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Novel Edge Fed Planar Inverted F Antenna (PIFA) for LTE High Band Applications

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Abstract

In this paper an edge fed planar inverted F antenna (PIFA) for LTE high band applications. The proposed antenna covers wider bandwidth from 2.78GHz to 3.94 GHz. Edge feed mechanism is used in the proposed structure by which wider bandwidth is achieved. The dimension of patch is 14×16mm^2 and of ground plane is 36×16mm^2. The dimension of patch, shorting plate, feeding plate are optimized using CST software to get optimum results and is presented in this paper. As this antenna is very compact in profile, has good performance, low cost and light weight, due to all these advantages it is suitable and can be easily incorporated as an internal antenna in mobile phones and in other portable device.

Keywords: Compact Profile, Edge Feed, High Band, LTE, PIFA

1. Introduction

LTE high band is latest technology in 4G and it has been in use since last couple of years. Now a days the basic need of communication is higher demand of data rate as well as higher speed, which gave the motivation to the growth of the Long Term Evolution (LTE) and LTE advance[7]. LTE advance performance is much better than older 3G system[6]. IT is also known as 4G technique. In 4G many antenna can be used like advance dipole antenna, microstrip antenna, printed antenna and PIFA antenna and many more. The basic requirement of antenna that it should be compact in size low weight so that the size of wireless device can be miniaturized.

For this the first solution was a monopole λ/2 antenna[8] which was soon replaced by PIFAs. Because monopole antennas have many disadvantages, like unable to resonate at multi-frequencies, protruding structure[9]. There are many other types of antennas are also used like fractal antenna and microstrip patch antenna, but all have different disadvantages[9,10]. On the other hand PIFA has numerous advantages over the other antenna like easy fabrication, low SAR and easy feeding[1,2]. For the future technology PIFA is a best antenna due to it is robust structure. PIFA antenna is used as internal antenna in mobile handset as it is very compact in nature[3]. But PIFA has a major disadvantage that is its bandwidth is narrow[5], due to this it is difficult to have multiband/wideband operation. So researchers are analyzing, designing and proposing various techniques by which PIFA can operate at wideband.

In this paper a compact size edge fed planar inverted F antenna for high band LTE applications (PIFA) is designed by optimizing the size of patch, feeding plate and shorting plate. The main aim is to design a new PIFA structure that which can work on LTE high band and higher bandwidth is obtained by providing edge feed and by optimizing the dimension of all parameters of an antenna. The structure of antenna should be compact so that it can be easily adjusted in small space.

2. Antenna Design

After study the dimensions of different parameters, finally the optimum dimensions of an antenna is proposed. The dimension of the ground plane is 36×16mm^2 and the dimension of patch is 14×16mm^2. The dimension of shorting plate is 6.035× 2mm^2. The dimension of

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feed line is 6.035×11mm^2. The front and back view of an antenna is shown in figure 2.1 and 2.2. In this structure the four number of slots are introduced and then cut from the ground plane. Resonant frequency depends upon the dimensions of slot as well as number of slots. In this antenna a torus is introduced on the patch and on the edge of patch triangle shape is introduced and then cut it from the patch. In table 1 the dimensions of the proposed antenna is shown.

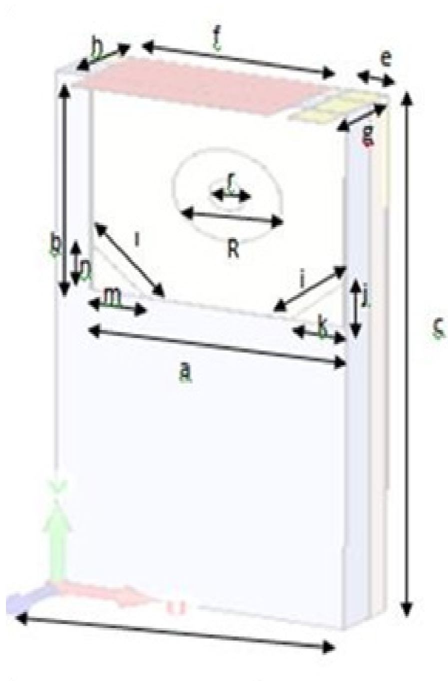

Figure 2.1 Front view of proposed antenna.

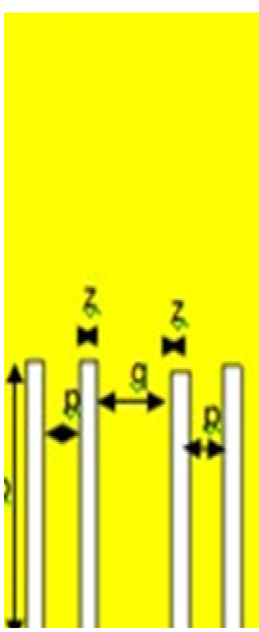

Figure 2.2. Back view of proposed antenna.

Table 1. Dimension of proposed PIFA

Symbols	Dimen -sions in mm	Symbols	Dimen -sions in mm
f (width of feeding plate)	11	m (side of LHS triangle)	16
h (length of feeding plate)	6.035	n (side of LHS triangle)	16
r (small radius)	1	e (width of shorting plate)	2
R (Large radius)	3	g (length of shorting plate)	6.035
i (side of RHS triangle)	4	c (length of ground plane)	34
j (side of RHS triangle)	7	d (width of ground plane)	16
k (side of RHS triangle)	7	a (width of top patch)	14
l (side of LHS triangle)	15	b(length of top patch)	9
z(width of slot)	1	q(distance between two slots)	4
p(distance between two slots)	3	o (length of slot)	14

3. Result

For designing and simulation CST Studio Suite 2014 software is used. The simulated frequency versus reflection coefficient of proposed antenna is shown in figure 3.1. This

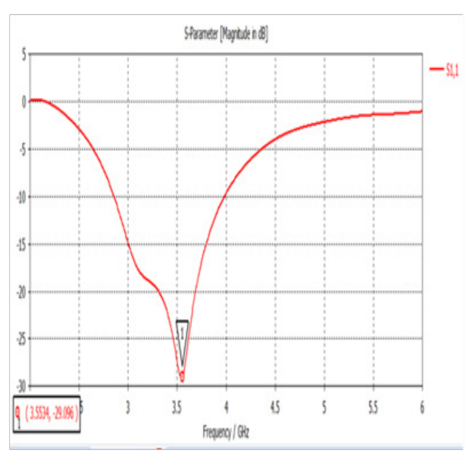

Figure 3.1. Simulated frequency versus reflection coefficient of proposed antenna.

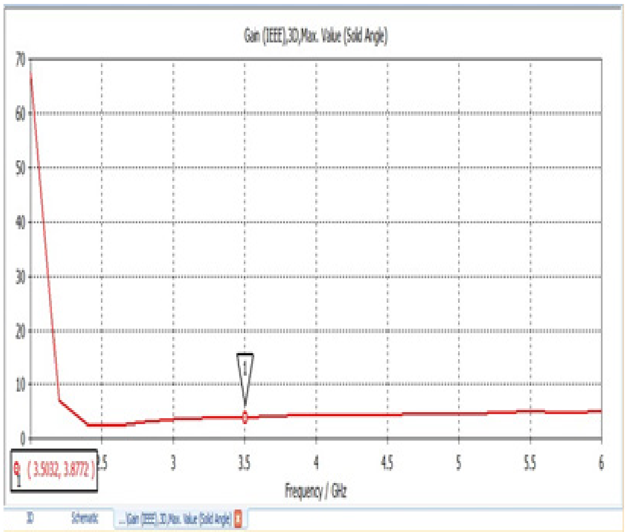

Figure 3.2. Simulated results of VSWR of proposed antenna.

Figure 3.2 depicts that at resonant frequency the value of VSWR lies between 1 to 2, which shows that the maximum power is radiated from antenna and less amount of power is reflected back.

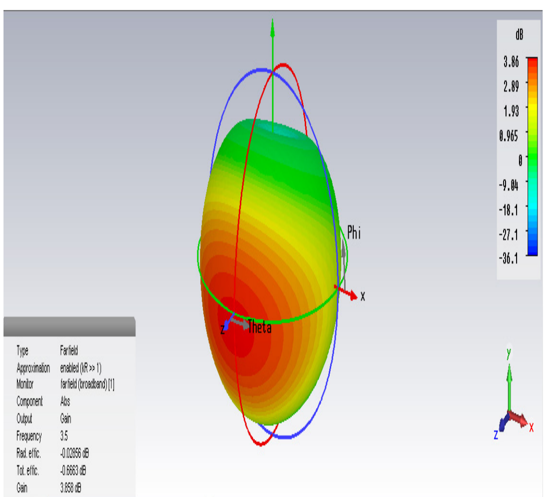

Figure3.3. Graph of peak gain of proposed antenna.

In Figure 3.3 the 3D graph of peak gain of proposed antenna is shown. Which shows that the peak gain is 3.86 over all bandwidth, which is good enough in case of 4G/5G applications.

In figure 3.4 variation of farfield directivity is shown in terms of theta angle. In this it shows that at resonant frequency, the main lobe magnitude is 3.8Bi and main lobe direction is 0.0 degree. The antenna radiates power in a beamwidth of 193.7 degrees.

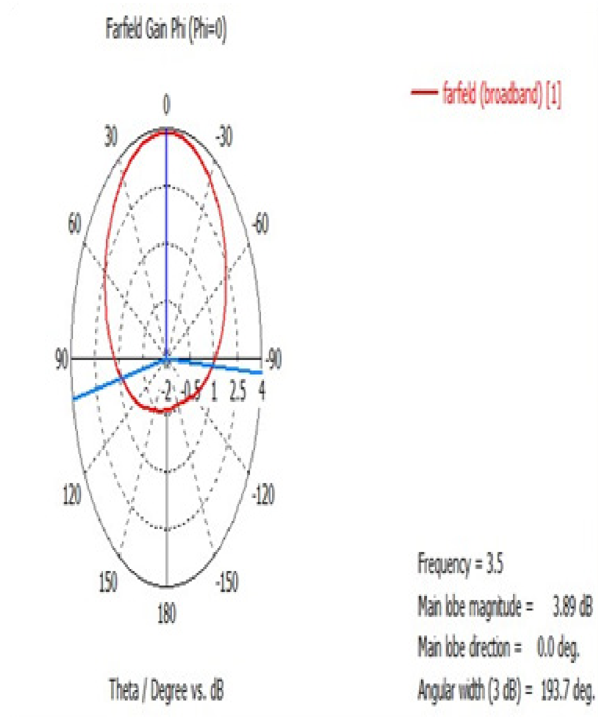

Figure 3.4. Graph of farfield directivity at phi= 0.

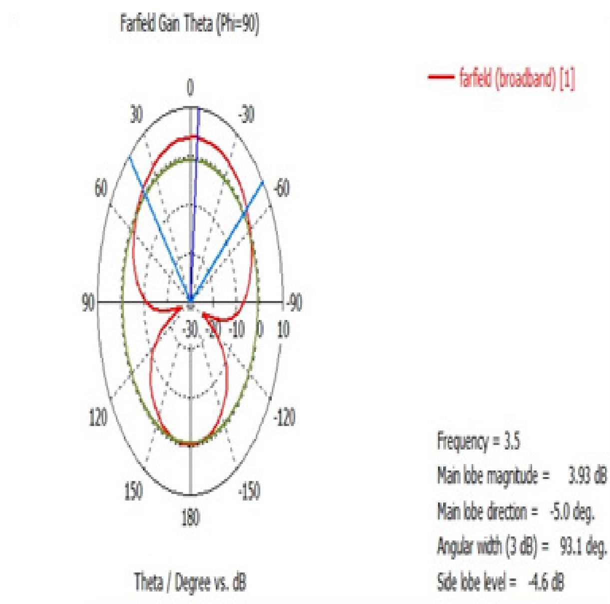

Figure 3.5. Graph of farfield directivity at phi= 90.

In figure 3.5 variation of farfield directivity is shown in terms of theta angle. In this it shows that at resonant frequency, the main lobe magnitude is 3.93B and main lobe direction is -5.0 degree. The antenna radiates power in a beamwidth of 93.1degrees.

4. Conclusion

In this paper an edge fed planar inverted F antenna (PIFA) for LTE high band applications is proposed. Edge feed mechanism is used in the proposed structure by which wider bandwidth is achieved. The dimension of proposed antenna is optimized using CST software and is presented in this paper. The dimension of patch, shorting plate, feeding plate are varied and optimized to get optimum results. The value of peak gain over entire bandwidth is 3.86 dB. The proposed antenna can further modified to include other bands of LTE.

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