International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in

Vol.3., Issue.6., 2015
(Nov.-Dec.,)

RESEARCH ARTICLE

ISSN: 2321-7758

DESIGN OF RECONFIGURABLE ANNULAR SLOT ANTENNA

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ABSTRACT

With the advancement in technology, the need of multifunctional antenna is increasing day by day. In this paper, the design of reconfigurable annular slot antenna is proposed using HFSS Software. The antenna is made reconfigurable by placing the short at an angle of 45 degree from the feed line. The reference antenna and reconfigurable antenna are resonating at 6.4 GHz and 2.4 GHz respectively. Thus the reconfiguration has also made it compact. The other parameters like gain, bandwidth and radiation pattern are also simulated. Reference antenna can be used for broadcast purposes whereas the reconfigured antenna can be used for mobile communication purpose.

Keywords: Annular Slot, Microstrip feed, Reconfigurable Antenna.

1. INTRODUCTION

Wireless technology is one of the main areas of research in the world of communication systems today and a study of communication systems is incomplete without an understanding of the operation and fabrication of antennas. Antenna that are electrically small, are efficient, have significant bandwidth, are inexpensive and easy to build and integrate simply into more complex system would complete all the needs of many new generation wireless system. But, the requirements for increased functionality, such as direction finding, radar, control and command, within a confined volume, place a greater burden in today's transmitting and receiving systems. A solution to this problem is the re-configurable antenna. Also we need a multifunctional antenna that can be used for different purpose, So Reconfigurable antenna came into picture. These antennas also have less power interference. These antennas are having multi bandwidth as they can be used for different purposes.

Many Reconfigurable antennas has been designed using PIN Diodes[1][2], planar annular slot antennas with integrated niobium hot-electron bolometers [3], dual patch elements[4], Varactor diodes [5], network characteristics modes[6], sectorial beam[7] and many other methods. But here we designed the reconfigurable antenna by changing the position of the short.

This paper has been divided into two sections. Firstly, we will design the reference antenna resonating at 6.4 GHz using annular slot. Then, we design the reconfigured antenna resonating at 2.4 GHz by placing the short at an angle of 45 degree from the feed line.

2. Reference Antenna Design

The annular slot antenna consists of circular slot on a square, metal ground plane that is fed by a micro strip line fabricated on the opposite side of the substrate as shown in Figure 1. The mean length of the slot circumference is approximately 3λ/2 at the design frequency, where λ is equivalent wavelength in a slot transmission line with slot width w, which is small compared to λ. The micro strip feed line terminates in open circuit that is approximately $\lambda_g/4$ from the ring, where λ_g is the guided wavelength on the micro-strip line. At the intersection of the micro strip line and slot, magnetic coupling occurs, which, due to the 3λ/2 ring circumference, creates a null in the radiation pattern in the direction of the micro-strip feed line.

Linear matching stubs are used to match the antenna at different frequencies when the slot configuration is kept constant.

Reference Antenna Configuration

- Rogers RT/duroid 5880(tm) Substrate 50×50mm^2
- No short circuit slot is there.
- Microstrip feed
- Lumped port used
- Inner Ring Radius = 8 mm
- Outer Ring Radius = 10 mm
- Ring slot width = 2 mm
- Ring slot thickness = 0.025 mm

The reference antenna is designed and simulated using HFSS as shown in Figure 1. The various parameters like gain, return loss, and radiation pattern are also simulated.

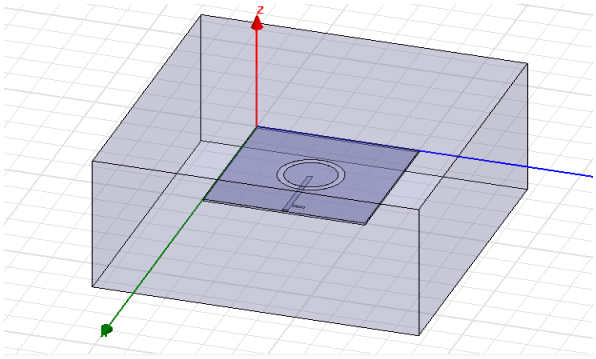

Figure 1. Reference Antenna design

The reference antenna is simulated and the result is shown in Figure 2. The reference antenna is resonating at 6.4 GHz and having return loss of -18 dB.

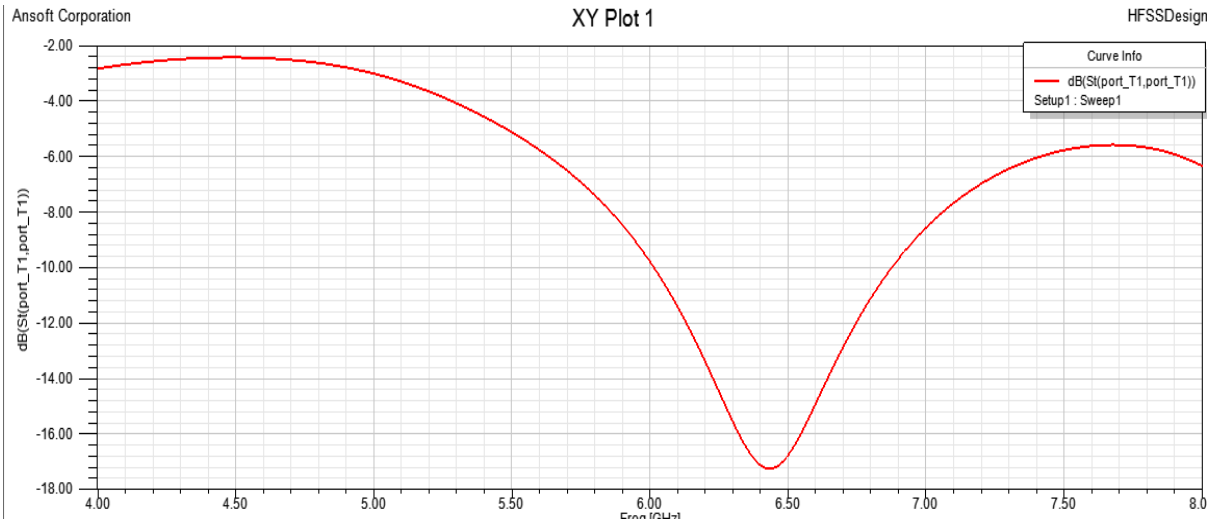

Fig. 2 Simulated Return loss of Reference antenna

In reference antenna, the gain is stimulated and the result is shown in Figure 3. The simulated gain is 6 dB at 6.4 GHz.

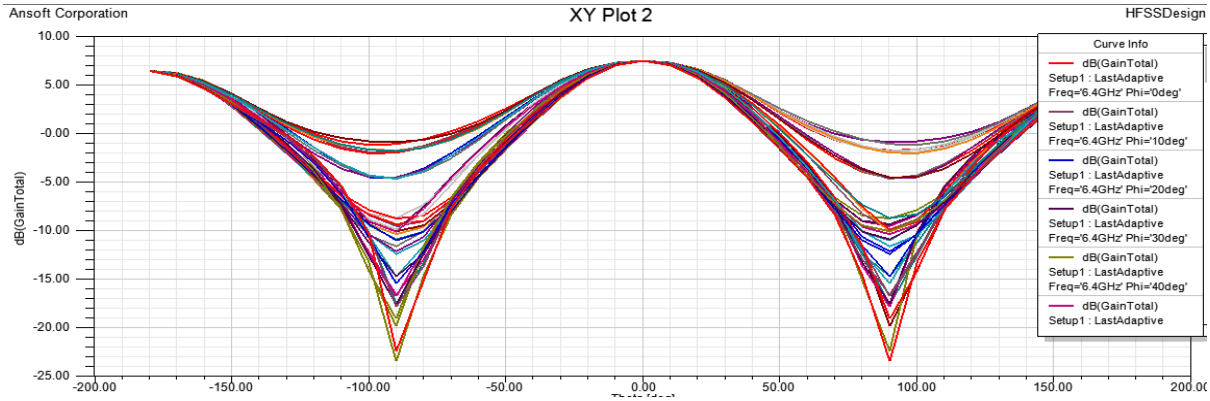

Figure 3. Simulated gain of Reference antenna

Radiation pattern of reference antenna at resonant frequency 6.4 GHz is shown in Figure 4 and the gain of antenna is 6 dB.

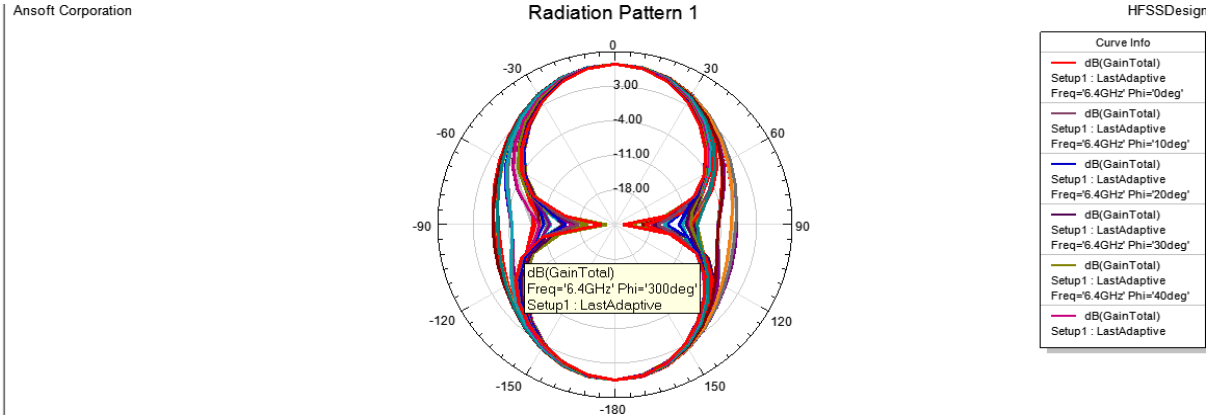

Figure 4. Radiation pattern of Reference antenna

4. Reconfigured Antenna

Varying the null position changes the impedance of antenna and requires the reconfigurable matching resonant frequency . circuit. The short is placed at an angle of 45 degree from the feed line as shown in Figure 5. Stub is used to match its

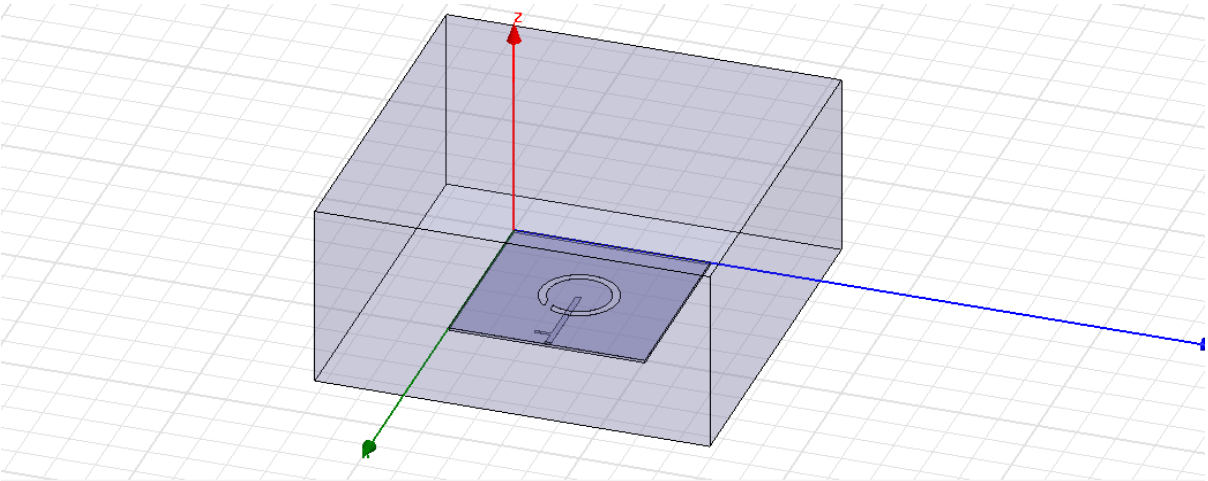

Figure 5. Reconfigured antenna with short at 45 deg

Reconfigured Antenna Configuration

- Rogers RT/duroid 5880(tm).Substrate 50×50 mm^2
- Ring slot 2mm thickness
- Short is placed at 45 deg to the feeding line of 2mm.
- Microstrip feed
- Lumped port used.

The reconfigured antenna is simulated and the result is shown in Figure 6. The reconfigured antenna is resonating at 2.4 GHz and having return loss of -17 dB.

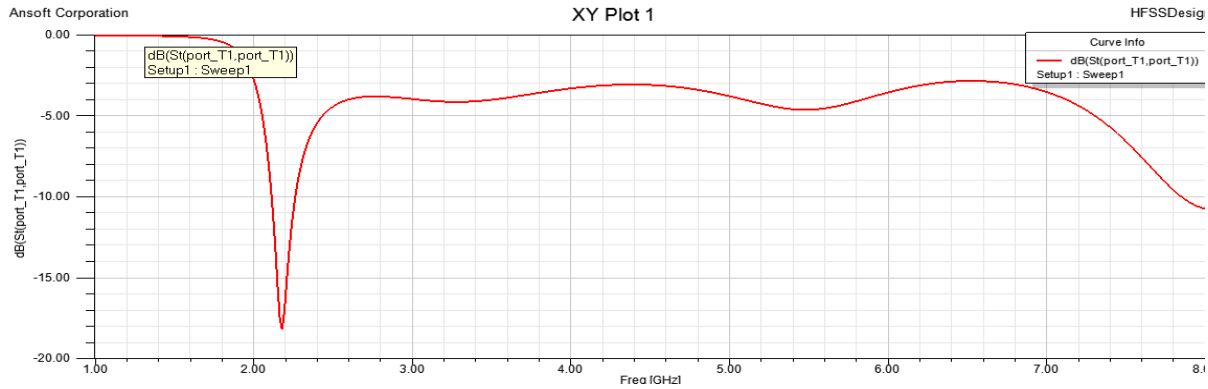

Figure 6. Reflection Coefficient of Reconfigured Antenna

In reconfigured antenna, the gain is stimulated and the result is shown in Figure 7. The simulated gain is 4 dB and at 2.4 GHz.

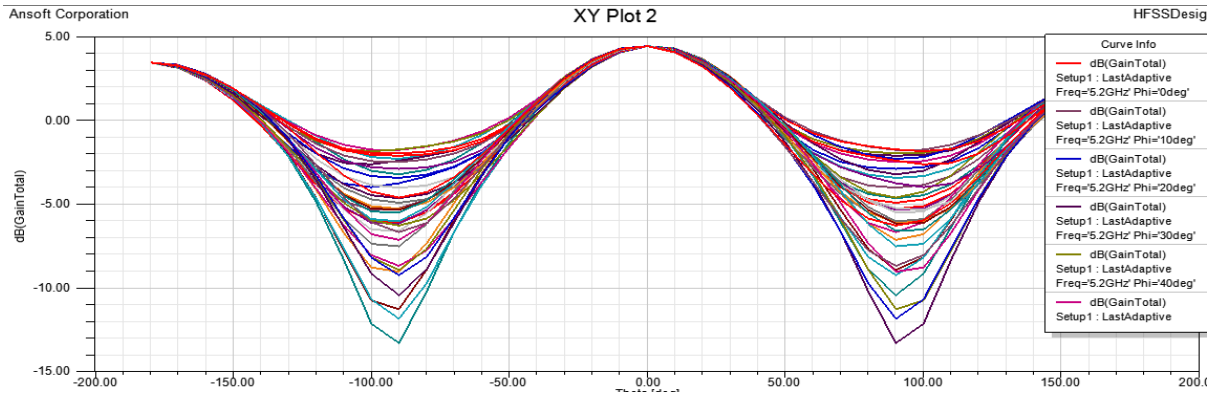

Figure 7. Simulated gain of Reconfigured Antenna

Radiation pattern of reconfigured antenna at resonant frequency 2.4 GHz is shown in Figure 8 and the gain of antenna is 4 dB.

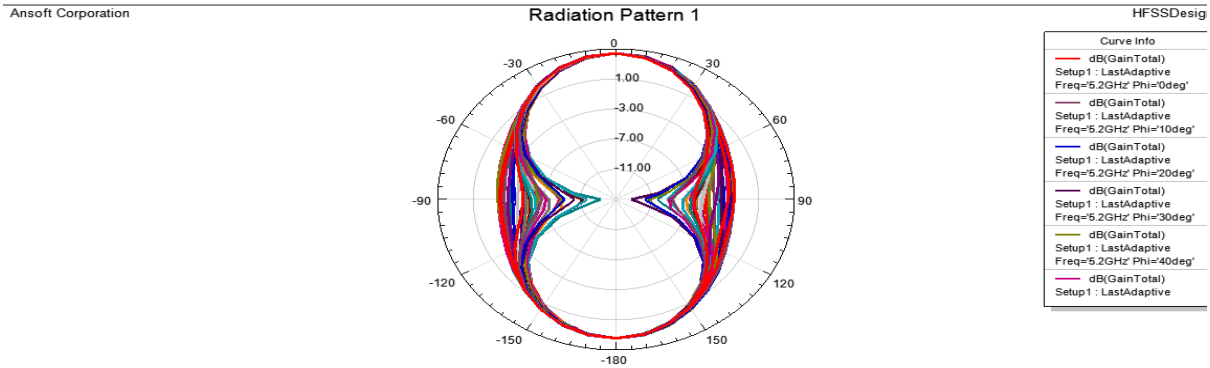

Figure 8. Radiation pattern of Reconfigured Antenna

Table : Parametric Performance of Reconfigured Antenna

Parameters	Reference Antenna	Reconfigured Antenna
Resonating Frequency	6.4 GHz	2.4 GHz
Return Loss	-18 dB	-17 dB
Gain	6 dB	4 dB

5. CONCLUSION

In today's wireless scenario, the need of multifunctional antenna has been increased, so we require reconfigurable antenna. In this paper, we have designed two antennas, a reference antenna and a reconfigured antenna . The reference antenna has a resonant frequency of 6.4 GHz, return loss of -17 dB, and gain of 4dB. A reconfigured antenna has a resonant frequency of 2.4 GHz, return loss of -18db, and gain of 6db. The size of the antenna after reconfiguration has been reduced. Reference antenna has broadcast applications like satellite communication, radar weather system and in some cordless system. Reconfigured antenna has mobile application like Bluetooth and some WiFi applications also.

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