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Compact Dualband Planar Inverted F Antenna for Wireless Services

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***Abstract*: In mobile phones and other hand held devices like the Personal digital assistants the antenna plays a pivotal role which decides the device performance over various communication standards. This paper presents a dual band Planar Inverted F antenna(PIFA), the main radiating patch is etched(F shaped slot) to control the resonating frequencies that cover 2.4GHZ Wireless local area network(Bluetooth/WLAN) and 5.2GHZ Wireless Interoperability for Microwave access(Wimax). Use of an extra shorting strip was found to enhance bandwidth at a low frequency band and the slot enhanced bandwidth a higher frequency band. The optimized dimensions of the proposed antenna are 9x 9 x 1mm³. The simulation results show that the antenna parameters satisfy the requirements of wireless handheld devices.**

Keywords: Return loss, Voltage standing wave ratio, Radiation pattern, Planar inverted F antenna.

I. INTRODUCTION

A PIFA is also known as short circuited microstrip antenna. It consists of a quarter wavelength patch separated from the ground plane by a dielectric, a top patch, a feed wire feeding the antenna and a shorting plate at one end of the radiating patch. PIFA has many advantages over the conventional antennas like small size, low cost and low backward radiation minimizing specific absorption rate (SAR). The distance between the feed point and the shorting plate determines the impedance of the antenna i.e. smaller the distance smaller the impedance. [1]

Also PIFA has moderate to high gain in both vertical and horizontal polarization states, which makes it quite suitable for the wireless communication service where the antenna orientations are not fixed and the environment is active, i.e. signal reflections are possible from all corners of the vicinity. In this case where environment is reflective major parameter of concern is total field that is the sum of the horizontal and vertical polarization field.[1].

The small bandwidth of PIFA is a major concern however by adjusting the width of the antenna, its height and the substrate permittivity and the size of the ground plane bandwidth can be optimized. This design uses the concept of multiple shorting strips to enhance bandwidth at the lower band and slots are used to enhance bandwidth at the high frequency.

II. ANTENNA DESIGN

The proposed PIFA is designed to work for Wimax (5.2Ghz) and Bluetooth(2.4Ghz).

The dimensions of the proposed PIFA are 9mm X 9mm. In the proposed design the ground plate is taken to be rectangular with size 15mm x 17mm resp. The patch lies 1mm above the ground plane .The patch is shorted to the ground via a rectangular shorting plates of size 1mm x 1mm and 0.2mm x 1mm respectively. The radius of the inner feed is 0.1mm and outer coaxial cover has a radius of 0.2mm.The height of the inner feed wire is 1mm. Fig.1 shows the design of the proposed antenna.

The antenna is fed through the inner feed connected to a 50Ω transmission line. The dimensions of the substrate are 15mm x 17mm x 1mm respectively and the relative permittivity of about 4.4(FR4 epoxy). The inner feed wire has the permittivity of 1(pec).

It was observed that creating an F slot on the top patch enhances bandwidth at the 5 GHz band .Optimization of the F shaped slot helped in attaining resonance at 5.2 GHz.

It was also observed that use of an extra shorting strip enhances bandwidth at the lower frequency band and also effects the resonant frequency.

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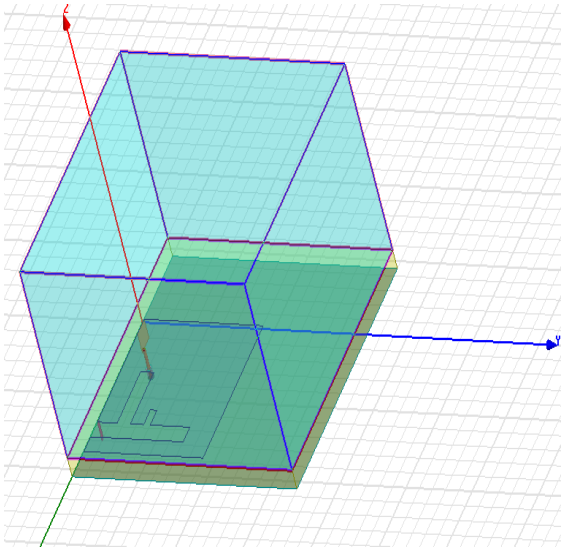

Fig. 1.Design of the proposed antenna.

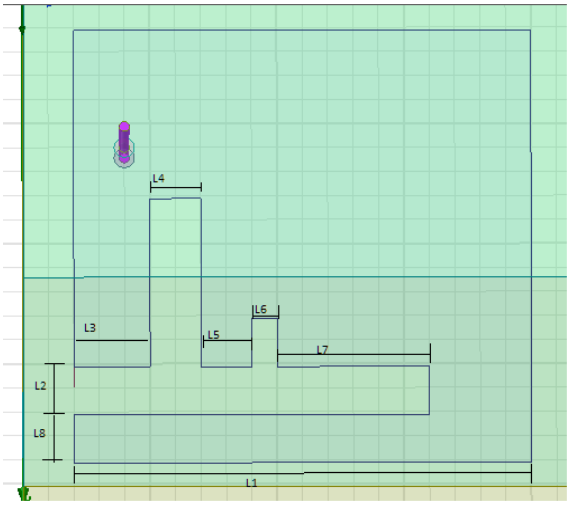

Fig. 2.Diagram for Patch

Figure 3.shows the slot parameters used in the design the slots on the patch are used to enhance bandwidth at a higher frequency band and use of extra shorting strip enhances bandwidth at the lower frequency band. It is observed that changing the dimensions of the slot results in decreased standing wave ration at the resonant frequencies. Furthermore it is observed that the length of the patch controls the resonating frequency, the width controls impedance matching, the height controls the bandwidth, the width of the shorting place increases bandwidth and the feed position from the shorting plate has effects on resonating frequency and bandwidth.

TABLE I. Parameters of PIFA antenna.

Parameters	Dimensions
Ground Plane	15mm x17mm
Substrate	15mm x 17mmx1mm
Patch	9mm x 9mm
Shorting Plate_1	1mm x1mm
Shorting Plate_2	0.2mm x 1mm
L1	9mm
L2	1mm
L3	1.5mm
L4	1mm
L5	1mm
L6	0.5mm
L7	3mm
L8	1mm
Feed Pin	Radius=0.1mm Height= 1mm

III. RESULTS

Figure 5 depicts the voltage standing wave ratio (VSWR) which a measure of impedance match or mismatch between the transmission line and antenna. The VSWR for the resonating frequencies of 2.4 and 5.2 is 2.5 and 1.6 respectively.

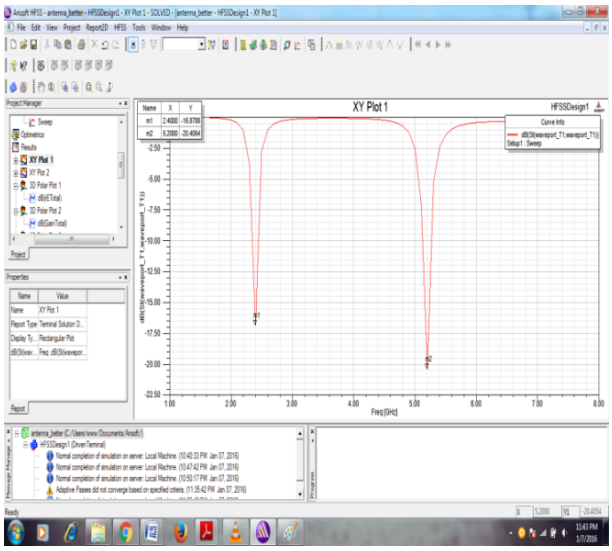

Fig.3 . Return Loss Plot.

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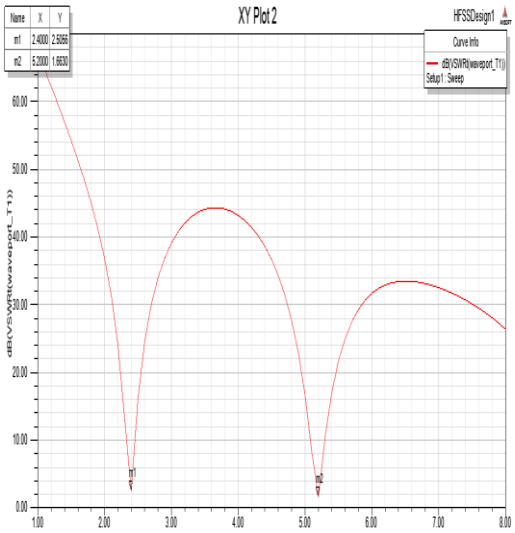

Fig. 4.Voltage Standing Wave Ratio Plot.

Figure 6.depicts the gain for the proposed antenna the antenna gain turns out to be-9db. Antenna gain is defined as antenna directivity times a factor representing the radiation efficiency. This efficiency is defined as the ratio of the radiated power (Pr) to the input power (Pi). The input power is transformed into radiated power and surface wave power while a small portion is dissipated due to conductor and dielectric losses of the materials used.

Figure 7.depicts the radiation pattern of the proposed antenna.

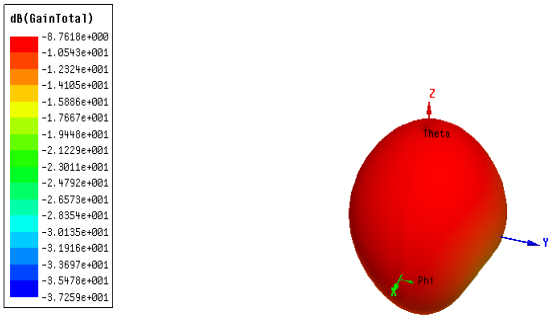

Fig. 5.Radiation Pattern of the proposed antenna.

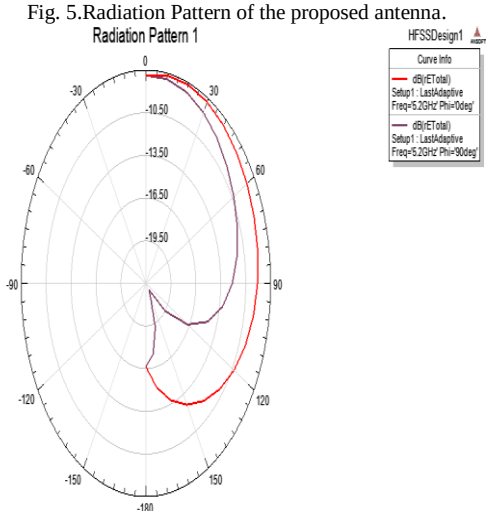

Fig.6.Two dimensional radiation pattern of the antenna.

IV. CONCLUSION

The proposed antenna supports Wimax frequencies centered at 5.2 Ghz and has a bandwidth of 100 MHz at this frequency It also supports Bluetooth frequencies centered at 2.4 Ghz and has a bandwidth of about 100MHz in this range.

V. ACKNOWLEDGEMENT

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