

SRR Loaded patch Antenna for X-band Applications

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Abstract: In this paper, A microstrip feed patch antenna loaded with split ring resonator (SRR) for X-band application and patch shape used in this design is an octagonal ring. The FR-4 material used in this design, thickness of 1.6mm and size of an antenna is 24.8mm x29 mm x1.6mm. The generalized parameters of antenna: reflection coefficient, VSWR, radiation patterns and the gain was discussed. The proposed antenna resonates at two frequencies 9.3GHz, 10.85GHz and their S₁₁, VSWR values are -25.94dB, 1.12 at 9.3GHz; -20.6dB, 1.21 at 10.85GHz. The good radiations patterns are observed at all resonant frequencies and fine to use for wireless applications.

Keywords: Split Ring Resonator (SRR), X-band, Octagonal ring patch, Microstrip

I. INTRODUCTION

In wireless communication, antennas play a very important role and transducer among transmitter and free space and well controlled to radiate electromagnetic energy into free space [1]. In recent days, the system requires small size, less weight, small profile and less size antennas for wireless communication and also need to provide more efficient, mobility and reliability[2-3]. Starting days microstrip patch antennas used due to simple to construct and consist of a patch that is placed on the top of a substrate, the ground is used in the bottom of the substrate and this antenna is having low weight and size, used for mobile and aerospace applications [4-5]. The microstrip antennas have developed drastically for the period of the past 35 years, overcome so many restrictions. The shape of the patch is generally circular and rectangular and changed the shapes day to day based on the user requirements [6-8].

The schematic version of microstrip as shown in fig 4.1. The w and h are represented as a width of a strip and height of the substrate. The design values depend on the ratio of W and h, their notation is represented in equation 1 to 3 [6-11].

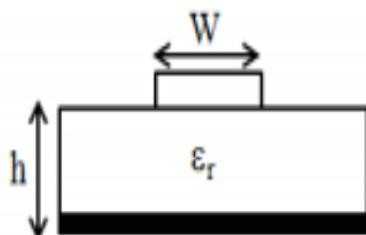


Fig. 1. Microstrip

$$\frac{W}{h} = \begin{cases} \frac{2}{\pi} \left(\frac{a-1-\ln(2a-1)+\dots}{\epsilon_r-1} \left[\ln(a-1+0.39) - \frac{0.11}{\epsilon_r} \right] \right) & \frac{W}{h} > 2 \\ \frac{8a^a}{e^{a^2}-2} & \frac{W}{h} < 2 \end{cases} \quad (1)$$

Where

$$a = \frac{377\pi}{2Z_0 \sqrt{\epsilon_r}} \quad (2)$$

$$b = \frac{Z_0}{60 \sqrt{\epsilon_r}} \sqrt{\frac{\sqrt{\epsilon_r}+1}{2} + \frac{\epsilon_r-1}{\epsilon_r+1}} \left(0.23 + \frac{0.11}{\epsilon_r} \right) \quad (3)$$

In this article, Section. 2 describe an antenna design, their parameters used in this design and section 3 gives a brief discussion about antenna parameters. The conclusion can be described in section 4 followed by references

II. ANTENNA DESIGN

The design of the proposed antenna is represented in fig. 2 and their parameters used for design is revealed in table.1. The proposed antenna is designed by using FR-4 substrate with a dielectric constant of 4.4, the thickness is 1.6mm. The microstrip feed is used in this design and copper used above the substrate with a thickness of 35um. The design as octagonal ring loaded with split ring resonator (SRR) and the shape of the SRR is a circle. The size of an antenna is 24.8mm x 29mm x1.6mm and designed for X-band applications.

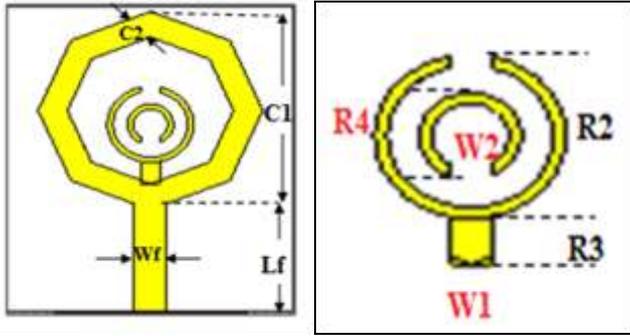


Fig. 2 Antenna design

Table 1. Design Parameters

Parameter	Dimension(mm)	Parameter	Dimension (mm)
L_f	10.8	R_2	8
C_f	3.2	R_3	1.5
C_1	19.5	R_4	6
C_2	3	W_1/W_2	1.5 / 1.5

III. SIMULATION RESULTS

The reflection coefficient over a frequency (GHz) was revealed in Fig. 3 and observed in the frequency range of 8 to 12GHz. It resonates at two frequencies over X-band range those resonant frequency values are 9.3GHz, 10.85GHz and their S_{11} values are -25.94dB, -20.16dB. The VSWR values of the proposed design were represented in Fig. 4 and observed in the frequency between 8 to 12GHz. Based on VSWR results, it resonates at 9.3GHz and 10.85GHz respectively. The VSWR values are 1.12 at 9.3GHz, 1.21 at 10.85GHz and VSWR bandwidth is matched with VSWR=2 line. The impedance bandwidth of the antenna is 250MHz at 9.3GHz, ranges from 9.15GHz to 9.4 GHz and 500MHz at 10.85GHz ranges between 10.6GHz to 11.1GHz.

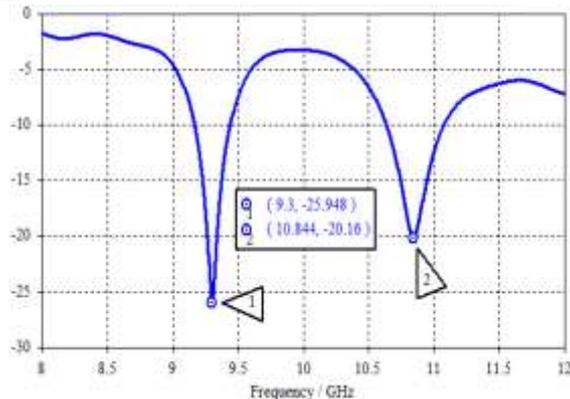


Fig. 3. Reflection coefficient over frequency (GHz)

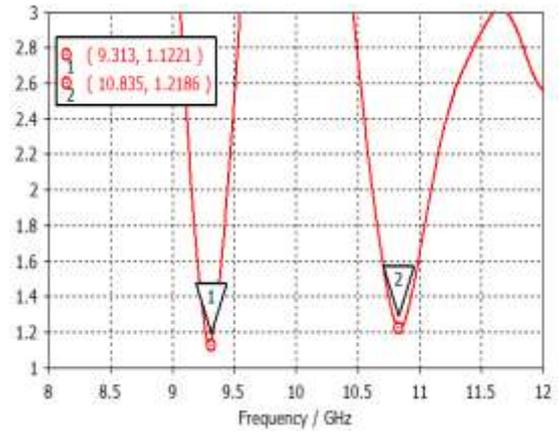


Fig. 4. VSWR over frequency (GHz)

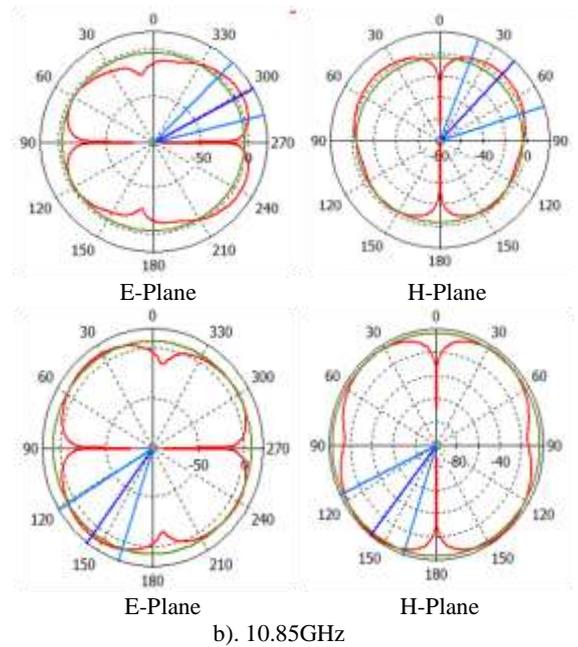


Fig. 5. Radiation patterns at resonant frequencies

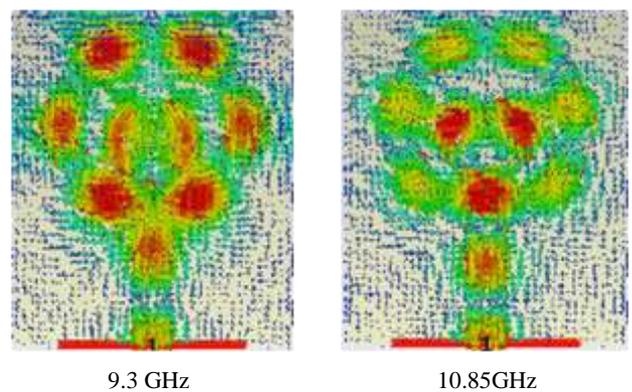


Fig. 6. Surface current at resonant frequencies

The emission pattern of a proposed antenna is exposed in Fig.5. The fig.5a, 5b represents the patterns at 9.3GHz and 10.85GHz and as bidirectional patterns in E-field, H-field at every resonant frequency. The surface current at resonant frequencies is represented in Fig. 5 and observed that current flow is high at SRR at octagonal ring patch at 9.3GHz and also flow is high at SRR at 10.85GHz frequency.

IV. CONCLUSION

In this article, A octagonal ring SRR loaded patch antenna has been introduced for X-band applications and microstrip feed is used in this design. The antenna is simulated and designed by FR-4 substrate material with a 4.4 dielectric constant and as a size of 24.8mm x 29mm x 1.6mm and also investigated generalized parameters of an antenna. The proposed antenna resonates at two resonant frequencies 9.3GHz, 10.85GHz. The percentage of impedance bandwidth of the antenna is 2.68% at 9.3GHz and 4.61% at 10.85GHz and also observed bidirectional radiation patterns in an X-band frequency range.

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