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S Shape Microstrip Patch Antenna

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ABSTRACT: This paper presents a dual band micro strip patch antenna. The frequency range of given antenna is from 1.4GHz up to 2.5GHz and the intermediate frequency between that ranges is 1.8GHz. The antenna is design on a thin substrate having substrate height is 1.6mm and dielectric constant is ϵ_r=4.4. This dielectric constant is popular and high pressure thrrmoset plastic which having good strength to weight ratios. Return loss for frequencies 1.4GHz and 2.5GHz are as follows -17db and -26.5db. The antenna is low cost, less weight and low profile with radiation efficiency more than 80%. This antenna satisfies all the performance parameter. The above given frequency range is good for telemetry application, WI-max, WLAN. The S-shape micro strip dual band patch antenna having one feed point. In which there is two connector. At one connector we apply 50ohm load for better return loss. This feeding technique gives a good .impedance matching at inputs of the radiating elements. The antenna is designed, analysed and optimized on IE3D Zeeland software version 15.90.

KEYWORDS: Rectangular micro strip patch, 50ohm load, Antenna array,PCB.

I. INTRODUCTION

An antenna is a transducer that converts radio frequency fields into alternating current or vice versa. There are both transmitting and receiving antennas for sending or receiving radio transmissions. Antenna plays an important role in the operation of all radio equipment. Antennas are essential components of radio equipment, and are used in radio broadcasting, broadcast television, two-way radio, communications receivers, radar, cell phones, satellite communications and other devices. An antenna is an array of conductors (elements), electrically connected to the receiver or transmitter. During transmission, the oscillating current applied to the antenna by a transmitter creates an oscillating electric field and magnetic field around the antenna elements. These time-varying fields radiate energy away from the antenna into space as a moving transverse electromagnetic field wave. Conversely, during reception, the oscillating electric and magnetic fields of an incoming radio wave exert force on the electrons in the antenna elements, causing them to move back and forth, creating oscillating currents in the antenna.

As per we know wireless communication is essential. For wireless communication we need different antennas. There are many antennas named as Yagi Uda, helical, horn etc. But all these antennas have high gain and bandwidth and they are having large size too. There for we are not using this antennas for wireless communication. For wireless communication we are using micro strip patch antennas. Micro strip patch antenna are widely used in extensive applications in recent times due to their inherent advantages of low profile, low cost, less weight, integration ability with the circuitry and support linear and circular polarization[1-2]. But the drawbacks of micro strip patch antennas are low gain, low power handling, narrow bandwidth, low efficiency.

To overcome this drawbacks we are using different shapes of antennas like as E-shape ,C-shape, H-shape ,S-shape etc. S shaped antennas could be used to provide additional capabilities that may result in wider instantaneous frequency band, more extensive volumes and radiation patterns with more desirable side lobe distribution. Micro strip S-shape patch antenna is designed by inserting two slots into rotated square patch. This increases the bandwidth of an antenna. The bandwidth is also increased by introducing PBG structure. The antenna design by this method has low volume and low profile configuration, easily mounted low fabrication cost and light weight. This antenna is suited for C-band communication .

While designing the micro strip patch antenna dielectric substrate plays an important role for design of antennas different types of substrate are used. Dielectric constant range from 2.2<= permittivity<=12. In this paper the dielectric substrate is choosen FR- 4 whose dielectric constant 4.4 [5]. FR-4 is popular and high pressure thermoset plastic which

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having good strength to weight ratios. FR-4 is used as electrical insulator having considerable mechanical strength. A maximum directive gain of single patch antenna is ground 6-9dbi. The input impedance of a resonant micro strip patch antenna is from 150ohm to 400ohm. And the desired impedance is 50ohm.

This antenna is design for various multiple applications such as Bluetooth, medical applications and ISM applications. A compact analysis and design of S- shaped micro strip patch antenna suited for WI-MAX application is simulated over IE3D software version 15.9. In this paper we present S-shaped micro strip patch antenna to enhance the gain and bandwidth.

II. LITERATURE SURVEY

In paper "S shaped micro strip antenna for Bluetooth application" S shape micro strip patch antenna is investigated for wideband operation using modal expansion cavity model. In that paper antenna resonates at 2.62GHz.The bandwidth of the S shape micro strip patch antenna 21.62% and 20.49%.

In "Design and analysis of S shaped micro strip patch antenna for GPS application" paper the antenna is designed to operate at UHF and higher frequencies.

In "Comparative analysis of S shaped multiband micro strip patch antenna "paper antenna is designed using complementary split ring Resonator and also using Meta material. The operating range is 1.5 GHz. The proposed antenna is designed for Bluetooth, L and S band application which is used in medical and ISM application. This paper gives the information about return loss, total gain plot, total directivity plot of an antenna.

In "S-shape Wideband Micro strip Patch Antenna with Enhanced Gain and Bandwidth for Wireless Communication" paper the antenna is designed for 4.07 GHz to 8.20 GHz. The proposed antenna is designed for S band and C band applications. The maximum achieved gain is 6dbi with return loss -33db.

In "Design and Analysis of Extended S-Shaped Micro strip Patch Antenna for Wideband Application" presents design and analysis of extended S- shaped micro strip patch antenna for wideband application. Design and simulation of this antenna is performed over IE3D software

III. RELATED WORK

S Shape Micro strip patch antenna is simulated and analyzed using IE3D software from this software we obtain respective parameters. All numerical calculation and the feed point obtain by the software named as matlab.We use co axial probe feeding technique to feed this antenna.

IV. ANTENNA DESIGN

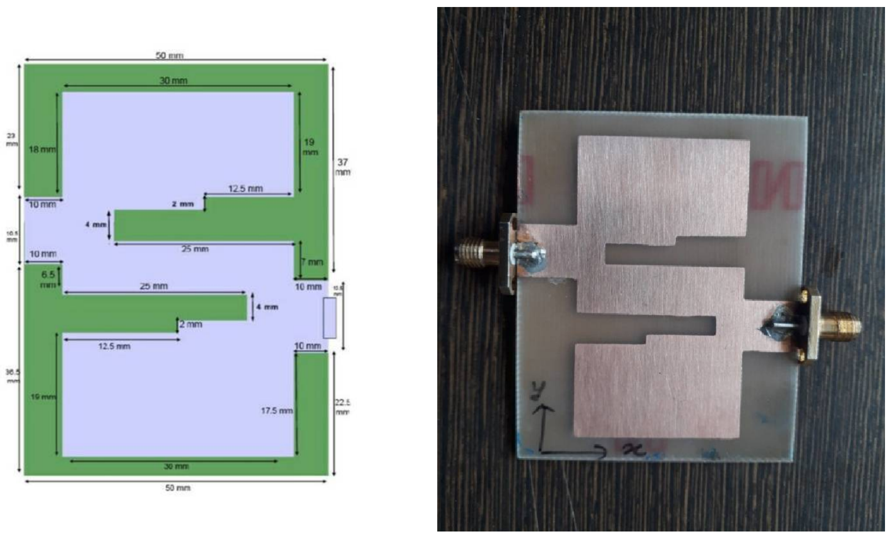

Fig. 1 S-Shape micro strip patch antenna

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This project represents design and analysis of extended S shaped micro strip patch antenna for wide band application. Design and simulation of this antenna is performed over IE3D software. The bandwidth is further increased by introducing PBG structure. The proposed antenna operates in S and C band. The S shape micro strip patch antenna is design by cutting to opposite notches in rectangular patch shape and we use co-axial probe feeding technique to feed this antenna Finally this antenna is simulated using IE3D software to obtain respective parameters.

V.SYSTEM SPECIFICATION

1.width calculation:

$$W = \frac{1}{2f_r\sqrt{\mu_0\ \epsilon_0}}\sqrt{\frac{2}{\epsilon_r + 1}}$$

Where, μ_0 = Permeabilty of free space= $4\pi*10^{-7}$

ϵ_0= permittivity of free space=$8.857*10^{-12}$

$$f_r = Resoanant\ frequency$$

$$\epsilon_r = relative\ permitivity\ of\ free\ space = 1$$

2. effective dieelectric constant calculations:

$$\epsilon_{reff=}\frac{\epsilon_{r+1}}{2}+\frac{\epsilon_{r-1}}{2}[1+12\frac{h}{w}]^{-1/2}$$

Where,

$$\epsilon_{reff=effective\ dieelectric\ constant}$$

$$h = hight\ of\ the\ antenna$$

$$w = width\ of\ the\ antenna$$

3. effective length calculation:

$$L_{eff=}\frac{c}{2f_r\sqrt{\epsilon_{reff}}}$$

Where,

$$C = velocity\ of\ light = 3*10^8$$

$$L_{eff=effective\ length}$$

4. length extension calculation:

$$\frac{\Delta L}{h} = 0.412\frac{(\epsilon_{reff} + 0.3)(\frac{W}{h} + 0.264)}{(\epsilon_{reff} - 0.258)(\frac{W}{h} + 0.8)}$$

Where, ΔL=change in length

5.actual length of patch calculation:

$$L = L_{eff-2\Delta L}$$

6.ground plane dimensions and calculations:

$$L_{g=6h+L}$$

$$W_{g=6h+w}$$

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V. RESULT

SMITH CHART

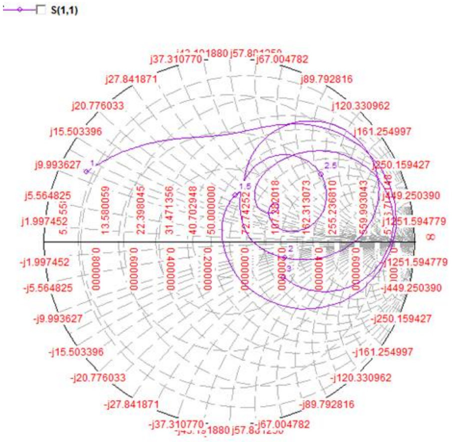


Fig 2(a) Simulated

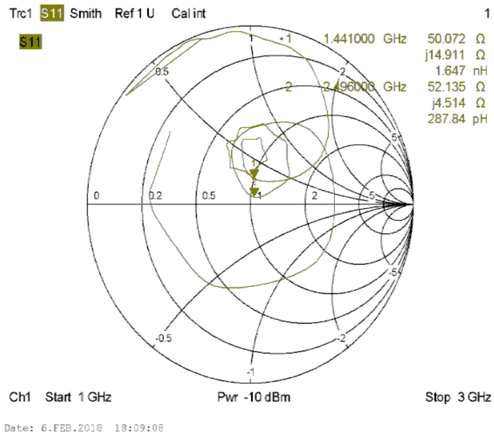
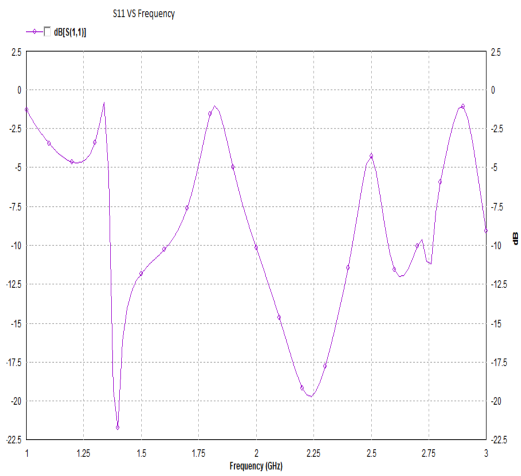


Fig 2(b) Obesreved

The smith chart is graphical aid or nomogram designed for electrical and electronics engineers specializing in radio frequency engineering to assist in solving problem with transmission lines and matching circuits. Smith chart is a polar plot of the complex reflection coefficient or it is define mathematically as the one port scattering parameter S11. A smith chart is developed by examine the load where the impedance must be matched. The most important application of smith chart is impedance matching. The above figures represents the simulated and measured smith chart results. The result is shown the input impedance 50Ω.

S11:

The proposed antenna gives the good return loss over the specified frequency range. The curve has very small values of return loss at frequencies 1.4 and 2.24GHz and are −22, - 9.5 dB respectively. A bandwidth is achieved from the current design. In the design, S11 is-22 dB used as telemetry applications and -19 dB is used for Wimax and WLAN applications as shown in Fig.3



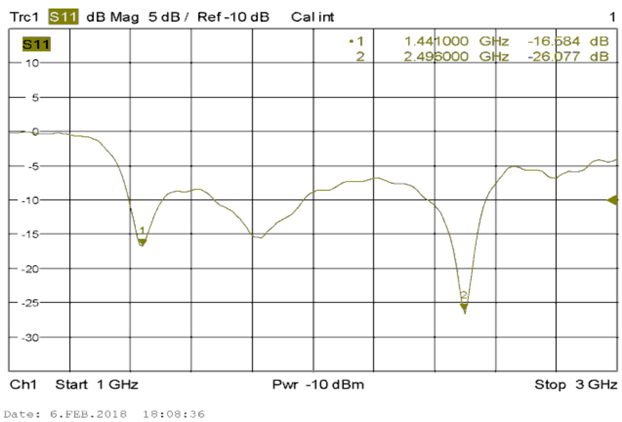


Fig 3(a) simulated

Fig 3(b)observed

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VSWR:

Above graph shows the VSWR measured and simulated. VSWR measured is done on VNA(vector network analyzer) and the simulation process is done by the software named as IE3D. In VSWR graphs on x-axis frequency is shown and at y-axis VSWR is shown. In this the result are mainly available for for two frequencies as follows 1.4GHz and 2.5GHz. The value of measured VSWR at frequency 1.4GHz is 1.347U and at frequency 2.5GHz is 1.101U. The input impedance is 50Ω for all the above graphs.

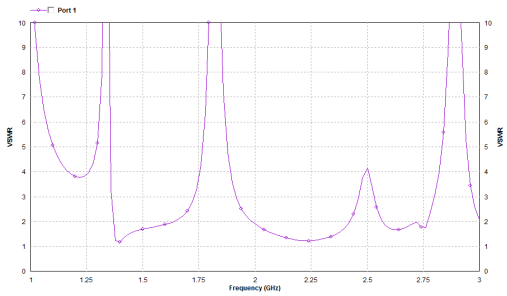

Fig4 (a) Simulated

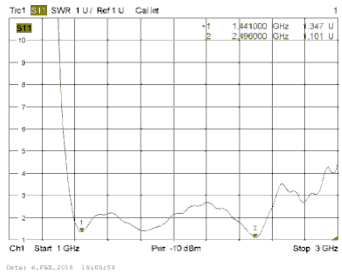

Fig 4(b) Obesreved

Radiation pattern :

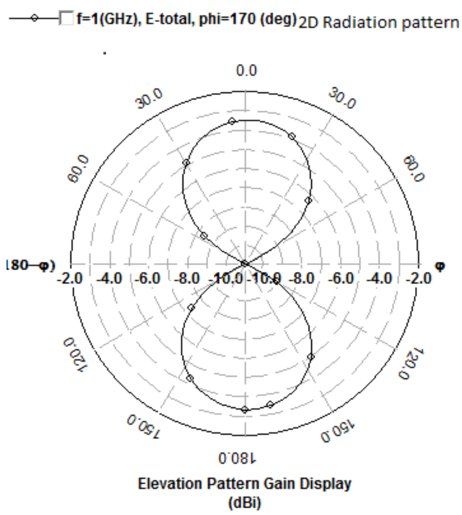

Fig 5. 2D radiation pattern of s patch antenna

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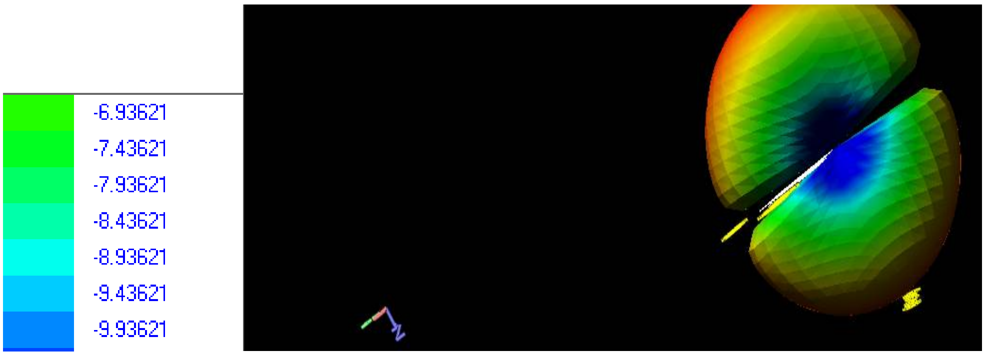
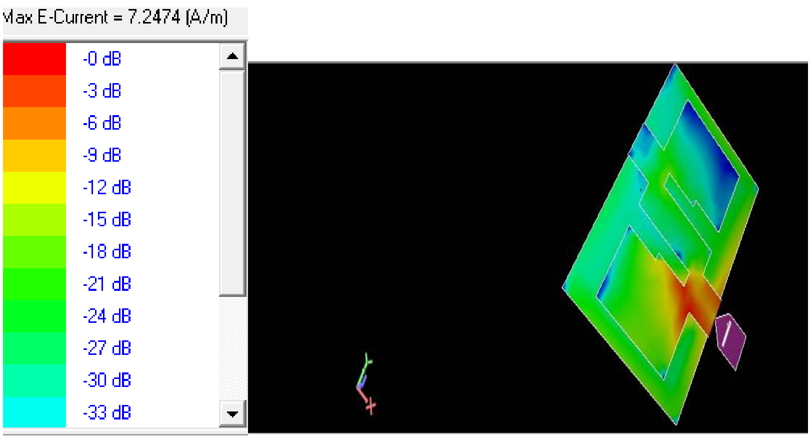


Fig 6.3D radiation pattern of s patch antenna

The simulated results of surface current distributions on the printed circuit board (PCB) metal portion of the proposed dual band antenna as shown in Fig. 5.



.Fig 7 Current distribution of s patch antenna

The proposed printed multiband antenna is formed by the radiating folded loop line, rectangular patch inserting meandered slit and the system ground plane, the whole antenna configuration makes an effective radiating system to cover the two wide bands of 1.4 to 2.5 GHz, World Interoperability

For Microwave Access (Wi MAX) system bands and Wireless Local Area Network (WLAN) bands.

The return loss results cover the WLAN and Wi MAX and telemetry applications shown in Fig.3. Fig. 4shows the simulated results of surface current distributions at resonant frequency. The large

Resonant current distribution is indicated by the light colour, and the small one is the dark colour. This indicates that the proposed antenna has the independency on the resonant current path on

The antenna radiator. Based upon the mentioned independency, we can easily design and tune the dual-band antenna to satisfy the bandwidth and frequency required. The simulated radiation

Pattern of the proposed antenna at each resonant frequency

of 1.4GHz and 2.5 GHz are illustrated in Fig 7.

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Efficiency:

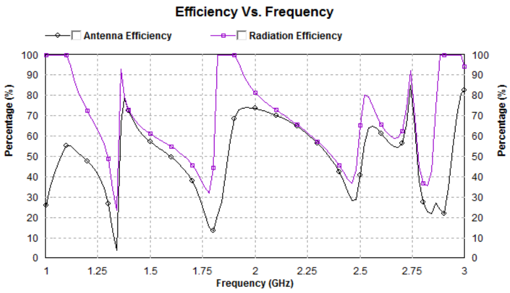

FIG 8.EFFICIENCY OF S PATCH ANTENNA

The compact dual band antenna with main features are wideband and good radiation efficiency higher than 80% to 100% over the operating lower band and upper band is as shows in Fig. 8.The antenna efficiency is also about to 80%. This is the good feature for telemetry applications.

VI. CONCLUSION

The proposed antenna conclude that it is applicable for telemetry application of the bandwidth 1.4 GHz and it is also applicable for WIMAX application of the bandwidth 2.5 GHz. The proposed antenna dimensions 50mm×70mm.It is compact in size and having the various application. The antenna will provide gain less than -30 db. Antenna efficiency is 81%. For future scope We also reduce size of antenna by using folded technology.

This type of array antenna improve the gain by changing other parameter

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