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 $\varepsilon_r = 3.9$ and $h = 1.6 \text{ mm}$ and works in frequency 2400 MHz with VSWR 1.589. S-Parameter level is below $-10 \text{ dB}$, 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 fabricate, 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 theoretical calculation to determine the rectangular patch.

\[ W = \frac{c}{2f_0 \sqrt{\varepsilon_r}} \quad (1) \]

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

\[ L_{\text{eff}} = \frac{c}{2f_0 \varepsilon_{\text{eff}}} \quad (3) \]

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

\[ L = L_{\text{eff}} - 2\Delta L \quad (5) \]

We find that $W = a = 39.9 \text{ mm}$, $L = b = 31.2 \text{ mm}$. 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 mm thick substrate.

RESULT
The observed parameters of the antenna are Return Loss ($S_{11}$), VSWR, Axial Ratio, and Gain. The fabricated antenna is as shown on Figure-2.
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 -9.54 dB 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. Frequency versus $S_{11}$ parameter (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.

**Gain**

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

CONCLUSIONS

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

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REFERENCES


