Compact Spiral Shape Microstrip Patch Antenna for LTE Applications with Defected Ground Structure

M.Lakshmu Naidu, B.Rama Rao, C. DharmaRaj

Abstract— ***This paper presents the design of compact Microstrip antenna for multiband operation using low cost substrate material.This antenna suitable for long-term evolution (LTE) applications is seemed handheld devices. The transmitting area is planar winding shape. The radio wire uses the CPW feed line same as that of the standard round microstrip gathering mechanical social gathering. The social event mechanical party works in the intermittent level of 2.13 to 5.70 GHz and gives a virtual size decreasing of 41% with broadside rad-iation qualities at each working band. The experi-mental and reenacted results are in unprecedented synchronization with each other. This radio wire may find applications in LTE, WiMax and specific remote correspondence applications.***

Keywords:— long-term evolution (LTE), Spiral, CPW,WiMAX

INTRODUCTION

Microstrip recieving wires contain flimsy band width, low size and work in any frequencies depending on the application. This paper outlines the strategy of winding molded fix gathering mechanical social affair operable over a wide repeat grow or at multi-frequencies where sensible tuning score is appeared. Wide band movement is useful in wide band correspondences and the multi go over undertakings are advantageous for multi-band flexible handsets.

LTE (Long Term Evolution) is the errand related to high per-formance air interface for supportive correspondence. LTE is the latest new progression that ensures centered edge over existing benchmarks: GSM, UMTS, etc. It improves customer duty with full flexibility. LTE limits the structure and customer gear complexities[1].

With the creating centrality of plan advance, the structure enlighten one of the real strategy improvement in recieving wire which happened from the get-go in 1956 and prompted the forma-tion of winding party device [2].A winding radio wire is a radio keep gathering device which holds a property of being go over self-regulating and as prerequisites be are wideband recieving wires and finds its application basically in the square business for perceiving applications [3].Various qualities intimated of a winding get-together mechanical social affair are as demonstrated by the running with polarization, radiation model and impedance are some extraordinary parameters which remain un-affected[5], they have a low expansion and as their shape proposes they are circularly staggered. Among the class of recieving wires the winding radio wires may be named as reduced overviewed amassing contraptions on account of its windings. Structure of winding radio wire can be redesignd by changing number of turns it and the scattering between its turns and the width of its arm [4]. A rectangular parasitic round fix radio wire is used to make two boisterous repetitive modes as discussed in [7] yet this recieving wire has the enormous ground plane. A multi-layered round fix radio wire with triple-T spaces has been used to improve the augmentation as portrayed in [8]. A microstrip maintained fix gathering mechanical social affair with two parasitic change L stubs has been discussed in [9] and it has low expansion at 2.4 GHz band. Insignificant twofold band planar monopole gathering contraption is discussed in [10] and it has low increase. A uni-planar coupled powerful event L recieving wire has outfitted switchable modes with ignorant exchange limit as open in [11]. In this paper the structure of a Compact Spiral Shape lacking ground plane with indent Microstrip Patch Antenna for LTE Applications is portrayed with Defected Ground Structure

I. DESIGN OF SPIRAL ANTENNA

A winding radio wire is self-relative if the metal and air zones of the social event device are proportionate is showed up in Fig. 1.The data impedance of a self-taking a gander at recieving wire can be found using Babinet's standard, given by $Z_{metal}Z_{air} = \frac{\eta^2}{4}$ (1)

Where η is the characteristic impedance

For a self-complementary spiral antenna in free space the input impedance should be

$$Z_{in} = \frac{\eta_0}{2} = 188.5\Omega \quad (2)$$

Each arm of an Archimedean spiral is linearly proportional to the angle, φ , and is described by the relationships

$$r = r_0\phi + r_1 \; and \; r = r_0(\phi - \pi) + r_1 \quad (3)$$

Where r1 is the inner radius of the spiral.

The proportionality constant is determined from the width of each arm, w, and the spacing between each turn, s, which for a self-complementary spiral is given by

$$r_0 = \frac{s+w}{\pi} = \frac{2w}{\pi} \quad (4)$$

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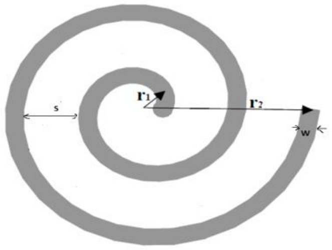

Fig .1 Geometry of Archimedean spiral antenna

The strip width of each arm can be found from the equation

$$s=\frac{r_2-r_1}{2N}-w=w \quad (5)$$

Assuming a self-complementary structure. Thus the spacing or width may be written as

$$s=w=\frac{r_2-r_1}{4N} \quad (6)$$

Where r_2 is the outer radius of the spiral and
N is the number of turns.

The above conditions apply to a two-arm Archimedean turning, however at this point and again four-arm spirals may be required. For this circumstance the arm width moves toward finding the opportunity to be $w_{4-arm}=\frac{r_2-r_1}{8N}$

(7) and the proportionality constant is

$$r_{0,4-arm}=\frac{4w}{\pi} \quad (8)$$

The Archimedean winding recieving wire transmits from a zone where the edge of the winding reciprocals one wavelength. This is known as the dynamic area of the winding. Each arm of the winding is energized 180° out of stage, so when the edge of the winding is one wavelength the streams at correlative or switch spotlights on each arm of the winding combine arrange in the far field. The low keep working clarification behind the winding is settled speculatively by the outside compass and is given by

$$f_{low}=\frac{c}{2\pi r_2} \quad (9)$$

where c is the speed of light. Similarly the high frequency operating point is based on the inner radius giving

$$f_{high}=\frac{c}{2\pi r_1} \quad (10)$$

In each useful sense the low repetitive point will could truly contrast with pre-dicted by (9) in light of reflections from the realization of the winding. The reflections can be constrained by using resistive stacking close to the completion of each arm or by adding conductivity disaster to some bit of the outside turn of each arm. In like manner, the high intermittent explanation behind constrainment may be not by any stretch of the imagination found from (10) in light of feed locale impacts.

For the turning in free space a lone feed wire relates each arm to a lone voltage source at the motivation behind intermixing of the feed wire. Commonly a wire extent of one quarter the perfect strip width is used in increases as a fitting change from strip width to wire estimation. That is

$$a=\frac{w}{4} \quad (11)$$

Where an is the wire length and w is the width of each winding arm. As such, a singular feed wire and the relationship of (11) will be used as starting stages in the ages. Another colossal parameter in setting up the NEC4 duplication is the estimation of the internal range, 1 r .Through experimentation it was found that repetitive free direct was grown accurately when within compass was for all intents and purposes indistinguishable to the strip width or scattering between turns, r = w = s 1 . Releasing up (2.6) for within range proportionate to the width gives

$$r_1=\frac{r_2}{4N+1} \quad (12)$$

The inner radius will be varied from half the radius found using (12) to three times the radius found using (12).

The structure of little studied, low profile lumped port kind of CPW continued twisting little scale strip fix gathering contraption with fragmentary and coplanar ground is proposed is composed with the range r is given by

$$r=\frac{F}{\left\{1+\frac{2h}{\pi\varepsilon_r F}\left[\ln\left(\frac{\pi F}{2h}\right)+1.7726\right]\right\}^{\frac{1}{2}}} \quad (13)$$

$$F=\frac{8.791\times10^9}{f_r\sqrt{\varepsilon_r}}$$

Equation (13) does not take into consideration the fringing effect. Since fringing makes the patch electrically larger, the effective radius of patch is used and is given by (Balanis, 1982)

$$r_e=a\left\{1+\frac{2h}{\pi\varepsilon_r a}\left[\ln\left(\frac{\pi a}{2h}\right)+1.7726\right]\right\}^{\frac{1}{2}} \quad (14)$$

A diminished Circular fix radio wire is progressed toward a FR-4 epoxy substrate having dielectric relentless undefined to 4.4. Fig-ure2 exhibits the HFSS structure of fix gathering contraption. Parameters like fix Length and Width are showed up over the span of activity of rectangular microstrip fix gathering mechanical party, and browsed the standard conditions.

The repetitive exchange speed and the rate transmission limit with respect to a round Microstrip fix radio wire are settled using [6]

Frequency bandwidth f_H-f_L (15)

And percentage bandwidth $\frac{f_H-f_L}{f_C}\times100$ (16)

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Where f_H and f_L are the two frequency points on the return loss curve obtained on the -10dB line and f_C is the center frequency at which the resonance peak is observed

The top view of the spiral Microstrip antenna shown in below Fig.2

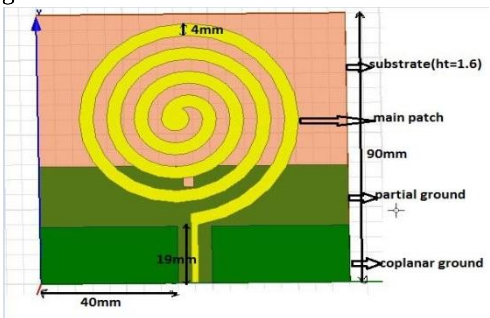

Fig. 2 Top View of the antenna

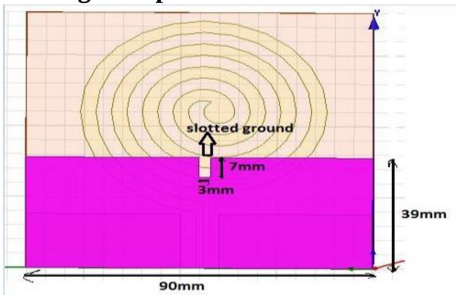

Fig. .3 Back View of the Antenna

Slotted and Coplanar Ground Concept

This fix recieving wire was dealt with and refreshed with full standard tial ground. The get-together contraption is coordinated using midway ground for improving expansion and return occurrence. The proposed recieving wire plan with isolated ground was found to have better working band-width and wide rot as such catastrophe.

The segments of the Designed Patch Antenna with lacking and coplanar ground are showed up underneath table.1

Table .1 Dimensions of Various Parameters of the antenna

Parameter	Value(mm)
Length of substrate	90
Width of substrate	90
Length of coplanar ground	19
Width of coplanar ground	40
Length of slot	7
Width of slot	3
Thickness of Spiral	4
Hight of substrate	1.6

III. ANTENNA FABRICATION

The recieving wire is made using FR-4 substrate of thickness 1.6 mm is showed up in Fig.4 The perfect shape is penetrated by setting up the front of the duplicated game-plan and after that the pre-pared spread is engraved on PCB for cutting technique in end the SMA port is welded for power supply.

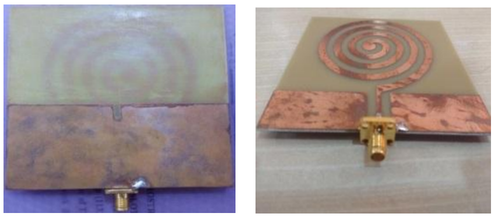

Fig. 4 a) Back View of the Antenna b) Top View of the Antenna

After fabricating the antenna, it is tested on Vector Network Analyzer (VNA).

IV.RESULTS AND DISCUSSIONS

This paper has shown the strategy, augmentation and the proto-sort of RSMA is made on FR-4 substrates with 4.4 di-electric eager and 1.6 mm thickness. The results exhibit that the slight complexities could be followed in repeated and meas-ured values with each other. The wideband occupations of winding recieving wire has dependably been profitable to it the work proposed by Magnus Karlssonet.al [12] states that Spiral a tenna has high phantom viability when risen up out of various party mechanical assemblies, for instance, planar radio wires.

The Fig.5 shows the area hardship Curve for the proposed anten-na. Return catastrophes is gotten as - 12.52dB at 2.13GHz and - 25.7dB is obtained at repeat of 5.7GHz.

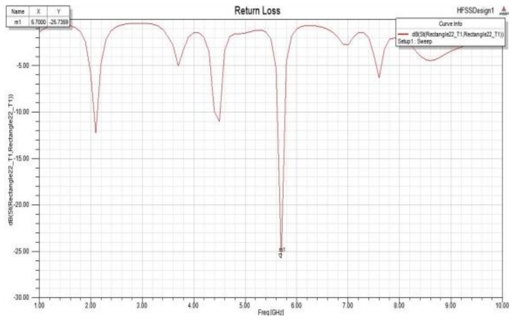

Fig. 5 Return Loss curve of the Spiral Antenna

VSWR is a proportion of the proficiently radio recurrence control is transmitted from a power source, through a transmission line into a heap. The base VSWR which relates to an ideal match is solidarity.

The term Antenna Gain depicts how much power is trans-mitted toward apex radiation to that of an isotropic source. The expansion of proposed gathering contraption is verified as 3.05dB as showed up in the Fig.6.

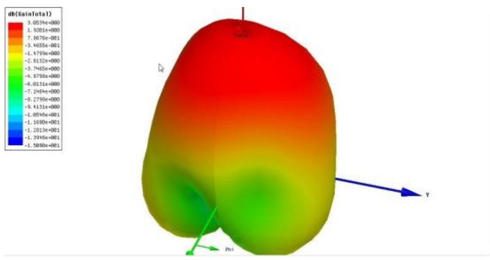

Fig. 6 Gain in 3D pattern of the Spiral Antenna

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The radiation case of a radio wire is a plot of the far-field radiation properties of recieving wire as a bit of the spatial co-ordinates which are overseen by the rising edge θand the azimuth point φ. It is a plot of the power overflowed from a recieving wire for every unit solid edge which is just the radiation control.

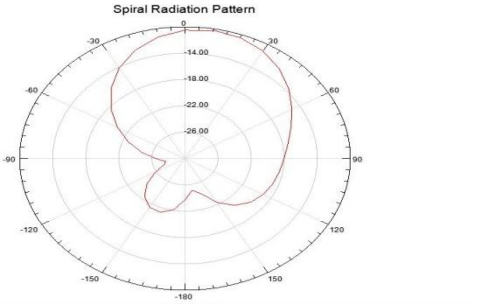

Fig. 7 Radiation Pattern of the Spiral Antenna

From the radiation configuration plot showed up in Fig.8it can be ob-serve that an end-fire radiation plot is created and no radia-tion is seen underneath the ground, which proposes a perfect ground condition is achieved..Since a Micro strip fix anten-na overflows standard to its fix surface, the rising structure for φ= 0 and φ= 360degrees would be gigantic. The radia-tion structure for proposed cut back scale strip fix gathering mechanical social gathering for growth Total, phi and theta at 0deg and 90deg is showed up in Figure above.

The consequences of return hardship, VSWR got from VNA are showed up in Fig.7 and Fig.8 These are generally proportionate to results from HFSS gadget.

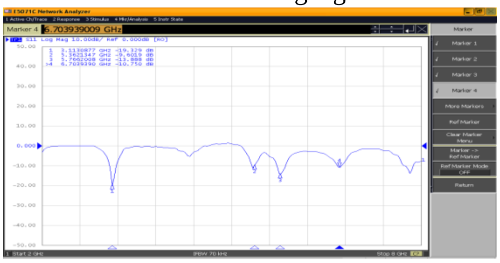

Fig. 8 Return Loss curve of the Spiral Antenna from Vector Network Analyzer

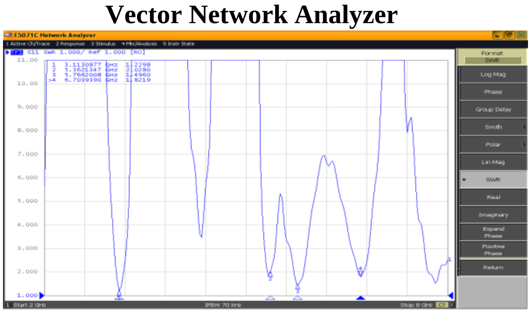

Fig. 9 VSWR curve of the Spiral Antenna from Vector Network Analyzer

In that limit the winding recieving wire is used to support high frequencies. Since a ton of information exchange limit is required for remote applications, wideband get-together mechanical social events are of at by and large centrality. The ultra wideband radio (UWB) utilizes the intermittent level of 3.1 to 10.6 GHz. So to improve execution past that of a specific social event mechanical party, an enormous measure of recieving wires can be joined to plot another assortment of radio wire. To enlarge information transmission, two winding radio wires can be electrically coupled in a parallel way. Generally, the winding social event mechanical get-togethers to be joined can have explicit radii of the radiation zone. This can result in an improved radio wire execution for UWB since the standing wave degree can be kept low for a genuinely broad information exchange limit. The winding party mechanical social affair estimations exceedingly influence the augmentation and SWR

V CONCLUSIONS

In this paper the dealt with Spiral shaped little scale strip fix gathering mechanical social gathering with midway ground with indent is kept using HFSS gadget, seemed great evaluated with the help of vector plan analyzer. The fundamental thought in this is opened lacking ground-Because of this the parameters like Return Loss, Gain, VSWR having favored characteristics over social event contraption without score at ground. The Return Loss gotten by age is - 25.7dB at 5.7 GHz and Return occurrence assessed by framework Analyzer - 13.88dB at 5.76 GHz ,in like manner gain increases from 1 to 3 and VSWR is 0.98 at low intermittent 5.7GHz.

The expanded reiterated results from HFSS are restlessly search for after to the reasonable results regardless less ascent to, because of some social affair issues, union chaotic heaps up.

REFERENCES

1. Stephen E. Lipsky "Microwave Passive Direction Finding" SciTech Publishing, 2004 ISBN 1- 891121-23-5 page 40.
2. Paul E. Mayes, "Frequency-Independent Antennas and Broad-Band Derivatives Thereof', Proceedings of the IEEE, Volume: 80 , Issue: 1, Digital Object Identifier: 10.110915.119570, Publication Year: 1992,Page(s): 103 – 112.
3. Arun Singh Kirar, Veerendra Singh Jadaun, Pavan KumarSharma, "Design a Circular Microstrip Patch Antenna for Dual Band", International Journal of Electronics Communication and Computer Technology (IJECCT) Volume 3 Issue 2 March 2013.
4. K. G. Thomas, and M. Sreenivasan, "A simple dual-band microstrip-fed printed antenna for WLAN applications", IET Microw. Antennas Propag., Vol. 3, no. 4, pp. 687-694, 2009.
5. M.M. Sharma, S. Yadav, A. Kumar, D. Bhatnagar, and R.P. Yadav, "Design of broadband multi-layered circular microstrip antenna for modern communication systems", Proceedings of Asia-Pacific Microwave Conference, pp. 742-745, 2010.
6. L. Peng, and C.-L. Ruan, "A microstrip fed patch antenna with two parasitic invert L stubs for dual-band WLAN applications", Wireless Personal Communications, Vol. 57, no. 4, pp. 727-734, 2009.
7. C.-L. Tsai, and C.-L. Yang, "Compact dual band 1.8/3.3 GHz planar monopole antennas using tuning mechanisms for GSM/WiMAX", Progress In Electromagnetics Research C, Vol. 27, pp. 55-68, 2012.
8. C.-S. Yang, and C. F. Jou, "Design and study of uniplanar coupled inverted-L antenna for single-/dual-band operation", Progress In Electromagnetics Research C, Vol. 48, pp. 167-175, 2014.
9. Magnus Karlsson, and Shaofang Gong, An integrated spiral antenna system for UWB,Microwave Conference, 2005 European (Volume:3) 4-6 Oct. 2005,DOI:10.1109/EUMC.2005.1610362.

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