN

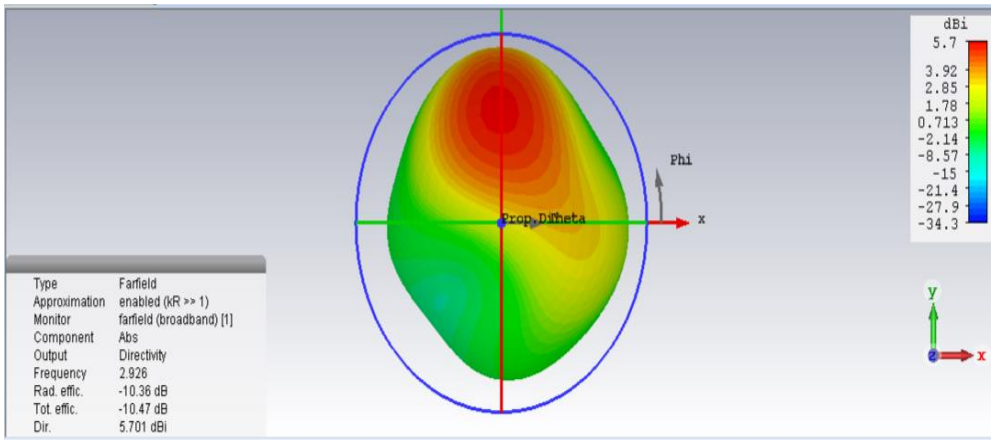
We have proposed our design by using four different structure and observe that it may be suitable for our wireless applications. The 3D radiation pattern for all structure and proposed antenna angle phi=90 degree is shown in figure. 2


dBi
5.97
4.11
2.99
1.87
0.746
-2.13
-8.51
-14.9
-21.3
-27.6
-34
Phi
Prop_DiTheta
x
y
x
Type Farfield
Approximation enabled (kR >> 1)
Monitor farfield (broadband) [1]
Component Abs
Output Directivity
Frequency 2.926
Rad. effic. -10.65 dB
Tot. effic. -10.71 dB
Dir. 5.972 dBi

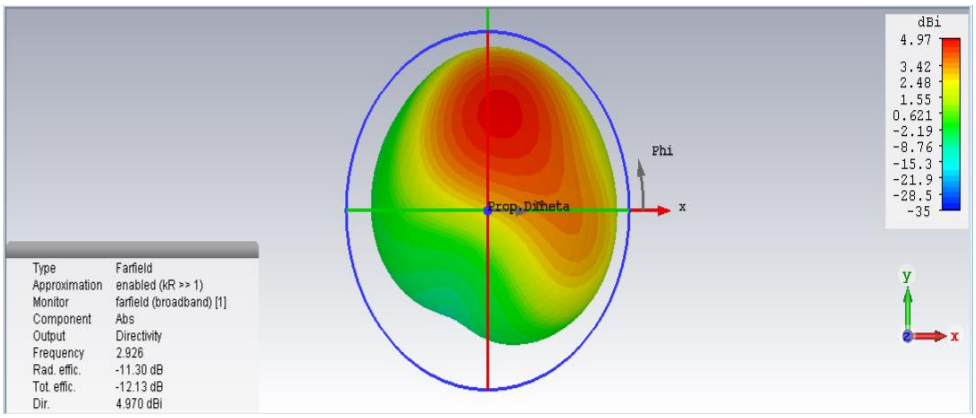
(a)


dBi
5.29
3.64
2.65
1.65
0.662
-2.17
-8.68
-15.2
-21.7
-28.2
-34.7
Phi
Prop_DiTheta
x
y
x
Type Farfield
Approximation enabled (kR >> 1)
Monitor farfield (broadband) [1]
Component Abs
Output Directivity
Frequency 2.926
Rad. effic. -10.24 dB
Tot. effic. -10.64 dB
Dir. 5.293 dBi

(b)


dBi
5.7
3.92
2.85
1.78
0.713
-2.14
-8.57
-15
-21.4
-27.9
-34.3
Phi
Prop_DiTheta
x
y
x
Type Farfield
Approximation enabled (kR >> 1)
Monitor farfield (broadband) [1]
Component Abs
Output Directivity
Frequency 2.926
Rad. effic. -10.36 dB
Tot. effic. -10.47 dB
Dir. 5.701 dBi

(c)



(d)

FIGURE 2. 3D Radiation Pattern in (a) Antenna 1, (b) Antenna 2, (c) Antenna 3, (d) Antenna 4

4. RESULTS AND DISCUSSIONS

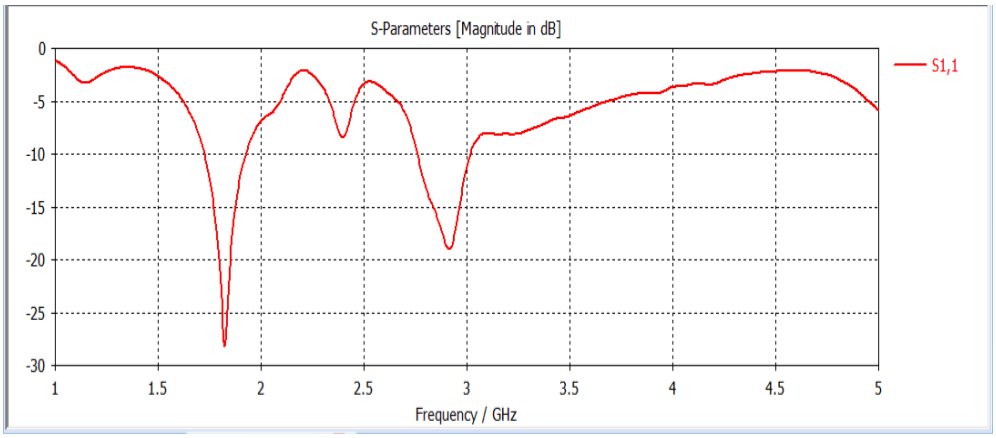
As we can see from the result and the comparison table from four different design we observe that VSWR ratio is almost close to 1 dB and the value of the return loss is negative that indicate there is not much of losses during the transmission and it is considered to be good sign.

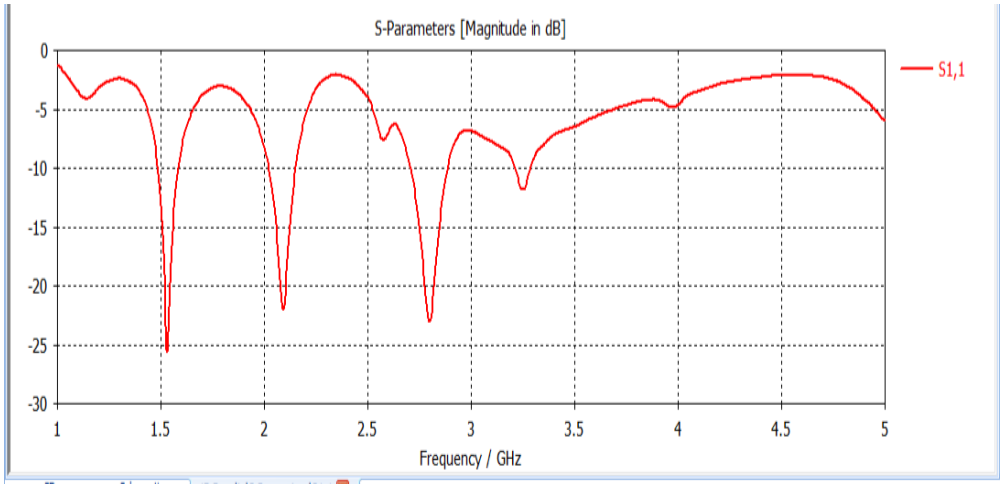
As we can see from the above design we slightly changes the patch, so we can have different output for observation. From the above we can see that the return loss of first design is -24dB and return loss of second, third and fourth structure are -14dB, -24.5dB, -15.5dB respectively.

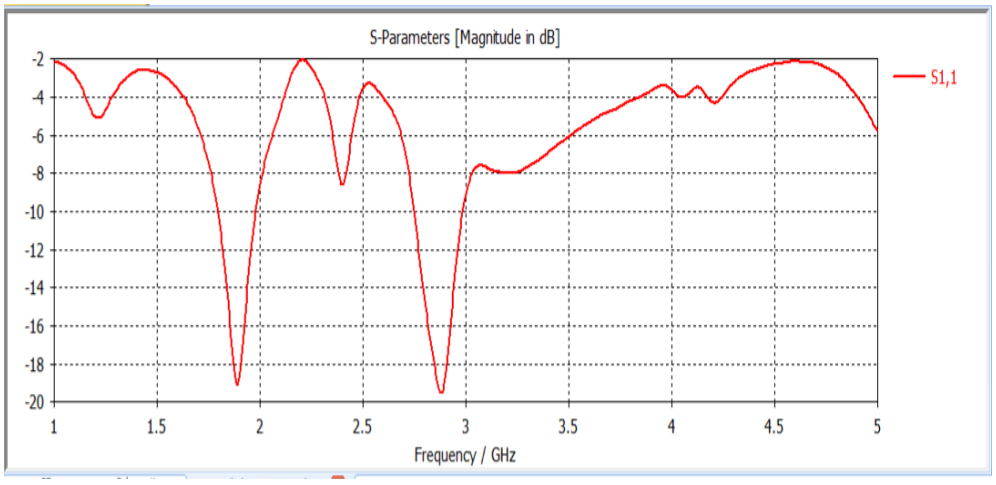
As we have seen from above five design in different frequencies the return loss is negative. So there is not much loss during transmission.

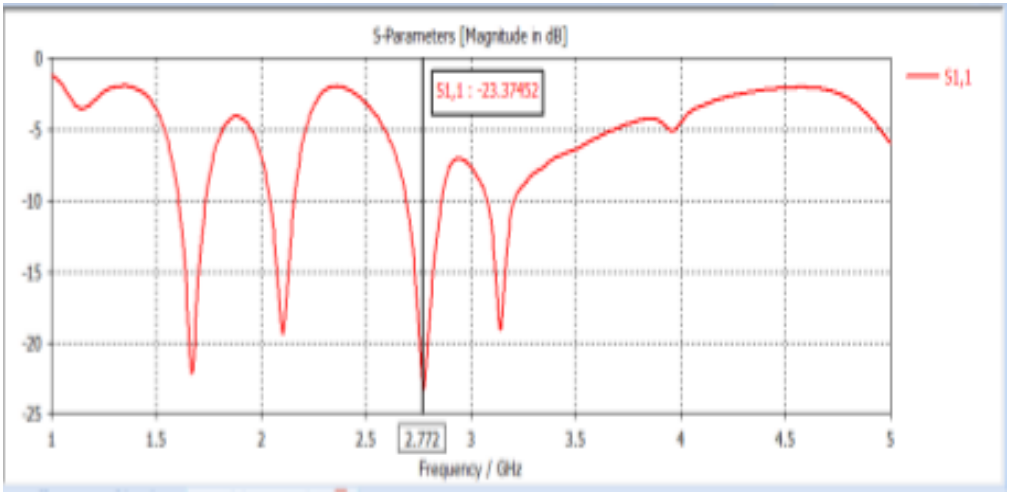
Now we see from the frequency VS Directivity graph we can observe from all five design that the directivity is positive and has good value of 4.1 dBi, 3.7dBi, 3.2dBi, and 3.63dBi respectively.

The VSMR ratio of all the four design is almost close to 1 so we can say that the antenna id matched to the the transmission line and more power is delivered to the antenna.

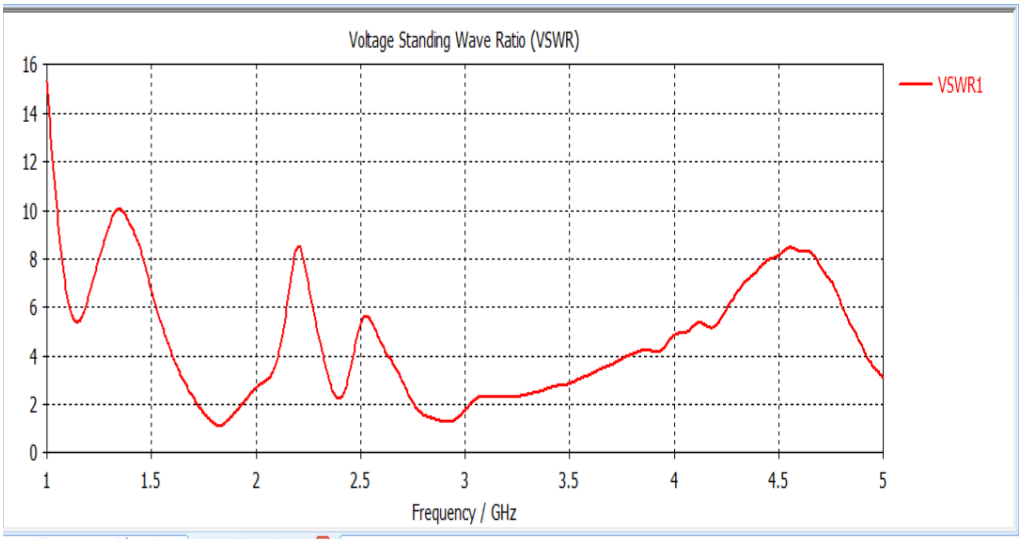

S-Parameters [Magnitude in dB]
S1,1
0
-5
-10
-15
-20
-25
-30
1
1.5
2
2.5
3
3.5
4
4.5
5
Frequency / GHz

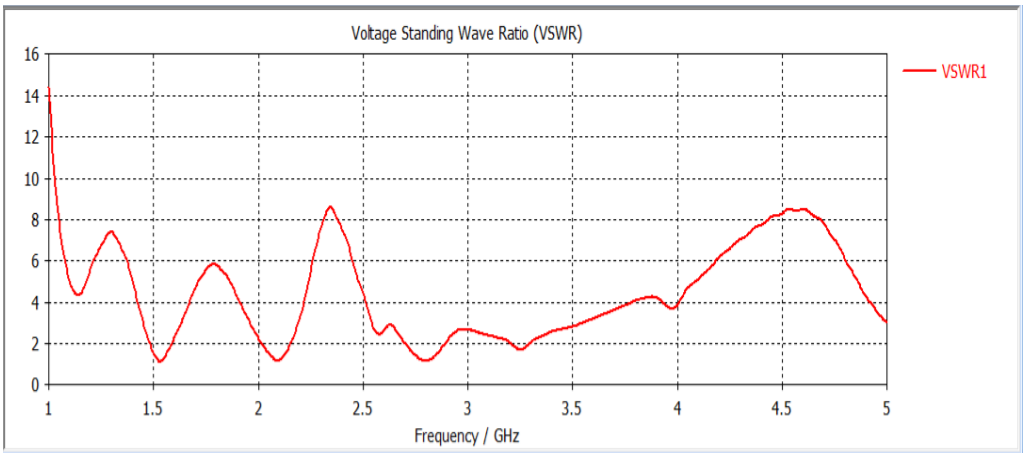

S-Parameters [Magnitude in dB]
S1,1
0
-5
-10
-15
-20
-25
-30
1
1.5
2
2.5
3
3.5
4
4.5
5
Frequency / GHz

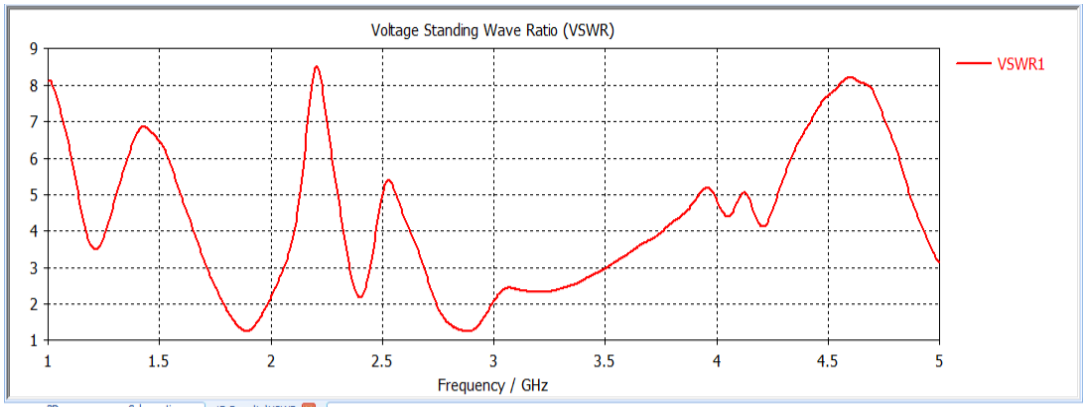

S-Parameters [Magnitude in dB]
S1,1
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
1
1.5
2
2.5
3
3.5
4
4.5
5
Frequency / GHz

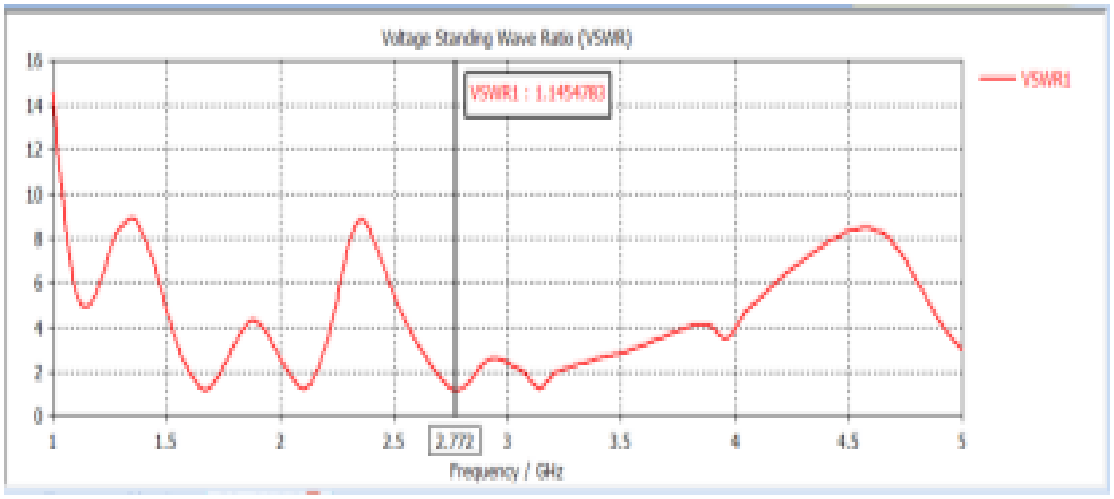

S-Parameters [Magnitude in dB]
S1,1 : -23.37452
S1,1
0
-5
-10
-15
-20
-25
1
1.5
2
2.5
2.772
3
3.5
4
4.5
5
Frequency / GHz

(a)

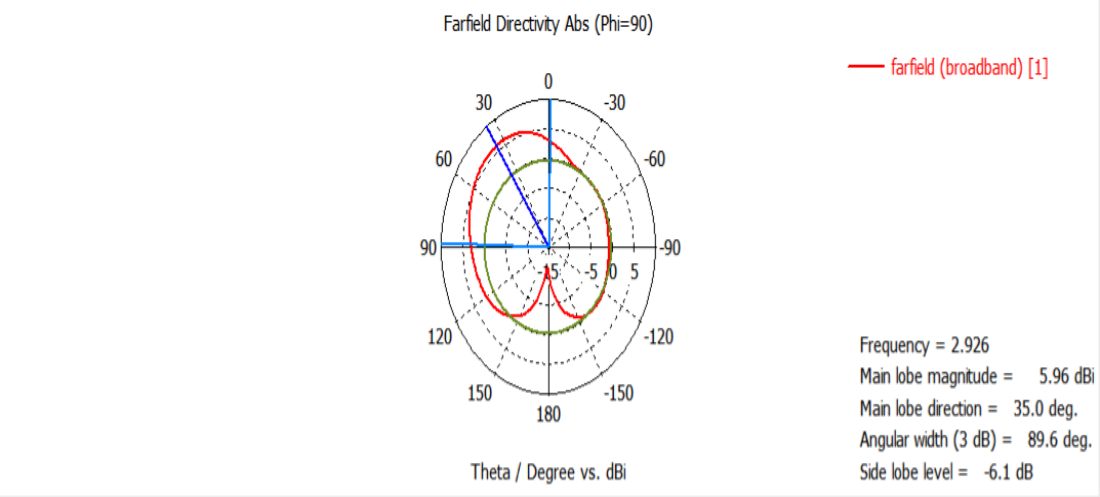

Voltage Standing Wave Ratio (VSWR)
VSWR1
16
14
12
10
8
6
4
2
0
1
1.5
2
2.5
3
3.5
4
4.5
5
Frequency / GHz

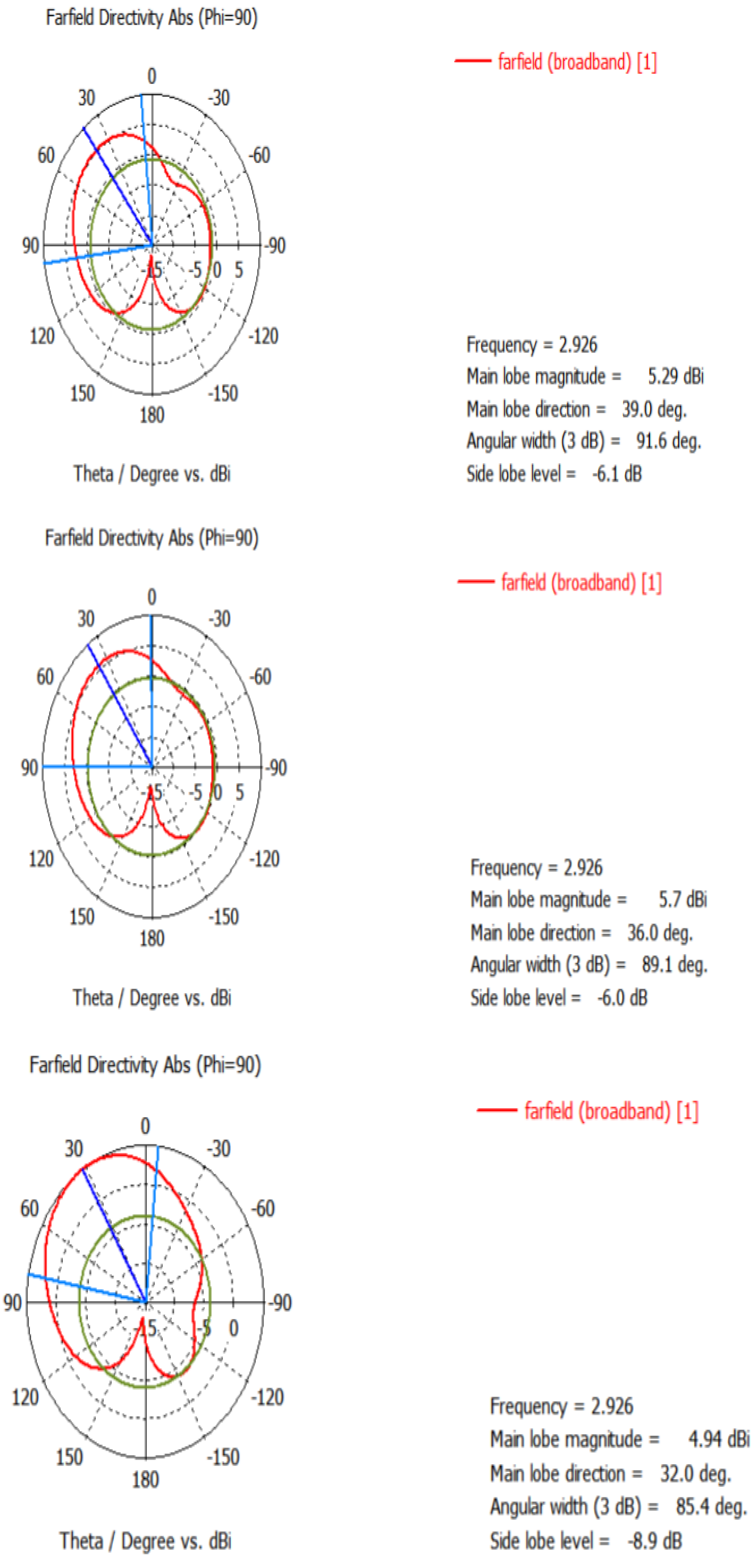

Voltage Standing Wave Ratio (VSWR)
VSWR1
16
14
12
10
8
6
4
2
0
1
1.5
2
2.5
3
3.5
4
4.5
5
Frequency / GHz


Voltage Standing Wave Ratio (VSWR)
VSWR1
Frequency / GHz


Voltage Standing Wave Ratio (VSWR)
VSWR1 : 1.1454783
VSWR1
2.772
Frequency / GHz

(b)


Farfield Directivity Abs (Phi=90)
farfield (broadband) [1]
Frequency = 2.926
Main lobe magnitude = 5.96 dBi
Main lobe direction = 35.0 deg.
Angular width (3 dB) = 89.6 deg.
Side lobe level = -6.1 dB
Theta / Degree vs. dBi



(c)

FIGURE 3. Simulated results for proposed antenna (a) s parameter, (b) VSWR, (c) Radiation Pattern

TABLE 2.

TABLE 2.COMPARISON TABLE

Parameter	Structure 1	Structure 2	Structure 3	Structure 4
Type of feed	Microstrip line feed	Microstrip line feed	Microstrip line feed	Microstrip line feed
Height	1.6mm	1.6mm	1.6mm	1.6mm
Length	60mm	60mm	60mm	60mm
Resonance frequency	2.4ghz	2.4 ghz	2.4ghz	2.4 ghz
Dielectric constant	9.8	9.8	9.8	4.4
Loss tangent	0.019	0.019	0.019	0.019
Antenna effeciency	-12.7	-32.1	-12.4	-11
Directivity	4.1dBi	1.8dBi	3.7dBi	3.2dBi
Return loss	-24dB	-14dB	-24.5dB	-15.5dB
VSWR	1.4	1	1.12	1.4

5. CONCLUSION

The main aim of this project is to design a micro strip patch antenna and to study about the parameters like, VSWR ratio, directivity, return loss and more. We designed a simple patch antenna using micro strip feed technique each design have different resonating frequency, 2.9Ghz, 3.1Ghz, 2.7Ghz, and 2.8Ghz with a dielectric constant of 9.8(alumina), which has a loss tangent of 0.019. All the results are observed and validated. Our design may be useful in near future. Our work will be further progress by doing some modification in the antenna.

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