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Design of Circular Patch Antenna with Coplanar Waveguide Feed for LTE Application

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Abstract*: In this paper, a circular patch antenna with Coplanar Waveguide (CPW) feed for LTE application is proposed. The proposed antenna design exhibits a decent impedance matching inside the LTE Bands 2.6 GHz. The planar monopole antenna with coplanar waveguide (CPW) feed has been considered here. It has greater advantage over microstrip compose feed lines, low scattering, low radiation spillage, the capacity to successfully control the trademark impedance, and the simplicity of mix. Rogers RT/duroid 5880 is used as substrate having a dielectric constant of 2.2 with a thickness of 1.6 mm and the conducting surface as copper. The proposed antenna obtains a narrow bandwidth in the frequency range of 2.6 GHz. It is suitable for LTE application because of its compact size and less cost to fabrication. The gain and efficiency of this antenna is good. The antenna is designed with the help of High Frequency Structure Simulator (HFSS) software.

***Keywords* : Coplanar Waveguide, microstrip, impedance matching, LTE, HFSS**

I. INTRODUCTION

Nowadays, 3G system has changed into 4G systems [1]. Contrasted with 3G systems, 4G systems have the altogether higher information rate tasks for the remote and versatile correspondence. The range of frequency bands from 400MHz to 4 GHz with radiocast space from 1.4 to 20 MHz are the various frequency required for mobile terminals [2]. In radio broadcast, Long Term Evolution is a basic for rapid distant comparability for mobile gadgets and information terminals, instead of other advancements. Nowadays, the space in the telephone is very small, because of that the proposed antenna should in small in size and it should be planar in structure for required multiband result and for simple manufacture. In this way, to satisfy the transfer speed requests of the 4th generation framework and guarantee the capacity to implant in a restricted space, minimized and small size multiband radio wires seem to have the possible for giving extensive data transmission inclusion in the 698 – 960/1710– 2690MHz groups in the LTE/WWAN conditions [3].

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Likewise, transmitting frameworks ready to proficiently work over the LTE groups are mandatory. Using this procedure, the antenna can be proposed in later. In [4], a printed wind line monopole for LTE-institutionalized cell phones is exhibited for working in the 700-MHz LTE band embraced in the US. Also, the building arrangement depicted in [5] is as yet dependent on a wander line geometry, yet it is gone for working over numerous groups of the LTE distributed range (i.e., the 700-and 2600-MHz LTE groups) with the end goal to permit adaptable use in various nations.

II. LITERATURE REVIEW

In this paper, a single band Planar Inverted F Antenna (PIFA) used for specifically Long-Term Evolution (LTE) mobile applications. Total dimension of PIFA is 21.72 mm x 18.5 mm x 4mm which consists of rectangular planar element designed using FR4 substrate. This antenna covers the frequency range of about 2600 MHz, because of its low profile, good gain and small size, this type of antenna is suitable for mobile phones [6].

In this paper, wideband microstrip antenna has been designed for mobile applications. In the rectangular patch antenna, the parasitic elements were added to obtain the desired wideband characteristics. The total dimension of this antenna is 140 x 120 x 1.6 mm. The frequency ranges covered by this antenna were 793.66 MHz up to 2501.34 MHz [7].

In this paper, dual-band 4-port diversity antenna has been designed for LTE MIMO applications. The total dimension of the antenna is 150 x 250 x 1.6 mm which is designed on FR4 substrate. The microstrip feeding technique is used. In this design the ground plane contains an inverted L shape structure whereas the rectangular metal stub is designed on the top plane. This antenna covers dual frequency bands such as 700 MHz and 2400 MHz. The inverted L shape structure produces the resonance at 700 MHz and the rectangular stub produces another resonance at 2400 MHz [8].

In this paper, a multi-band PIFA antenna has been designed for mobile handset applications. The total dimensions of the antenna are 60 × 30× 1.6mm which has been designed using FR4 substrate. It offers better impedance matching. The frequency ranges covered by these antennas were 1.7 GHz to 2.37 GHz [9].

In this paper, multi-antenna system has been designed for LTE mobile device application. The total dimension of the antenna is about 77 x 7 x 1.6 mm . In this design the switch circuit has also designed [10]. Due to this switch circuit the antenna covers the frequency range of about 758 MHz to 960 MHz.

III. ANTENNA DESIGN

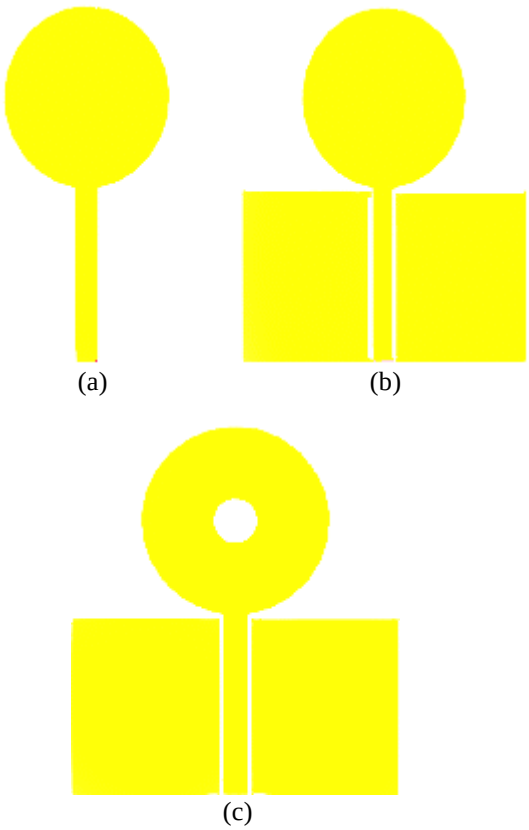

Fig 1: Design steps for proposed antenna

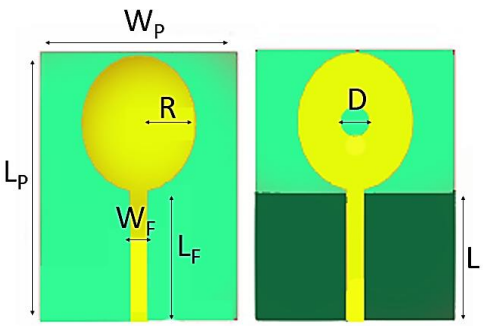

Fig 2: view of proposed antenna with and without slot

Table 1: Dimensions of Proposed antenna

PARAMETERS	DIMENSIONS (mm)
LP	32
LF	16
WP	28
WF	2
R	8
D	4
L	15

The proposed antenna is designed using the formula of circular patch antenna and effective radius of this antenna. The configuration (a) consists of circular radiating patch. The substrate used for antenna design is Rogers RT/duroid 5880 which is having a dielectric constant of 2.2. The configuration (b) consists of Coplanar Waveguide feeding techniques can be used for this proposed antenna that has been introduced as the ground plane. It gives advantages of low scattering, low radiation spillage, etc. In the configuration (c) slot is introduced in the patch to obtain the efficient resonant frequency and also provides better impedance matching characteristics.

IV. SIMULATION RESULTS

Fig 3 shows the simulated Reflection coefficient for the proposed antenna without slot. These antennas do not provide the desired impedance matching and so it does not resonate.

Fig 4 depicts the simulated Reflection coefficient of the proposed antenna with slot. This antenna covers the frequency range of 2.6 GHz which will be used for 4G mobile communication applications. The introduction of slot in the patch provides better impedance matching characteristics.

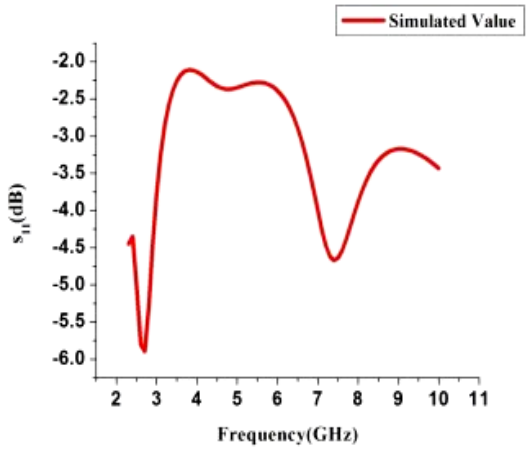

Fig.3: Simulated (S11) dB of the design without slot

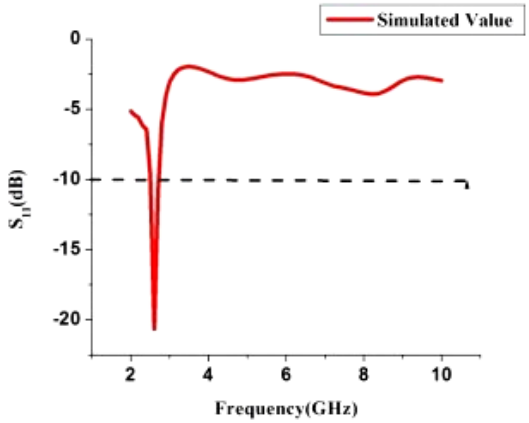

Fig.4 Simulated (S11) dB of the design with slot

In Fig 5 the gain of the antenna obtained is 1.48 dB. The proposed antenna is efficient for both transmission and reception. It can also radiate very well, high efficiency and low losses. In the Fig 6 the VSWR covers the value between 1 to 2. Hence the signal gets fully transmitted without any distortion and there is no reflection of signal takes place. This Proposed antenna is well suitable for Long term Evolution application. The resonant frequency, Impedance matching, Gain and VSWR of the antenna are good and better.

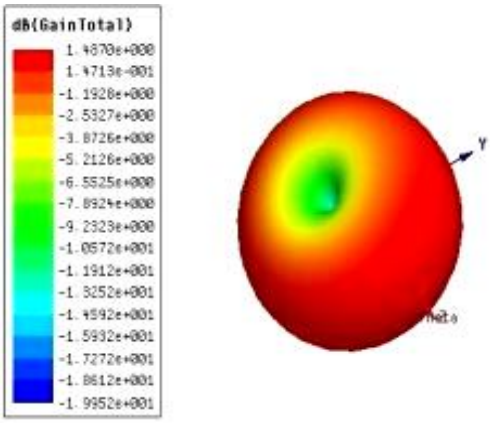

Fig. 5: Gain of the proposed antenna

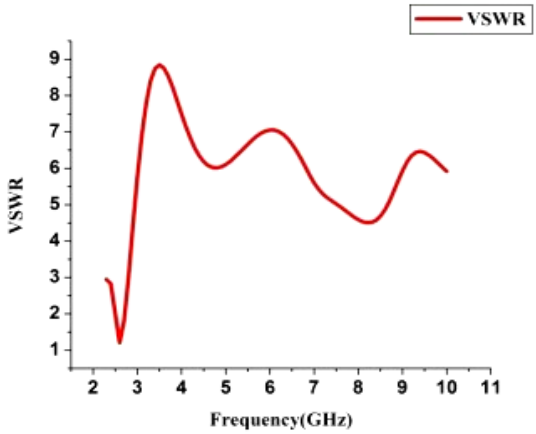

Fig. 6: simulated VSWR for the proposed antenna

V. CONCLUSION

A Circular Patch antenna with addition of CPW feed can be proposed for 4G/LTE application. By adding a slot at the center of the patch, the proposed antenna shows a narrow band with a resonant frequency of 2.6 GHz. The gain of the designed antenna is 1.48 dB. The proposed antenna is optimized to obtain the required bandwidth with a dimension of 32 x 28 mm. The proposed CPW feed antenna obtained a reflection coefficient of -21 dB at resonant frequency of 2.6 GHz. This antenna is compact in size and very efficient for LTE range applications.

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