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Wideband Biodegradable Organic Substrate based Resonator for Fixed Microwave Service and Short Wave Radio Applications

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ABSTRACT:

The utilization of wireless communication devices is significantly increasing. It is believed that two in three human has access to wireless devices across the globe. With increase in access utilization of wireless communication devices, it is apparent that requirement of the resonators is also growing. The proposed resonator is having dual frequencies viz. 2.15 GHz and 4.56 GHz. At these frequencies the bandwidth is in order of 8.40% and 9.42% respectively. The biodegradable substrate based planar resonator is proposed for wearable military applications where on-body communication devices can incorporate the biodegradable resonator for fixed microwave services and Short Wave Radio Services.

KEYWORDS: wideband resonator, biodegradable organic substrate, planar resonator, on-body communication

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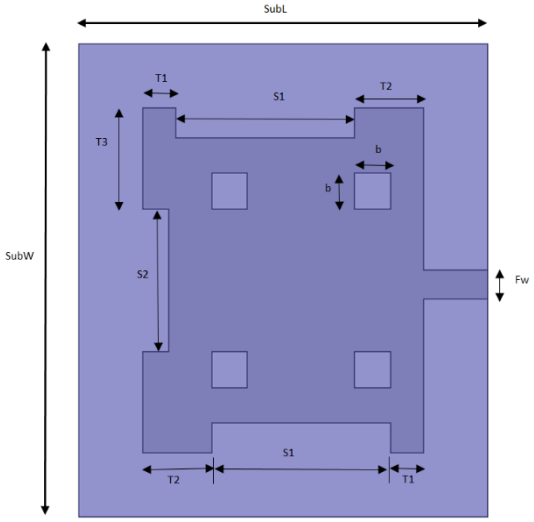
INTRODUCTION:

The requirement of resonators which having capability to get mounted on surface of communication device is continuously growing especially due to on-body communication devices[1].The biodegradable organic substrate utilized in the proposed resonator is paper. The paper is has shown significant utilization in antennas design especially through printing of inkjet and direct-write environment[2].The paper is low profile which hence it can be utilized for on-body communication and short range communications. There are many published works which is having design of resonator by utilization of paper substrate[3-10].

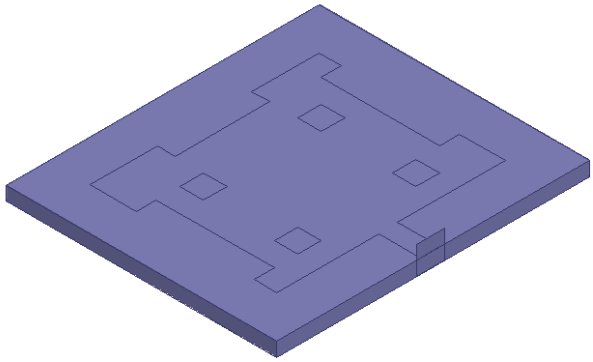
The bending of the paper substrate due to its flexibility is critical design issue, however, the paper offers ease in design and fabrication. Paper is also cost effective hence it is feasible to produce such resonators in mass production. The dissipation factor is lesser than 0.1 and higher than 0.05.Because of such dissipation factor, the losses are high and gain is restricted, however, they can be utilized for short range wireless communications. Other flexible and transparent resonators are proposed on variety of the substrates in the literature[11-15]. This paper presents the biodegradable organic substrate based resonator for fixed microwave services and short wave radio applications.

DESIGN, RESULTS AND DISCUSSION:

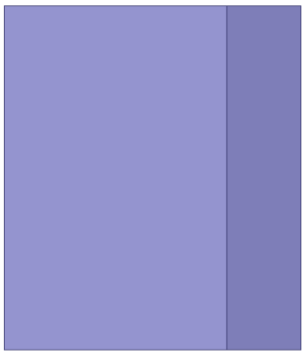
The wideband resonator is illustrated in Figure 1.The standard size substrate resonator available in market are having thickness of 3 mm.The dielectric constant of used paper is around 2.34 and it is having the loss tangent of around 0.065. The substrate length (SubL) was kept as 57.26 mm and Substrate Width (SubW) is kept at 66.36 mm. The resonator patch was fed through microstripfeed line having width fw of 4mm and length of 8.88 mm. The truncated length of ground plane along with length is 14.31 mm. The other resonator dimensions are in mm: T1= 4.75, T2=9.75, T3=14.18, S1=25, S2=20 and b=5.



(a) Top View with Physical Dimension



(b) 3-D View



(c) Truncated Ground Plane

Fig.1. Proposed Resonator

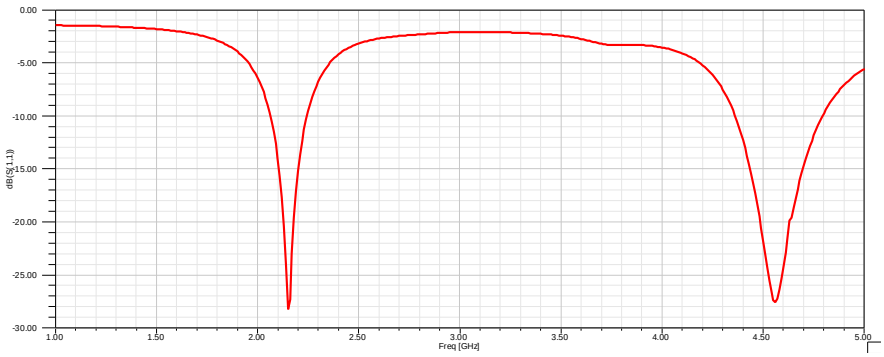


Fig. 2.Reflection Coefficient of Resonator

Figure 2 illustrate the reflection coefficient of proposed resonator. The resonator resonates at dual band frequencies at 2.15 GHz and 4.56 GHz which is having applications in fixed microwave services and short wave radio wireless application respectively. The slots and partial ground plane in

the resonators are introduced to increase the bandwidth at both resonator frequencies. The simulated bandwidths are in order of 8.40% and 9.42% at resonance frequencies respectively. Figure 3 is voltage standing wave ratio (VSWR) in dB. The VSWR of presented resonator is quite below 1 dB level. Figure 4depicts the distribution of surface current density. The apparent from the figure resonator has maximum radiation near radiating edges and stripline. Figure 5illustrate the radiation pattern at 2.15 GHz and 4.56 GHz respectively. The radiation pattern of 2.15 GHz is dipole like pattern and 4.56 GHz is split in to two lobes. Figure 6 depicts the resonator gain at two resonant frequencies.The peak simulated gain of the antenna is around -0.78dBi at 2.15 GHz and -0.2 dBi at 4.56 GHz. The paper material is quite lossy which reduces overall radiation out of the resonator.

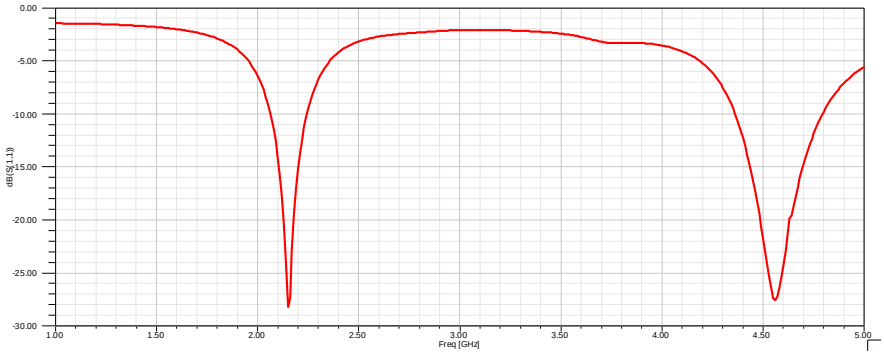
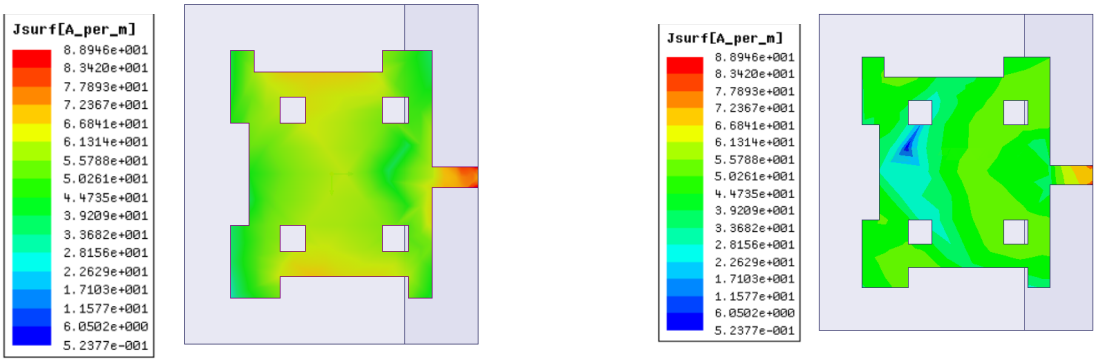
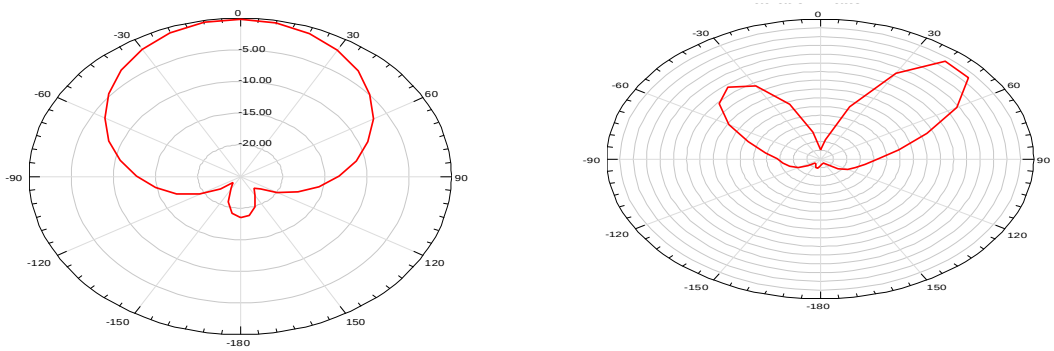


Fig 3: Voltage Standing Wave Ratio



(a) : At 2.15 GHz (b) :At 4.56 GHz

Fig. 4. Surface Current Distribution of the resonator



(a) : At 2.15 GHz (b) :At 4.56 GHz

Fig. 5. Radiation Patterns of the Proposed Antenna

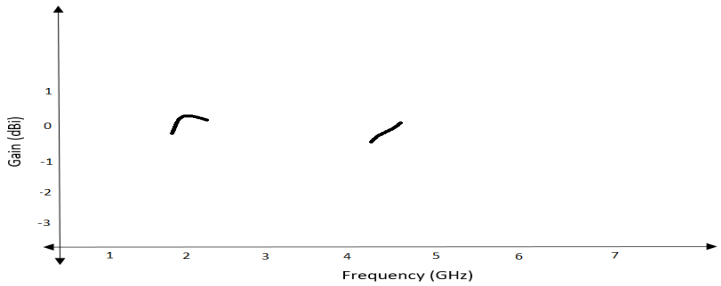


Fig.6: Resonator Gain

CONCLUSION:

A wideband resonator having biodegradable capacity is presented.The proposed resonator is having low weight and small size. The resonator is operating with wide bandwidth of8.40% and 9.42% at 2.16 GHz and 4.56 GHz respectively.Since, the resonator is having high dissipation factor the antenna gain is limited however it can be utilized for short distance communications.

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