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2.4 GHz Circularly Polarized Microstrip Antenna for RFID Application

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ABSTRACT

Due to deployment of the wireless technology, the microstrip antenna can be used for RFID application especially for tag antenna. The existed RFID tag antenna usually use dipole model to get the maximum performance. However, the dipole antenna which has linear polarization performance has disadvantages on alignment that makes data detection on RFID can not be accurate. To reduce error during data detection caused of misalignment between reader and transponder, the tag antenna should have circularly polarized performance. The antenna was made with microstrip-line fed on FR-4 Epoxy substrate and works covers 2.4 GHz of its frequency range of 2 up to 3.3 GHz which S-parameter level below -9.54 dB and the direction of the transmitted power omnidirectionally and has circular polarization at frequency range of 2.39 until 2.46 GHz which has axial ratio below 3 dB.

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INTRODUCTION

The deployment of the wireless technologies is going rapidly especially in the antenna that supports the wireless system to receive and transmit the information. The antenna should be easy to fabricate, has various models and has proportional size with the wireless system. The antennas type which has these criteria is the microstrip antenna (Preradrovic, Stevan, Karmakar, Nemai C., 2009).

Microstrip antenna can be applied in many wireless technologies. One of the wireless technologies which applied the microstrip antenna is in Radio Frequency Identification System (RFID), as the tag antenna that transmits the saved information in the transponder into reader to detect the information (Punit, 2004). Existed tag antenna mostly used printed dipole as the model to get the maximum performance during data detection (Deavours, 2010).

Usage of the printed dipole has disadvantages especially in alignment of propagation. Printed dipole which has linear or elliptical polarization can cause problem if the tag and reader get the misalignment (Finkenzeller, Dr. Klaus, 2003). The reader can not detect the information accurately because of that misalignment. To solve the problem, the tag antenna should be circularly polarized.

Antenna Design:

The tag antenna is designed with the dimension of substrate 30 X 40 mm with the microstrip line-fed. Microstrip-line fed method is chosen because it is easy to fabricate and match impedance. For the shape of the microstrip-line chosen the L shape to get orthogonal phase magnitude which can occur circular polarization (Joseph, R., T. Fukusako, 2012; Kumar, Girish, Ray, K.P. 2003).

The applied substrate material is FR-4 Epoxy that has dielectric constant (εr) 4.4 with thickness 0.8 mm. Antenna models is shown on Figure 1.

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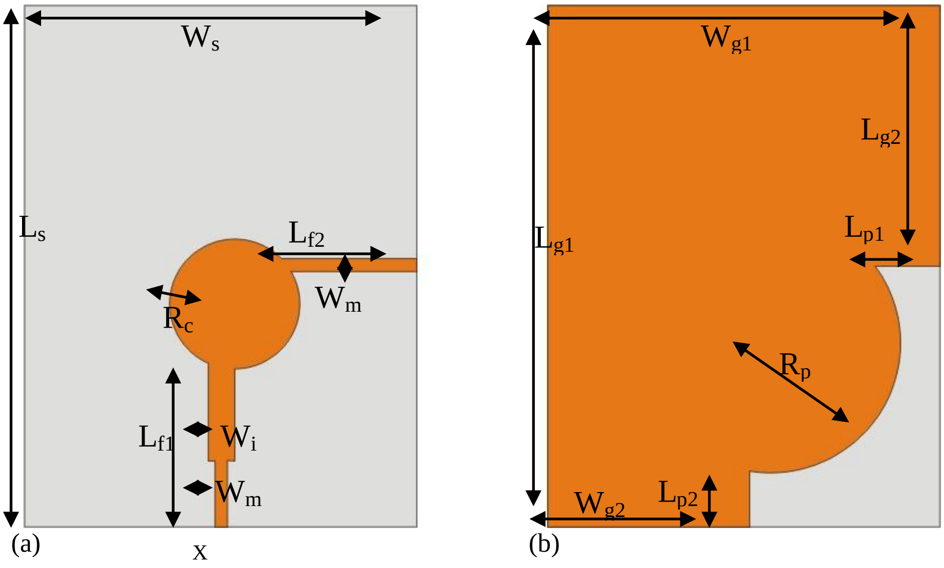
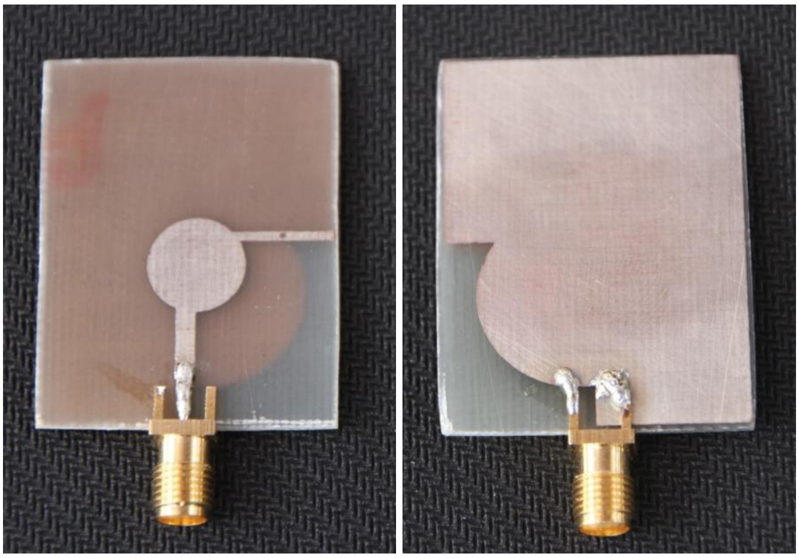


Fig. 1: The antenna design; X= the excitation port; (a) front view (b) rear view, with 0.8 mm FR-4 substrate (εr= 4.4) Ls= 40 mm; Ws=30 mm; microstrip-line fed with the dimension of Wm= 1 mm; Wi = 2 mm; Rc = 5 mm; Lf1 = 12.5 mm; Lf2 = 10.2 mm; ground plane with the dimension of Lg1 = 40 mm; Wg1 = 30 mm; Lg2 = 20 mm; Wg2 = 15.5 mm; Lp1 = 5 mm; Lp2 = 4.1 mm; Rp = 10 mm

Result:

The fabricated antenna was shown on Figure 2.



(a) (b)

Fig. 2: The fabricated antenna; (a) front view; (b) rear view

The Observed Parameter antenna covers result of S-parameter (S11), directivity pattern and axial ratio.

S_{11} Result:

S_{11} which obtained the frequency of the antenna that can work shown on Figure 3

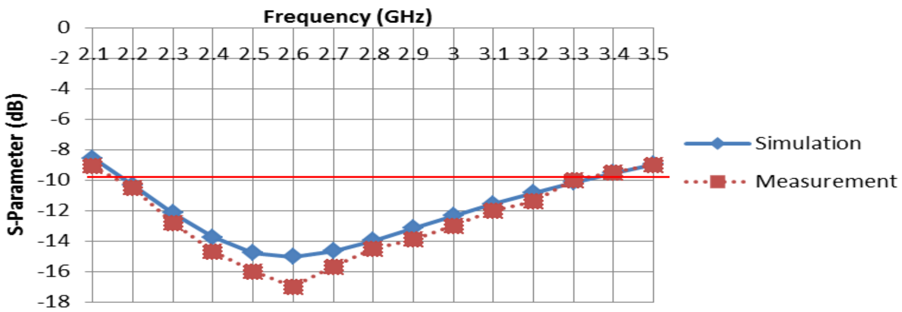


Fig. 3: S_{11} parameter vs frequency

Figure-3. Shows that the antenna can work covers frequency of 2.4 GHz in the work frequency range of 2.2 until 3.3 GHz. The frequency range of the antenna obtained from the S11 level below 9.54 dB which is the maximum tolerance level of the antenna that can work (Yuwono, Rudy, *et al*., 2013).

Directivity Result:

The directivity result of the antenna at frequency of 2.4 GHz shown on polar diagram as directivity pattern which is shown at Figure 4.

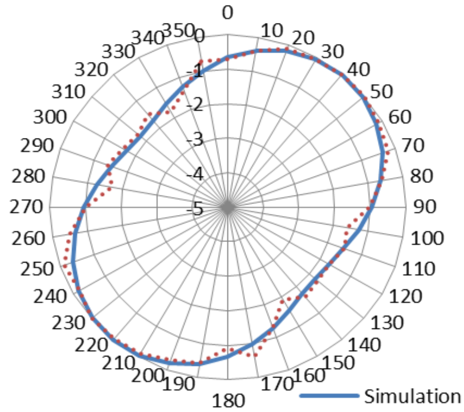


Fig. 4: Polar diagram of directivity pattern of the antenna at frequency of 2.4 GHz

Figure 4 shows which the antenna has directivity pattern of omnidirectional. It is obtained from the directivity pattern that can transmit the power in all direction.

Axial Ratio Result:

The result of the axial ratio shown on Figure 5.

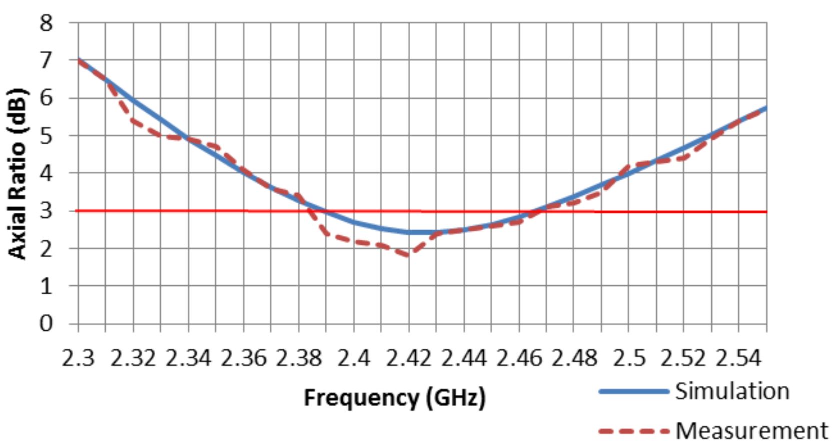


Fig. 5: Axial ratio with the function of frequency

Figure 5 show that the antenna has circular polarization at frequency range of 2.39 up to 2.46 GHz obtained from the axial ratio level that has value below 3 dB. With that performance the antenna can be used for RFID tag with circular polarization.

Conclusions:

The RFID tag antenna which made with microstrip-line fed method on 0.8 mm FR-4 epoxy with the dimension of the substrate 30 mm X 40 mm has performance can work covers frequency of 2.4 GHz in the range of frequency 2 up to3.3 GHz with the directivity pattern omnidirectional. The antenna also has circular polarization which is obtained from the axial ratio at frequency of 2.39 up to 2.45 GHz which is used for RFID application.

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