Novel SRR loaded Hexa Band Antenna Design and Analysis

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Abstract- A novel hex-band antenna for LTE/ Bluetooth / Wi-Max subsystems is etched on top face of FR4 epoxy substrate backed by Split Ring Resonator (SRR) ground. The antenna presented is having dimensions of 52×33mm^2 printed on FR4 substrate of thickness 1.6mm. The proposed antenna achieved six resonance peaks at 3.1/4.1/6.4/6.8/8.4/12.5 GHz. The Split Ring Resonator (SRR) improves the current directions. The proposed antenna exhibit circular polarization at resonating frequencies 2.2/2.3/5.2 GHz. It has a peak gain of 4.2dB.

***Index Terms*: Meta-materials, Split Ring Resonator, Circular polarization.**

I. INTRODUCTION

Meta-materials are engineered structures exhibits unique features unlike natural materials. These exhibits negative permittivity and permeability, so called as negative refractive index materials[1] or left-handed meta-materials (LHMs)[3]. The man made metamaterials with unique properties when incorporated in antenna, then antenna's performance is enhanced. The 4G wireless communication system require a single antenna to resonate at different frequencies, with compact size and enhance radiation characteristics[2]. The antenna to operate at different frequency bands, its surface is introduced with slots or SRRs[4-6].

So the object of current study is to design a low profile, enhanced gain, multi-frequency by embedding metamaterial structures using HFSS software.

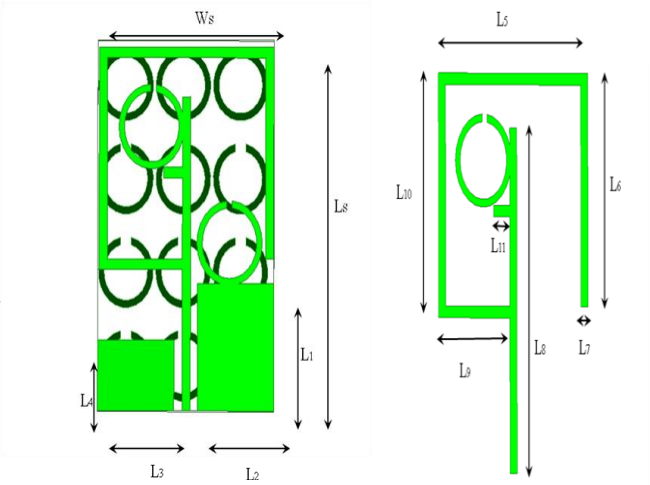
II. ANTENNA DESIGN

2.1 Antenna Design and Analysis

In current article, antenna design is done within three iterations. During first iteration, design a noval antenna with coplanar waveguide (CPW) feed. During second iteration, design of circular shaped SRRs and determine its electromagnetic (EM) characteristics. At final iteration, proposed antenna with CPW feed is etched on top face of FR4 epoxy substrate backed by SRR ground. The over all size of antenna is 52×32×1.6 mm^3 as shown in figure 1. The design parameters and corresponding dimensions are presented in table 1.

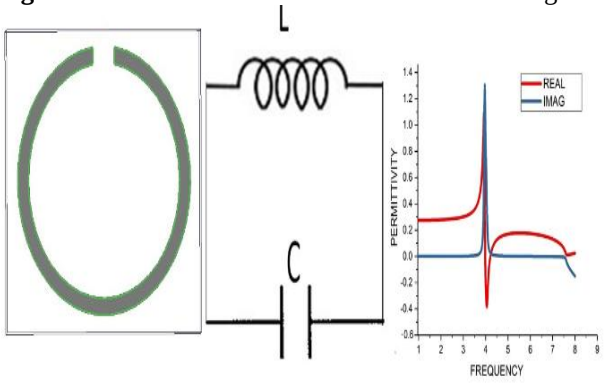
Table1. Antenna parameters

Antenna parameter	dimension (in mm)	Antenna parameter	dimension (in mm)
L1	18	L6	30
L2	14	L7	1.5
L3	14	L8	44.5
L4	10	L9	15.25
L5	32	L10	31.25
L11	3.45	Ls	52
Ws	33	-	-



a) Front View **b)** Patch

Figure1. CPW feed noval antenna on SRR loaded ground.



a) Unit Cell **b)** Equivalent design **c)**Magnetic Response

Figure2. Characterization of SRR unit cell.

2.2. Generation of Hexa-band frequencies

The SRR unit cell dimensions are 8mm×1.635mm along X, Y, Z axes, they arranged as asymmetric on ground results circular polarization. The complete architecture operates at five different frequency bands, for example Bluetooth, WLAN, Wi-Fi, GPS, Wi-MAX.

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The concept of circular polarization is much in satellite communications for tracking of targets.

III. RESULTS

3. Results and Discussion

The six operating frequencies of an antenna are 2.4GHz/3.3GHz/4.1GHz/6.4GHz/8.4GHz/12.4GHz. How ever at 2.55GHz/3GHz/5GHz/6.5GHz frequencies proposed antenna is producing circular polarization. In figure 4 and 5, for better comparison, simulated and measured results are presented.

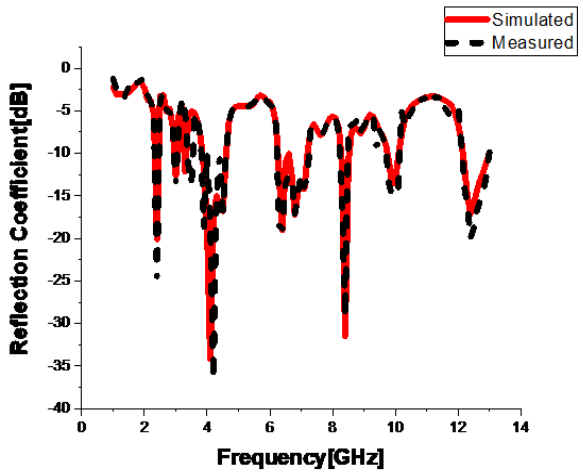

Fig4. Measured versus simulated S_{11} results of the proposed antenna.

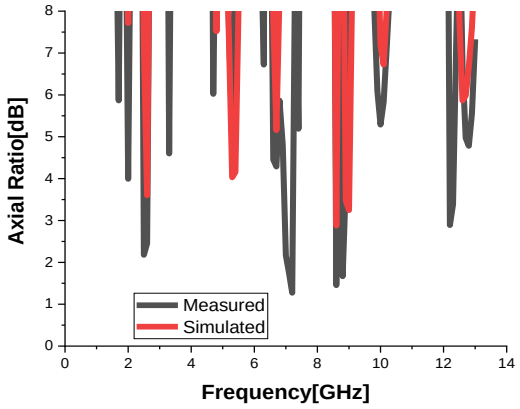

Fig5. Axial Ratio versus frequency plot.

3.1. Parametric Analysis

During parametric analysis, feed line width is altered corresponding reflection coefficient results at different width values are as depicted in the fig-6.

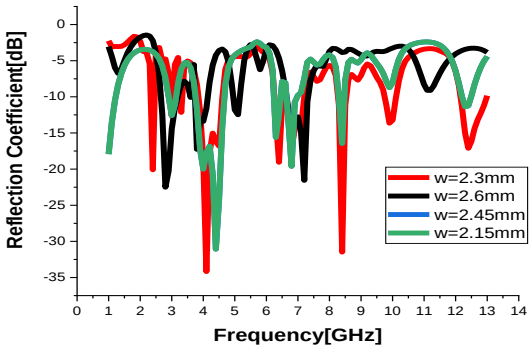

Fig6. Reflection Coefficient at different feed width value.

3.2. Radiation pattern

The radiation pattern at 2.2GHz, 2.5GHz, 3.2GHz frequencies is shown in figure 7. This is achieved by outer metallic strip in the design.

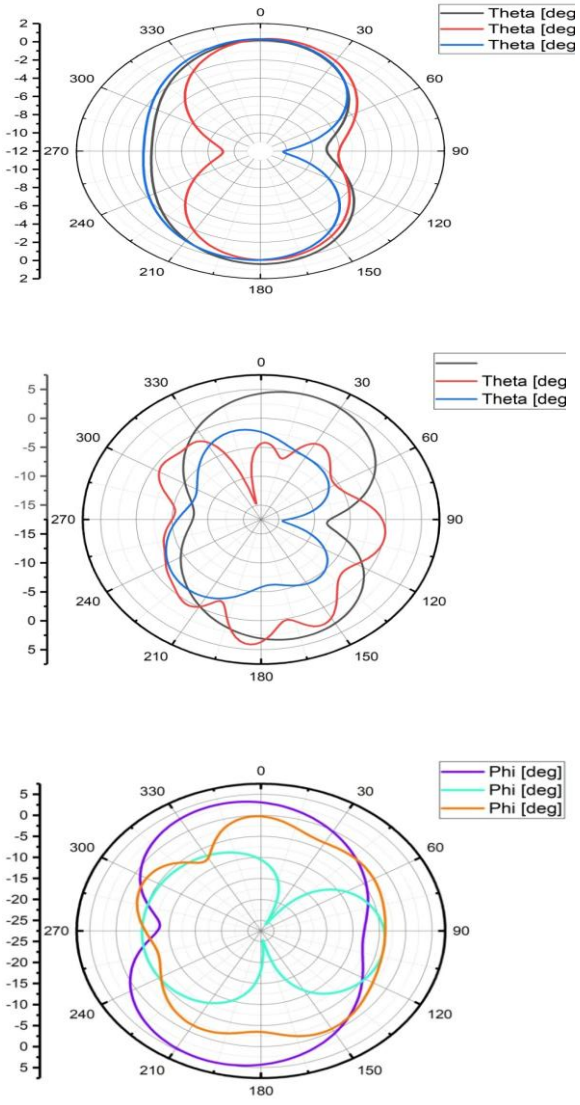

Fig 6.2-D Radiation patterns at different phase angles.

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IV.CONCLUSION

Hexa band antenna is proposed and designed. Proposed antenna is loaded with SRRs, results bandwidth enhancement. This antenna is exhibiting circular polarization at three bands. This model best suitable for Bluetooth, Wi-Fi, W-BAN (2.4GHz), and X-band applications.

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