

COMPACT DUALBAND PLANAR INVERTED F ANTENNA

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ABSTRACT

The antenna in mobile phones and other handheld devices decides the device performance over various communication standards. Nowadays multiple radio frequencies are being integrated into a single wireless platform to allow maximum connectivity. This paper presents a dualband planar inverted F antenna which occupies a size of 9mmx9mmx1mm. An F shaped slot is etched on the patch which helps in attaining resonance and enhancing bandwidth at high frequencies use of multiple shorting strip helps in attaining resonance at lower frequency. The radiating patch controls two resonating frequencies to cover 2.4 GHz and 5.2 GHz Bluetooth and Wireless Interoperability for Microwave access.

Keywords: *Planar Inverted F Antenna, Return Loss, Radiation Pattern, Voltage Standing Wave Ratio, SAR*

I. INTRODUCTION

The Planar inverted F antenna also known as a microstrip antenna consists of a quarter wavelength patch separated from the ground plane by a dielectric ,a feed wire and a shorting plate at one end of the radiating patch. The distance between the feed point and the shorting plate determines the impedance of the antenna i.e. smaller the distance smaller the impedance. We consider the voltage and current distribution in a quarter wavelength patch antenna its observed that right in the centre of patch the impedance is zero this implies that there is a short at the centre of the patch between the patch and the substrate .thus by using a patch of quarter wavelength with the extreme shorted to ground plane we can not only reduce the antenna size but the V-I distribution remains same. This principle was primarily used to replace the half wavelength patch antennas with PIFA.

Since the revolution of wireless communication , realizing an antenna that meets the needs of mobile phone users has been difficult. Initially Monopole $\lambda/2$ antennas were used which were soon replaces by PIFAs. Monopole disadvantages like the antenna's vulnerability to physical damage, uncontrolled radiation toward user and lack of multiple resonant frequencies on one hand and advantages of PIFA naming a desired cross-polarization, easy feeding, low SAR paved way for its extensive usage[1,2]. 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.[3].

II. ANTENNA DESIGN

The proposed PIFA has a simple structure fed by a 50Ω microstrip line and 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 size of the substrate is 15mmx17mmx1mm.The radius of the inner and outer coaxial feed wire is 0.1mm and 0.2mm respectively. The length of the inner feed wire is 1mm. The patch lies 1mm above the ground plane .The patch is shorted to the ground via two rectangular shorting plates of size 1mm x 1mm and 0.2mm x 1mm respectively. 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 . The dimensions of the substrate are 15mm x 17mm x 1mm respectively and the relative permittivity of about 4.4(FR4 epoxy).

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.It is observed that the length of the patch controls the resonating frequency, the width controls impedance, 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.Fig.1 shows the design of the proposed antenna and Fig 2. Shows the slot on the patch.

Table 1. 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 ratio at the resonant frequencies.

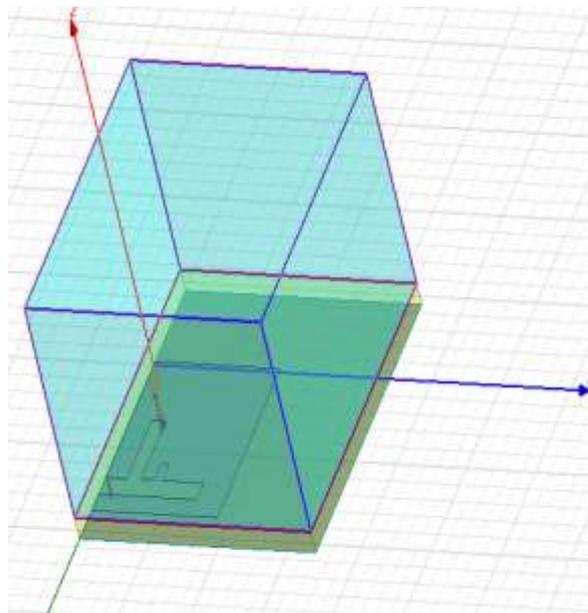


Figure1. Design of the Proposed antenna

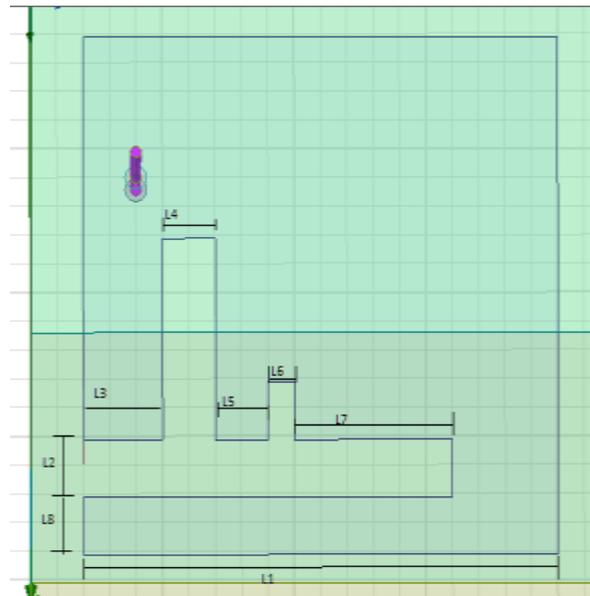


Figure 2. Design of the slot on the patch

It was observed while designing the antenna that optimizing the dimensions of the second shorting pin helped in attaining resonance at 2.4GHz respectively. Furthermore optimizing the dimensions of the F shaped slot on the

patch not helped in attaining resonance at 5.2Ghz.The height of PIFA is less compared to conventional structures thereby reducing the overall volume. Ground plane of antenna has minimum effect on performance.

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

Table 1. Dimensions of the proposed antenna

SIMULATED RESULTS

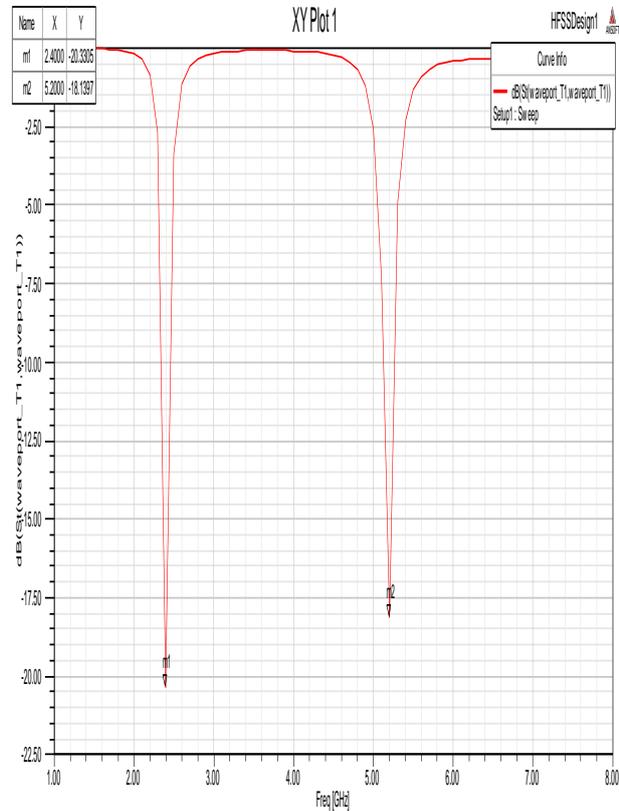


Figure 3. Return Loss Plot

Fig.3 shows the return loss plot of the proposed antenna. Return loss in communication systems is simply defined as the power of the signal reflected by a discontinuity in a transmission line. The discontinuity can be a mismatch. Fig.4 depicts the voltage standing wave ratio (VSWR) which is 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 5 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 (P_r) to the input power (P_i).

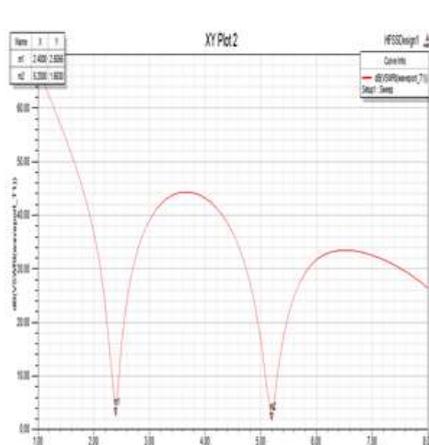


Figure 4. Voltage standing Wave Ratio

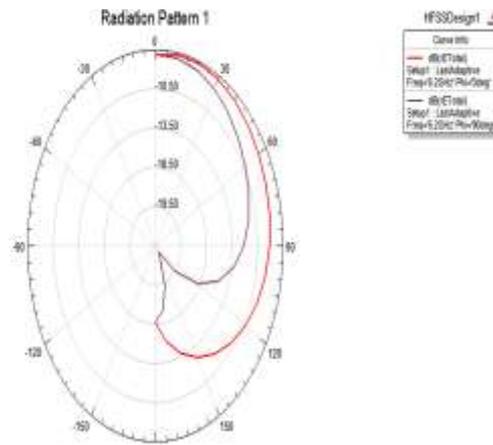


Figure 5. 2D Radiation Pattern

III. CONCLUSION

The proposed antenna supports Wimax frequencies centered at 5.2 Ghz and Bluetooth frequencies centered at 2.4Ghz. The bandwidth for both the frequencies is 100Mhz respectively.

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