THE RING ANTENNA WITH I-SHAPED FEEDING ON CIRCULARY REFLECTOR PLANE FOR RFID APPLICATIONS

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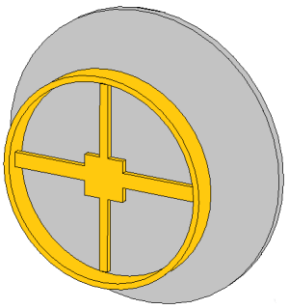
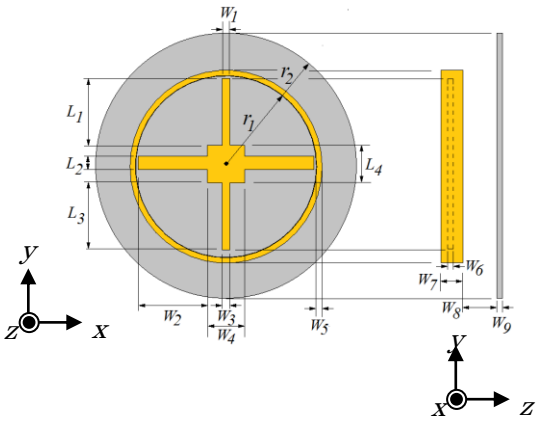
ABSTRACT Topics from this research is the double I-shaped feeding and reflector plane that can affect the performance of ring antenna for operating wireless signal in RFID Technology, by using ring-shaped copper antenna placed on circularly reflector plane. The double I-shaped feeding provides good performance such as large beamwidth and the circularly reflector plane can be enhanced the directive gain. For appreciate results, the ring antenna without circularly reflector plane can operating in frequency of 1.9 - 2.5 GHz with directive gain as 4.88 dB and this antenna is added the copper reflector structure for improve directive gain around 8.20 dB at 2.45 GHz. The consequence of, the proposed antenna in band of 1.8 – 3.38 GHz, caused by the I-shaped stub at feeding are below -10 dB.

1. INTRODUCTION

With the advances of wireless communications, the radio frequency identification (RFID) is esteeming alike, it is applied for identifying objects warehouse supply chain management, service logistic, control, and other automation process. Moreover, the antenna is component in RFID reader that is important to obtain the highest efficiency of the system. Therefore, the desired features of the proposed antenna for RFID reader are sufficiently high gain and wide coverage area. The high-gain antenna can be saved costs in wireless communication applications. The disadvantage of a high-gain antenna that is expensive and there is a pattern of spread does not match the required direction and including maintenance costs affordable. We have developed a high-gain antenna, but does not cover the frequency range used and the direction does not match the demand (M. N. Majid, et al., 2014). Thus, the development of antennas is used in accordance with the desired frequency range and a form of transmission power, with the specific direction or toward the front of the antenna. The antenna structure forms a ring with a rectangular probe tuning style with a total adjusted stub (Love, A.W., 1978, Kosulvit, S., et al., 1998, and Phongcharoenpanich, C., et al., 2002). In response of the frequency range, it covers more applications and suitable for 1850 - 1990 MHz, 1920 – 2170 MHz, 2400 - 2484 MHz (B. R.Rao, et al., 2013, M. R. Islam, et al., 2011, Y. C. Chen, et al., 2013, and C. Y. D. Sim, et al., 2015



(a) 3D



(b) Front and side

Fig. 1 Geometry of proposed antenna.

2. DESIGN AND SIMULATED RESULTS

2.1 Antenna Structure

The design of a ring antenna structure with radius of r_1 = 34 mm and radius of circularly reflector is r_2 = 50 mm. The distance between feeding and reflector is approximately $\lambda/4$. Materials of an antenna uses a copper with the conductivity of the material (σ) as 5.8×10^7 S/m. The copper thickness is 0.017 mm as shown in Fig 1. The best tuning parameters are shown in Table 1.

Table 1 Antenna Parameters.

Parameters	Size (mm)
$W_{1,3}$	3
W_2	24
W_4	14
$W_{5,6,9}$	1
W_7	8
W_8	25
L_1	24
L_2	5
L_3	23
L_4	14
r_1	34
r_2	50

2.2 Antenna results

This antenna is used a probe signals technique that is I stub tuning with a circularly reflector. The first add the stub tuning shape is placed above the antenna. When W_1 are fixed with width of 3 mm, L_1 is varied with 6, 12, 18 and 24 mm, respectively. That is W_1 = 3 mm and L_1 = 24 mm, which the result of the frequency response ranging is 54.80% (2.27 - 3.98 GHz) as shown in Fig. 2.

Secondary, when added stub tuning I-shaped on the left and right on the antenna with W_2 and varies size from 6, 12, 18 and 24 mm, respectively. That is W_3 = 24 mm L_2 = 5 mm, which results in a frequency response range is 55.29% (1.85 - 3.26 GHz) as shown in Fig. 3.

Finally, the circularly reflector is inserted with radius r_1 = 50 mm. By tuning the distance (W_9) is 20, 25, 30, and 35 mm, respectively. It found that covering frequencies used 62.01% (1.78 - 3.38 GHz) at the distance of the W_9 = 25 mm and impedance bandwidth is wider, covered 1850 - 90 MHz, 20 - 2170MHz, 2400 - 2484 MHz as shown in Fig. 4. Therefore, Fig. 5 is S_{11} that is compared the antenna model 1 to model 4

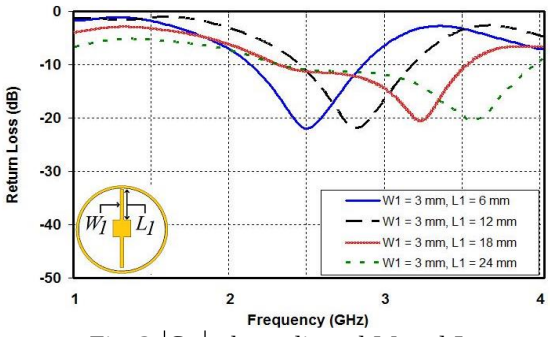


Fig. 2 $|S_{11}|$ when adjusted W_3 and L_3.

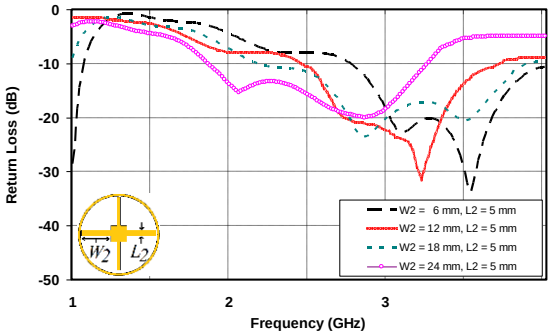


Fig. 3 $|S_{11}|$ when adjusted W_2 and L_2

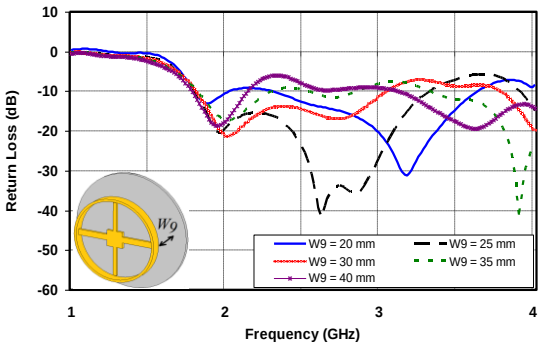


Fig. 4 $|S_{11}|$ when adjusted W_9

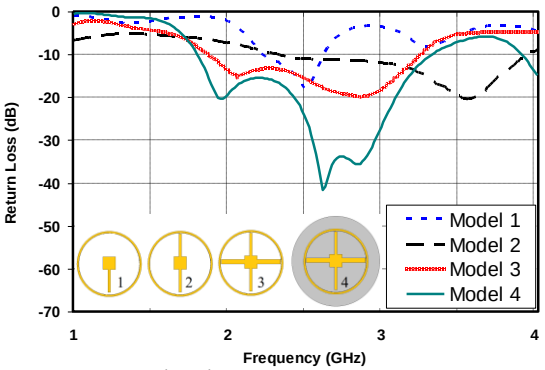


Fig. 5 $|S_{11}|$ of proposed antenna.

Ring antenna without a reflector with has average gain of 4.88 dBi, but with reflector has an average gain of 8.52 dBi as illustrated in Fig. 6, boosts power to rise 68.03% in the form of power transmission antenna. There is a specific way to the front of the electric field and magnetic field at frequencies 1.8 GHz, 2.45 GHz and 3.3 GHz, as shown in Fig. 7.

The gain of the antenna with an average of 8.52 dBi as shown in Fig. 6, which boosts power at higher 68.03%, also a form of transmission power of the antenna is directed specifically toward the front of the electric field and magnetic field at a frequency of 1.8 GHz, 2.45 GHz and 3.3 GHz as shown in Figure 7.

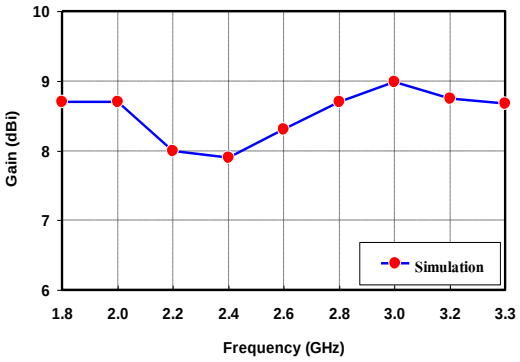
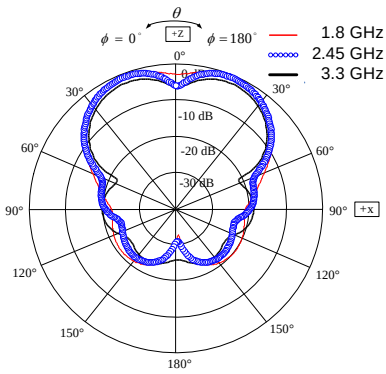
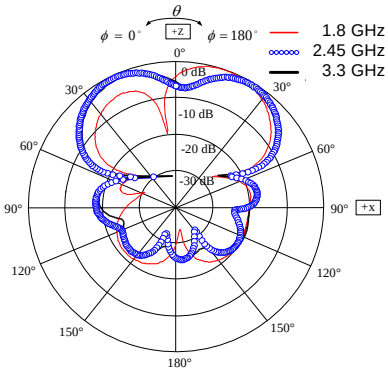


Fig. 6 Gain of ring antenna with I-shaped on circularly reflector.



(a) E-plane



(b) H-plane

Fig. 7 Radiation patterns.

CONCLUSION

This paper presents the design of the ring antenna with the I-shaped probe on circularly reflector plane for applications in wireless communications system, which increases liver tuning I-Shape three sides with reflectors. By choosing the distance between the antenna reflector $\lambda/4$ allow the frequency of use in a wide frequency range; To work more 62.01% (1.78-3.38 GHz) and reflector will increase the gain in the frequency range 1.8-3.3 GHz 8.20 dBi.

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