MICROSTRIP PATCH ANTENNA USING PARASITIC ELEMENTS

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ABSTRACT

The circularly polarized microstrip antenna having v-shaped slits and parasitic elements has been proposed.The circular polarization can be achieved using asymmetries.Gain has been improved by using two parasitic elements of same dimensions.The coaxial feed with FR4 substrate having dielectric constant of 4.4 is used.Proposed antenna is suitable for various telecoms,LAN,Wi-Fi applications in ISM-band.It is showed that the proposed antenna has resonance in ISM-Band and a peak gain of 7.4dBi.The proposed antenna is simuated using HFSS software and then fabricated.Then simulated and measured results are compared.

Keywords— *Circular polarization, microstrip antennas, LAN*

I. INTRODUCTION

Microstrip patch antennas have been popularly used in mobile and radio wireless communication.Because of its various advantages like low profile, low cost, conformal,robust and small size.However, they have disadvantages of low efficiency, narrow bandwidth and surface wave losses. Microstrip antennas are also used in military application and global positioning system (GPS).Patch antenna has a radiating conducting patch on a grounded dielectric substrate.The patch is a very thin metal disk. Researchers have made many efforts to overcome this problem and many changes have been made to extend the bandwidth.

Now in wireless communication systems,compact circularly polarized microstrip antennas with good performance are used at low microwave frequencies.Design of the compact CPMA is attractive for portable device applications. Small size of the CPMA can be achieved at the limited gain and narrow 3-dB axial ratio (AR) bandwidth or return loss impedance bandwidth. Two orthogonal modes can be generated using slits at around resonance frequency with 90 degree phase-shifts for CP radiation requirements.

Because of high power of today's computers HFSS(High Frequency Structure Simulator) simulator are software tool to perform planer and 3D analysis of high frequency elements. HFSS simulator is also an effective modeling tool for RF/Microwave design.The given antenna is designed and simulated on HFSS simulator software and then fabricated. And the fabricated antenna is tested on VNA.

VNA is used for measurement of reflection coefficient. In the Vector Network Analyzer (VNA), the data is represented in the form of return loss parameters and they are defined by measuring the travelling waves in the form of voltage between the ports.

It is now both possible to surf the web from your laptop wirelessly and we can enjoy cricket match on your TV.A WLAN is a data communication network used as an extension to or an alternative for a wired LAN in a building or organization. As a result,broad band WLAN antenna is mostly used that fulfills the desired requirements.The broadband antenna must be compact,low profile directive for high transmission efficiency and designed to be discrete.Due to these well met requirements with the ease of manufacture and repeatability makes the micro strip patch antennas are prefered for broadband wireless application.

In this , we design a micro-strip patch antenna in which four v slots are used in micro-strip patch to increase its axial ratio bandwidth and frequency response.And the two parasitic elements has been added for increasing the gain of the antenna.

II. ANTENNA GEOMETRY AND DESIGN PROCEDURE

A microstrip patch antenna has a radiating patch on one side of a dielectric substrate which has a ground plane on other side (fig1). The EM waves fringe off the top patch of the substrate, reflecting off the ground plane and radiates into the air.Generally,radiation occurs due to the fringing effect between the patch and ground.The radiation efficiency of the patch antenna depends mainly on the relative permittivity of the dielectric (ε).Ideally, a thick dielectric,low ε and low insertion loss is used for broadband purpose and increased efficiency. The dielectric material chosen is of FR4-epoxy substrate having relative permittivity of 4.4 and the thickness of 1.6mm.

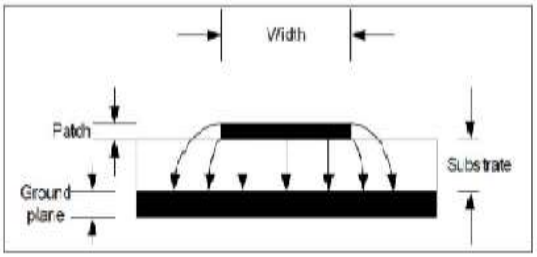

Fig1.microstrip patch antenna

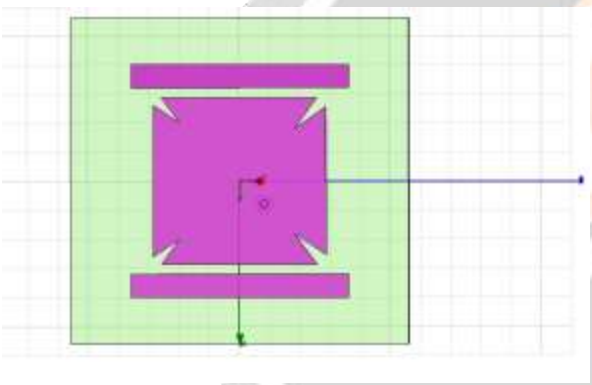

Fig 2.microstrip patch antenna

The dimension of patch is designed by using basic design approach described for microstrip patch antenna as listed below.

Next step is to calculate the other parameters like length and width of micro strip patch is given as follows:

Step 1:

Width of micro strip patch is given below:

$$w = \frac{c}{2f_0\sqrt{\frac{\varepsilon_r + 1}{2}}} \qquad (1)$$

Step 2:

Length of micro strip patch is given below:

$$\Delta L = (0.412 * h)\frac{\left(\varepsilon_{reff} + 0.3\right)\left(\frac{w}{h} + 0.264\right)}{\left(\varepsilon_{reff} - 0.258\left(\frac{w}{h} + 0.813\right)\right)} \qquad (2)$$

Step 3:

The resonant frequency for any mode is given by:

$$f_0 = \frac{c}{2\sqrt{\varepsilon_{reff}}}\left[\left(\frac{m}{l}\right)^2 + \left(\frac{n}{m}\right)^2\right]^{1/2} \qquad (3)$$

A square patch antenna designs are one of the earliest example of microstrip patch antenna. Various techniques, like offset feeds, truncated corners and diagonal slits were used to produce circular polarization from square or rectangular patch antennas.Fig. shows the simulated design of the antenna.The size of the antenna is limited to 56 mm × 56 mm at most. Thus the initial design was chosen of dimensions 56 mm × 56 mm. A probe feed from the bottom is attached to the patch through a hole drilled into the substrate. The coaxial feed location is along the orthogonal X-axis from the center of a patch. Fig 1 b introduces the asymmetric V-shaped slits square patch for CP radiation and rectangular strips for wide axial ratio beamwidth.

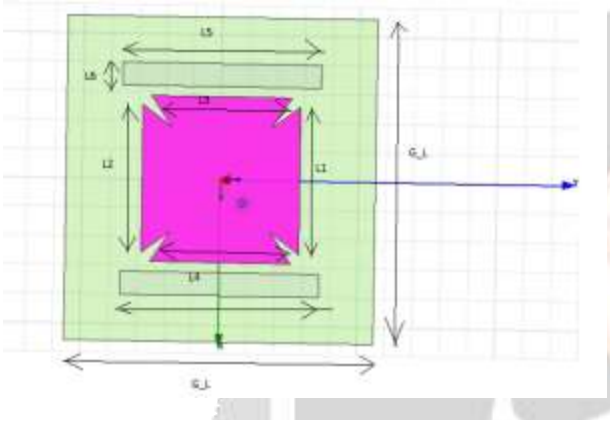

Figure 3: Proposed antenna geometry

The dimensions of the strips and the corner of the V-shaped symmetric slits are used to create the resonance and circular polarization at 2.45 GHz. The optimized dimension is as follows:
G_L=56 mm, *L1=25.47* mm, *L2*=26.06mm, *L3*=25.76mm, *L4*=27.06 mm, *L5*=36 mm and *L6*=4mm.

III. FABRICATED DESIGN OF ANTENNA

Fig.4 fabricated prototype of antenna

IV. RESULTS AND DISCUSSION

The designed V-shaped asymmetric square patch with rectangular slit was simulated for validate the design. Then fabricated prototype has tested on VNA.And the results were compared with simulated results.

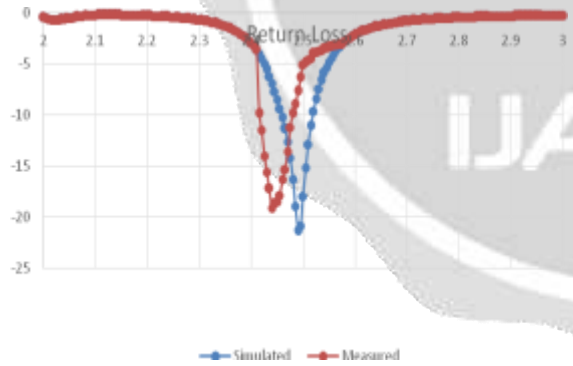

Fig.5 simulated and measured return loss

Fig.5 shows the simulated and measured return loss of the antenna.It shows that tested return loss is -19.09db.

Fig.6 simulated and measured VSWR

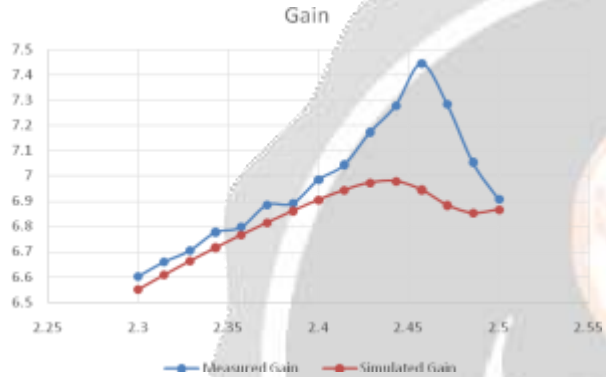

Fig.7simulated and measured gain of antenna

Fig.6 shows the simulated and measured VSWR of the antenna.It shows the vswr of 1.30 which is less than <2 at 2.46ghz frequency .The fig.7 depicts the simulated and measured gain of antenna.

V.FABRICATION AND MEASUREMENT

The fabrication process involves 5 steps.

1. Generate mask on transparency
2. Photo exposure process
3. Etching in developer solution
4. Etching in Ferric Chloride
5. Soldering the probe for SMA connector

A SMA adapter was connected at last of the microstrip line for measurement. Network analyzer will be used to measure the S11 of the antenna.The simulated and measured results of the prototype will be compared.

Table 1: Comparison table

Sr.No.	Results	Freq (GHZ)	Return Loss(dB)	VSWR	Bandwidth (MHZ)	Directivity (dB)
1.	Simulted Results	2.46	-21.32	1.25	64	6.7
2	Measured Results	2.44	-19.09	1.30	70	7.4

VI. CONCLUSION

A compact Circular polarized V-shaped asymmetric MSP antenna was fabricated.Slits are inserted on four corners of the patch. The fabricated antenna exhibits an effective bandwidth of 70MHz from 2.41-2.48 GHz for 10-dB return loss and vswr of 1.30 which is less than 2. The gain of the fabricated antenna is around 7.4 dBi.The overall dimension of the antenna is 56mm×56mm×1.6mm at 2.45GHz and thus can be considered as a suitable for various like WLAN applications, ISM-band(2.43-2.49Ghz) and S-band satellite applications.

VII. REFERENCES

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