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DESIGN CIRCULAR POLARIZATION MICROSTRIP ANTENNA FOR 2400 MHZ WITH RECTANGULAR BASIC PATCH

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ABSTRACT

The antenna have many variety of types and microstrip antenna has more advantages than the other types of antenna. The antenna was made from FR-4 epoxy with substrate ε_r = 3.9 and h = 1.6 mm and works in frequency 2400 MHz with VSWR 1.589. S-Parameter level is below –10dB, the bandwidth of antenna shown as VSWR < 2, has circular polarization at frequency 2400 MHz. This design and results are calculated using CST software.

Keyword: circular polarization, microstrip antenna, rectangular patch.

INTRODUCTION

Antenna has much variety of types, one of which is microstrip. Microstrip antenna has a metallic patch on a grounded substrate. The metallic patch has many configurations according to the needs [1]. Some of the advantages of microstrip antenna compared with the other types of antennas, it's thin and small, relatively simple on manufacture, has a light weight, easy to fabricated, can generate a linear polarization and circular polarization using only the rationing that is simple, easy to integrate with other electronic devices, and the cost is relatively cheap [2].

Antenna design

The easy way to make a circular polarization in microstrip antenna is with dual feed and using a 90° phase shift between the fields [3]. For basic rectangular patch we use teoritical calculation to determine the rectangular patch.

$$W = \frac{c}{2f_o\sqrt{\frac{(\varepsilon_r + 1)}{2}}} \quad (1)$$

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}} \quad (2)$$

$$L_{eff} = \frac{c}{2f_o\sqrt{\varepsilon_{eff}}} \quad (3)$$

$$\Delta L = 0.412h\frac{(\varepsilon_{eff} + 0.3)\left(\frac{W}{h} + 0.264\right)}{(\varepsilon_{eff} - 0.258)\left(\frac{W}{h} + 0.8\right)} \quad (4)$$

$$L = L_{eff} - 2\Delta L \quad (5)$$

We find that W = a = 39.9 mm, L = b = 31.2 mm. The size of antenna is shown on Figure-1. The material we use is FR-4 epoxy with dielectric constant of 3.9 with 1.6 mmthick substrate.

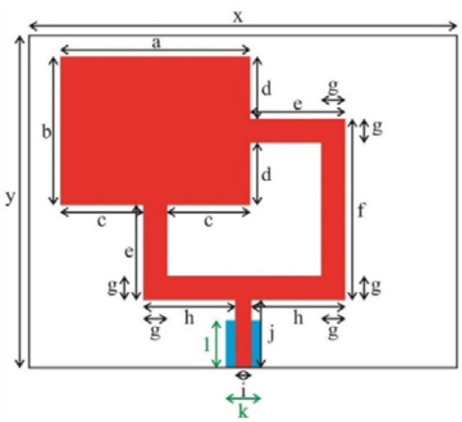

Figure-1. The antenna design, red is patch and blue is groundplane ,with h = 1.6 mm FR-4 epoxy Substrate (ε_r= 3.9); x = 90 mm; y = 70 mm; a = 39.9 mm; b = 31.2 mm; c = 17.45 mm;d = 13.1 mm; e = 19 mm; f = 37.1 mm; g = 5 mm; h = 19.539 mm; i = 3.372 mm; j = 15.4 mm; k = 7.372 mm; l = 12mm.

RESULT

The observed parameters ofthe antenna are Return Loss (S_{11}), VSWR, Axial Ratio, and Gain. The fabricated antenna is as shown on Figure-2.

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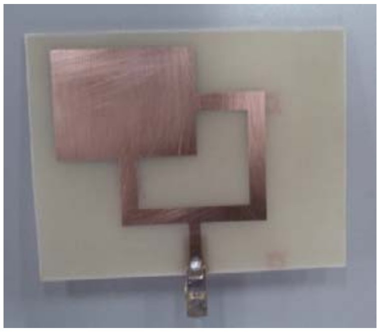
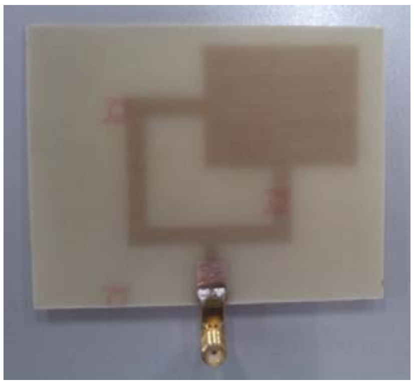


(a)



(b)

Figure-2. Fabricated antenna; (a) front view; (b) rear view.

Return loss

Return Loss which was obtained using the frequency of the antenna that can work is shown on Figure-3. S_{11}or S-Parameter also referred as return loss, and S_{11}level must be less than–10 dB and S_{11}level can be below -9.54dB which is the maximum tolerance level of the antenna that can work [4]. For Frequency 2400 MHz the return loss is -12.861 dB as shown on Figure-3.

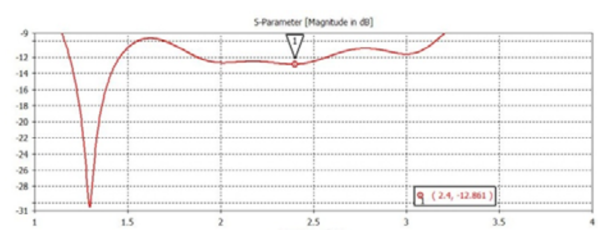


Figure-3. Frequencyversus S_{11} parameter (return loss) (Frequency, return loss).

VSWR

VSWR determines bandwidth of antenna if the value of VSWR < 2. In this antenna, frequencies that have VSWR < 2 are in 1.1553 GHz – 3.178 GHz range. Figure-4 shows the value of VSWR in 2400 Mhz is 1.589 and antenna works in frequency 1.1553 GHz - 3.178 GHz, so bandwidth is 2.0227 GHz.

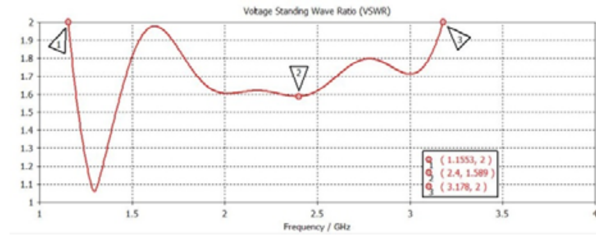


Figure-4. Frequency versus VSWR value (Frequency, VSWR).

Axial ratio

Axial ratio is define for see how is antena polarization, 1 - 3 dB is circular, 3 - 10 is ellips, and > 10 is linier. This antenna has circular polarization because axial ratio value is below 3 dB.

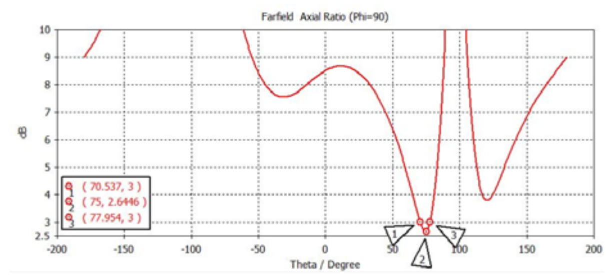


Figure-5. Degree versus axial ratio (dB) (Degree, axial ratio).

Gain

Gain for this antenna is 2.4791 dB for 2400 MHz which means passable

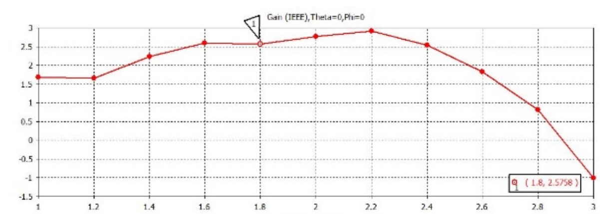


Figure-6. Frequency versus gain (Frequency, Gain).

CONCLUSIONS

This antenna with FR-4 epoxy substrate 90 mm x 70 mm, ε_r = 3.9, and h = 1.6 mm which has circular polarizationin frequency of 2400 MHz. In the simulation results obtained RL < -10, VSWR < 2 at 2400 MHz, Axial ratio <3dBwhich mean has circular polarization, gain> 2dB.

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