ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 4, Special Issue 22, December 2017

SRR Loaded CB-CPW fed OPAMP Shape Antenna for On-Body Interfacing Applications

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Abstract: The new SRR loaded circular ring encircled by an OPAMP shaped patch with conductor backed coplanar wave guide fed with miniaturization of antenna is outstandingly necessary part for wearable transceiver device module for healthcare interfacing application. This antenna designed to fine-tune at resonating frequency 2.48GHz and 3.57GHz, 3.6GHz. The simulated results for the magnitude of reflection coefficients are-23dB at 3.6GHz, -26dB at 2.48GHz,-23dB at 3.52GHz and -14dB at 3.57GHz for an OPAMP shaped proposed wearable antennas respectively. These values are more suitable for standard WLAN, Wi-MAX, ISM band interfacing communication.
Keywords: Split Ring Resonator, conductor backed CPW, WLAN, and WiMAX, ISM band interfacing communication.

I. Introduction

Our day to day life increasingly health care problems since the number of micro system developed to be implanted into the human body has increased in recent years[1,2].The SRR loaded opamp shaped patch antenna is enabled low-power, intelligent, miniature, low profile antenna is used for interfacing various wireless networks like WiMax, WLAN and ISM band communication. These technologies are very helpful for securable data or video signal transfer. The main advantage of split ring resonator loaded antenna has enhanced the bandwidth and gain [11]. The concept of meta-material is introduced by Sir Jagadish Chandra Bose from India. Bose investigated negative refractive index phenomena in electromagnetic waves. Now it is designed by use of the Finite Difference Time domain design numerical codes and its simulation software called as a CST microwave studio.

The special consideration on body antenna had small size and weight, conformal and more compactable to on-body parts. New advanced MEMS sensor technology embedded with wearable antenna, therefore bio-medical transceiver circuits are become focus to good functionality, accuracy measurements and future possibility of low power with higher data rate bio-telemetric communication.

Recently many people are suffering disease like cancer, cardiovascular disease; Parkinson's disease, Bronchitis, obesity, diabetes and many more chronic or fatal diseases are reported in World Health Organization (WHO) [1, 11].

As people are increasingly suffering from medical problems treatment becomes more expensive than previous scenario. As world's population is growing exponentially the cost of health care monitoring is also increasing. The expected population growth by 2050 is double as compared to 2010. Therefore cost of medicine increased day to day life. Therefore technological improvement is very much essential for this field.

In this paper organized as section II SRR loaded OPAMP shaped Wearable antenna for health monitoring during yoga, sports and other exercise and other biological aspects, over a WiMAX, WLAN, and ISM band communication. Section III indicated the explanation of the geometrical diagram of the proposed antenna. The section IV of this paper concentrates on the simulation results and descriptions. Section V is the conclusion part of the paper discussing future scope of on-body antenna in the field of wireless applications.

II. MATHEMATICAL MODELING FOR PROPOSED ANTENNA

The The asymmetrical coplanar wave guide is the one of the quasi mode transmission line using in microwave printed circuits as well as in fabricated antennas, as signal carrying element. It consists of two identical ground plane and one middle metallic strip conductors are in the same plane. The effective dielectric constant and characteristic impedance of this line is given by [3, 4].

$$\varepsilon_{reff,sub} \cong p(\varepsilon_r - 1) + 1 \quad (1)$$

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$$z_o \cong \frac{30\pi y}{\sqrt{\varepsilon_{reff,sub}}} \quad (2)$$

The letter p is called the filling fraction, the expression for m depends on the shape of geometry and y is elliptical integrals [5].

$$\varepsilon_{reff,sub} = \frac{\varepsilon_{r,sub}+1}{2} + \frac{\varepsilon_{r,sub}-1}{2}\left[1 + 12\frac{h}{w}\right] \quad (3)$$

The equation (3) indicates effective dielectric constant of substrate. This proposed antenna used a biocompatible substrate-Teflon with dielectric constant is 2.1 , thickness 1.6 mm, so as to resonate at 2.48GHz, then the width of single element of rectangular patch is given by[2,6,7],

$$W = \frac{c}{2f_{op}}\sqrt{\frac{2}{\varepsilon_{r,sub}+1}} \quad (4)$$

From equation (4) width of antenna 20mm obtained. Finally the effective length of a SRR loaded proposed antenna is calculated analytically.

$$L_{eff} = \frac{c}{2f_{op}\sqrt{\varepsilon_{r,sub}}} \quad (5)$$

From equation (5) the effective length of a SRR loaded proposed antenna is 20mm obtained.

The permittivity and permeability relationship between frequencies is given by.

$$\varepsilon_{b(\omega)=}\ \varepsilon_{ob}\left[1 - \frac{\omega_{pe,b}^2}{\omega_b(\omega_b - j\Gamma_{e,b})}\right] \quad (6)$$

$$\mu_{b(\omega)=}\ \mu_{ob}\left[1 - \frac{\omega_{pm,b}^2}{\omega_b(\omega_b - j\Gamma_{m,b})}\right] \quad (7)$$

III. SCHEMATIC ILLUSTRATION OF PROPOSED OPAMP SHAPED WEARABLE ANTENNA.

The special characteristic of SRR and CSRR loaded antenna showing negative permeability and negative permittivity. The SRR/CSRR loaded wearable antenna is comprehensively applicable for medical field, defences, navigation field etc. The bio-medical sensors take out bio-information from a body and transmit a signal to another equipment or device, this transmission element now seem to be like a Circular shape split ring loaded structure encircled by a OPAMP shaped patch antenna. The proposed antenna used biocompatible Teflon substrate. The electrical characteristic of the tissue are, ϵ_r =52.65 at 2.45GHz, and conductivity is 0.95(s/m) at 2.45GHz [5, 6, 7]. The geometry of the antenna and patch dimension is shown in Fig.1 and Table.1.

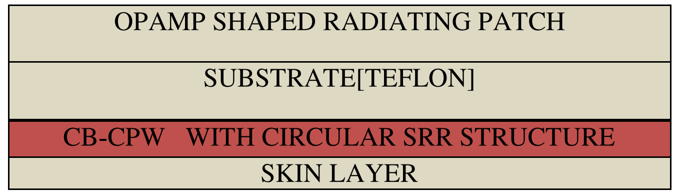

Fig.1.The proposed antenna layers.

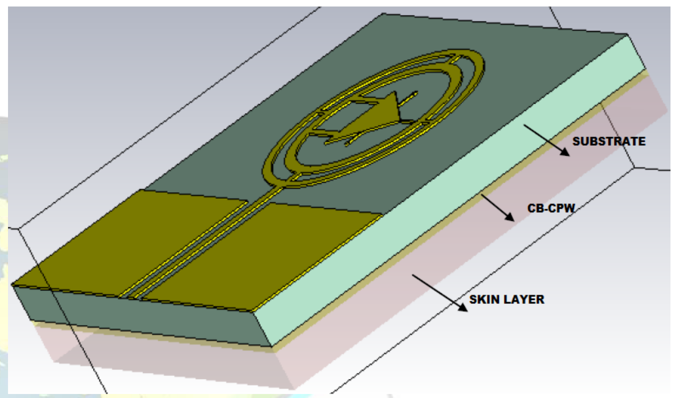

Fig.2.The proposed antenna layered structure.

Table.1. Dimension of a proposed structure.

Antenna dimension	Value(mm)
W	20
W_1	9.2
W_2	9.2
L	20
L_1	6.9
L3	10
L4	5
R_1	6.4
R_2	4.8
G	2.4
S_1	0.5
S_2	0.5
F	4.8
E	6.4
D	1

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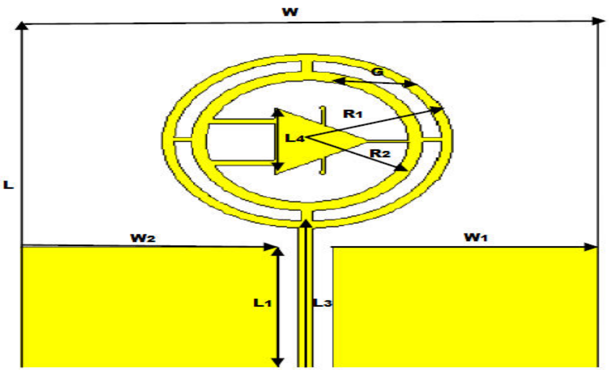

Fig.3.Geometrical representation of CPW fed OPAMP shaped antenna.

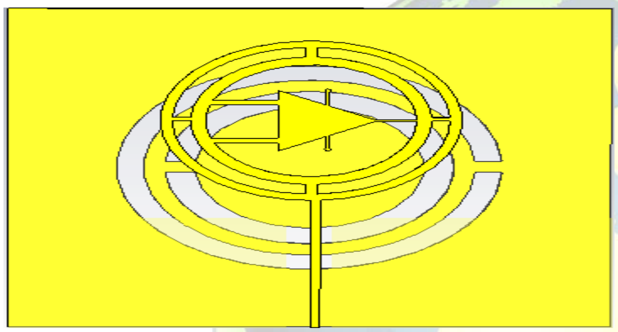

Fig.4. Geometrical representation of SRR loaded OPAMP shaped antenna.

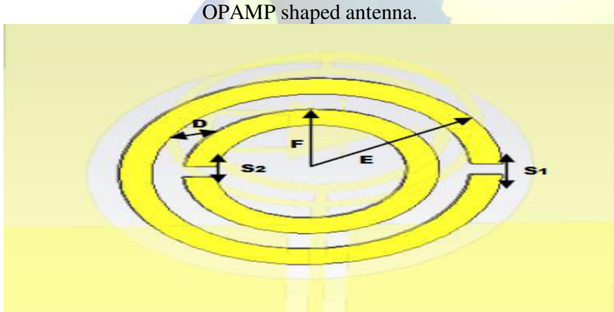

Fig.5. Geometrical representation of CSRR loaded OPAMP shaped antenna.

IV.RESULTS AND DISCUSSION

The antenna is computer-generated while implement on body for wearable health monitoring during yoga. The premeditated antenna is implementing on the skin layer. Few antenna parametric results are discussed as give below.

A.MAGNITUDE OF REFLECTION COEFFICIENT

The give designed antennas resonate at a resonating frequencies are 2.48GHz, 3.52GHz, 3.57GHz, 3.6GHz. The $|s_{11}|$ values are consist of -23dB at 3.6GHz, -26dB at 2.48GHz,-23dB at 3.52GHz and -14dB at 3.57GHz and -10dB band widths are (80[a], 50[b], 60[c]) MHz, respectively are shown in Fig.6.

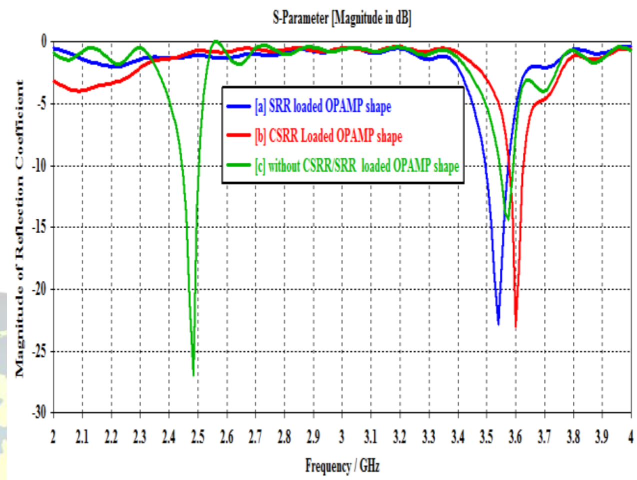

Fig.6.Magnitude of reflection coefficient versus frequency plot [a] SRR loaded [b] CSRR loaded [c] without SRR/CSRR loaded antenna.

B .VOTAGE STANDING WAVE RATIO

VSWR at the antenna input terminals are directly related to reflection coefficient, characteristic impedance and input impedance [10, 12]. VSWR values are 1.15[a], 1.15[b], 1.11[c] for a proposed OPAMP shaped antennas.

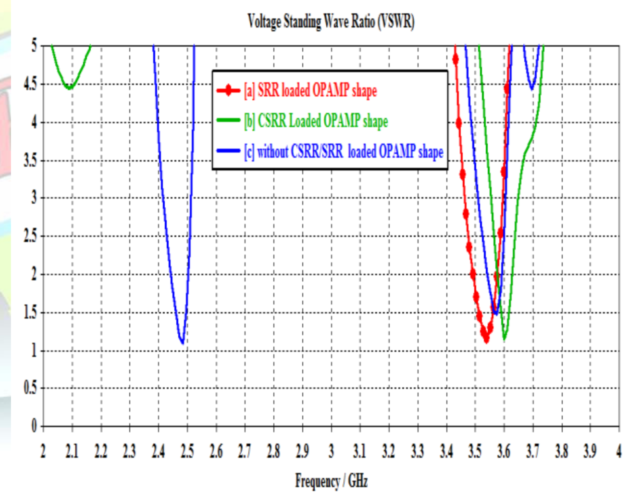

Fig.7.VSWR versus frequency plot [a] SRR loaded [b] CSRR loaded [c] Without SRR/CSRR loaded OPAMP shaped antennas.

C.FAR FIELD GAIN

The some amount of radiated power is absorbed by human tissue. This absorption rate is called SAR value, due to this wearable antenna gain is reduced some amount [8, 9]. This absorption is related to the operating frequencies are shown in Fig.8-11.

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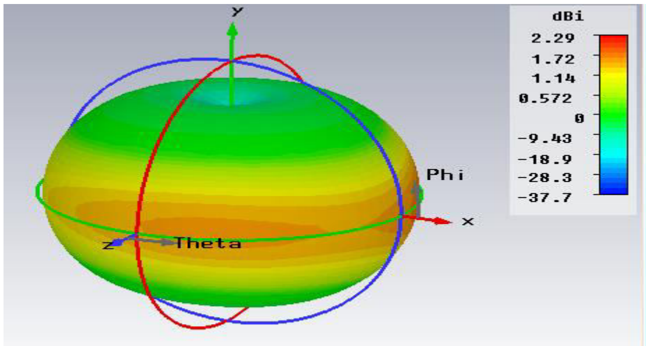

Fig.8.3D-plot of directive gain at 2.48GHz.

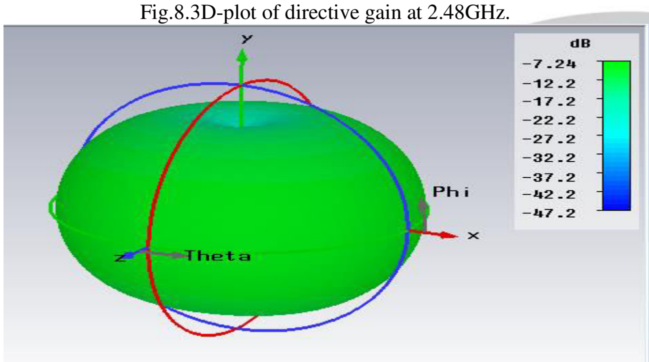

Fig.9.3D- plot of gain at 2.48GHz

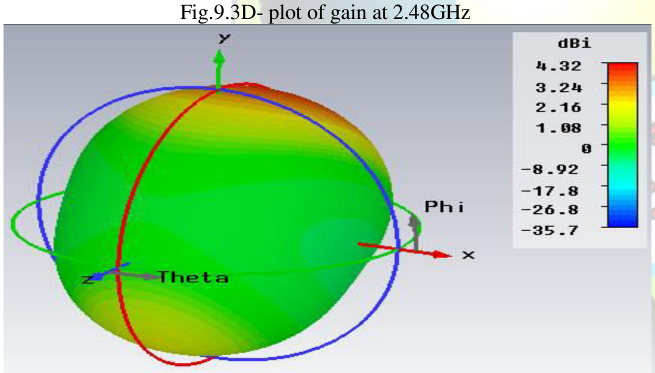

Fig.10.3D-plot of directive gain at 3.57GHz.

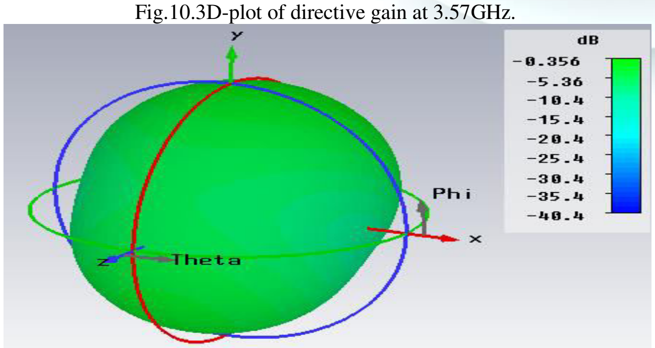

Fig.11.3D- plot of gain at 3.57GHz

D. RADIATION PATTERN

It is a graphical representation or mathematical representations at farfield.the radiation pattern of proposed antennas are shown in Fig.12-15[10].

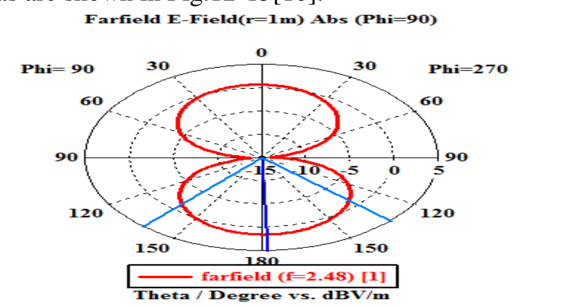

Fig.12.E-field of OPAMP shaped antenna at 2.48GHz.

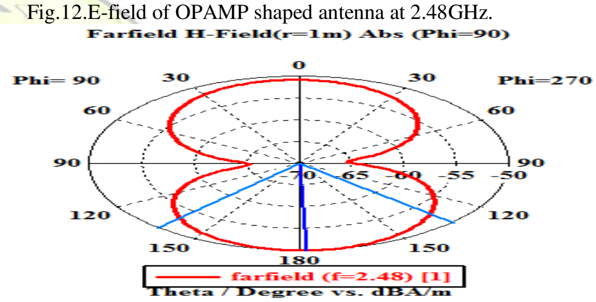

Fig.13. H-field of OPAMP shaped antenna at 2.48GHz.

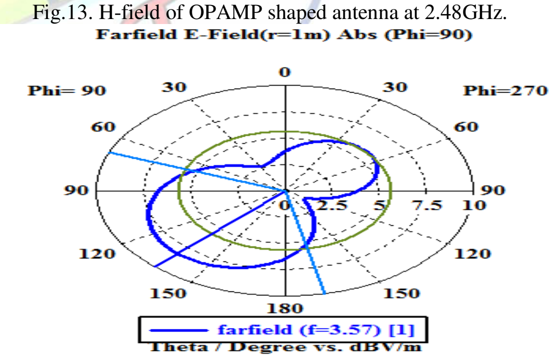

Fig.14. E-field of OPAMP shaped antenna at 3.57GHz.

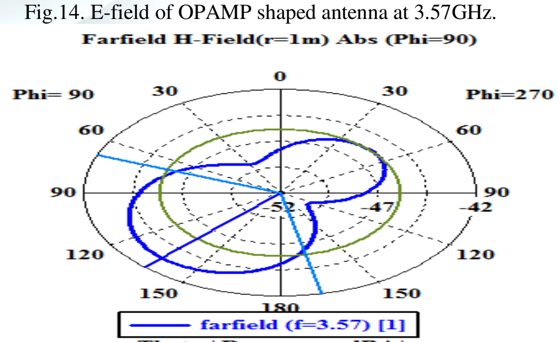

Fig.15. H-field of OPAMP shaped antenna at 3.57GHz.

Table.2. Comparisons between different on-body antennas.

Reference	Dimension[mm^3]	Gain[dB]	10dB-BW [MHz]	Dielectric Materials
[11]	15240	-16	12	ARLON1000
[4]	10240	-	20	Rogers3120
[6]	6480	-	20	RT/duroid6002
[11]	1265.6	-25	142	Rogers3120
Prop.Ant. [a]f=3.52 GHz	640	-2	80	Teflon
Prop.Ant. [b] f=3.6 GHz	640	-2	50	Teflon
Prop.Ant. [c]f=2.48GHz	640	-7	60	Teflon
Prop.Ant. [c] f=3.57GHz	640	0	50	Teflon

V.CONCULSION

The designed SRR and CSRR loaded, a circular-ring encircled diamond shaped patch antenna is more suitable for on-body communication and health care signal monitoring applications. The designed antenna overall dimension are 20x20x1.6mm^3.The all proposed SRR and CSRR loaded antenna resonated at a resonating frequency range between 2.4 to 2.5GHz and 3.4 to 3.6GHz and 3.6 to 3.7GHz.These are ISM band, Wi-MAX band and WLAN band, since these antennas are capable to interface between WBAN to other wireless networks.

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BIOGRAPHY

Sajith.k, received the B.Tech degree from in College of Engineering Thalassery, kerala in 2011, and M.Tech degree in Pondicherry university in 2013, where he is currently pursuing the Ph.D degree in electronics and communication engineering. During his research carrier, he developed many wearable antennas for health monitoring applications and also he received best paper award in IEEE-ICRAET conf. in India. Email- sajithrajan999@gmail.com

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ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
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Vol. 4, Special Issue 22, December 2017

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