Communications on Applied Electronics (CAE) – ISSN : 2394-4714
Foundation of Computer Science FCS, New York, USA
Volume 6 – No.6, January 2017 – www.caeaccess.org

A Wideband Microstrip Rectangular Patch Antenna for Cognitive Radio Applications

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ABSTRACT
A wideband Microstrip patch antenna consists of metallic patch and ground between which is a dielectric medium called the substrate. Microstrip patch antennas are used for communication purposes especially in Cognitive Radio applications. In this paper a simple Microstrip patch antenna is designed Using CST Microwave Studio for a Range from 1.1GHz to 3.1GHz

General Terms
Wireless application, Cognitive Radio application

Keywords
Wideband, VSWR, Radiation pattern, Beamwidth, directivity, gain

1. INTRODUCTION
Microsrtip antennas are used for number of wireless applications such as WLAN [1][2], Wi-Fi[3], Bluetooth [4] and many other applications. A simple microstrip patch antenna consists of a conducting patch and ground plane between them is a dielectric medium called the substrate having a particular value of dielectric constant. The dimensions of a patch are smaller as compared to the substrate and ground. Dimensions of a microstrip patch antenna depend on the resonant frequency and value of the dielectric constant figure 1.

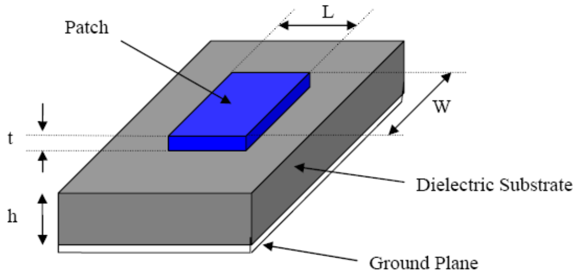

Figure 1 Structure of Micro Strip Antenna

2. DESIGN PARAMETERS
For designing of a microstrip patch antenna, we have to select the resonant frequency and a dielectric medium for which antenna is to be designed. The parameters to be calculated are as under. Width (W): The width of the patch is calculated using the following equation [5][3][6].

$$W = \frac{C_0}{2f_r}\sqrt{\frac{2}{\varepsilon_r + 1}} \qquad (1)$$

Where,

W = Width of the patch

C_0= Speed of light

ε_r = value of the dielectric substrate

Effective refractive index:

The effective refractive index value of a patch is an important parameter in the designing procedure of a microstrip patch antenna. The radiations traveling from the patch towards the ground pass through air and some through the substrate (called as fringing). Bath the air and the substrates have different dielectric values, therefore in order to account this we find the value of effective dielectric constant. The value of the effective dielectric constant (ε_{reff}) is calculated using the following equation [5][3][6]: possible.

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-1/2}, \; W/h > 1 \qquad (2)$$

Length:

Due to fringing, electrically the size of the antenna is increased by an amount of (ΔL). Therefore, the actual increase in length (ΔL) of the patch is to be calculated using the following equation [5][3][6]:

$$\frac{\Delta L}{h} = 0.412\frac{\left(\varepsilon_{reff} + 0.3\right)\left(\frac{W}{h} + 0.264\right)}{\left(\varepsilon_{reff} - 0.258\right)\left(\frac{W}{h} + 0.8\right)} \qquad (3)$$

Where 'h'= height of the substrate

The length (L) of the patch is now to be calculated using the below mentioned equation [5][3][6]:

$$L = \frac{C_0}{2f_r\sqrt{\varepsilon_{reff}}} - 2\Delta L \qquad (4)$$

Length (Lg) and widtg (Wg) of ground plane: Now the dimensions of a patch are known. The length and width of a substrate is equal to that of the ground plane. The length of a ground plane (Lg) and the width of a ground plane (Wg) are

Calculated using the following Equation [7]:

$$L_g = 6h + L \quad (5)$$

$$W_g = 6h + W \quad (6)$$

For feeding the microstrip patch antenna, there are different methods for example, feed line method, coaxial probe feeding method etc. But mostly coaxial probe method is used.

3. Proposed antenna design

Using the equations mentioned above, a Rectangular microstrip patch antenna is designed to cover the range from 1.1 GHZ to 3.1 GHZ. The length width (W) and length (L) of the patch is found to be 40 mm and 31 mm respectively. The height of the substrate is 3 mm. for ground plane, the length (Lg) and width (Wg) of the ground plane is calculated to be 80 mm and 60 mm respectively. The simulation is carried out in CST Microwave Studio software as shown in below figure 2 and figure 3.

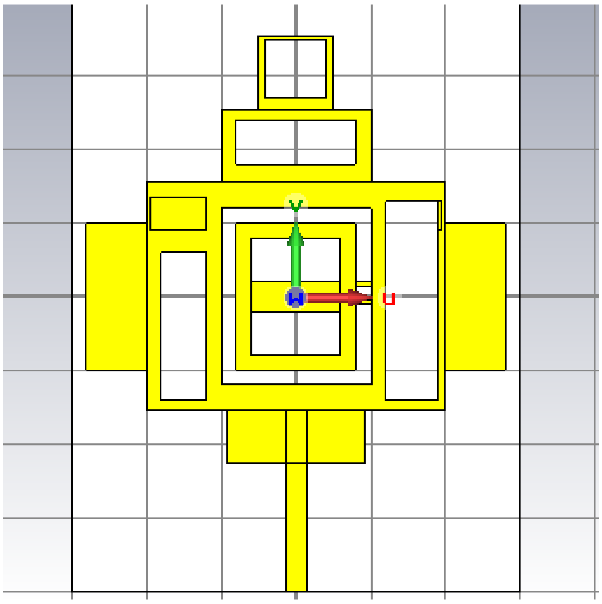

Figure 2 the Antenna Patch

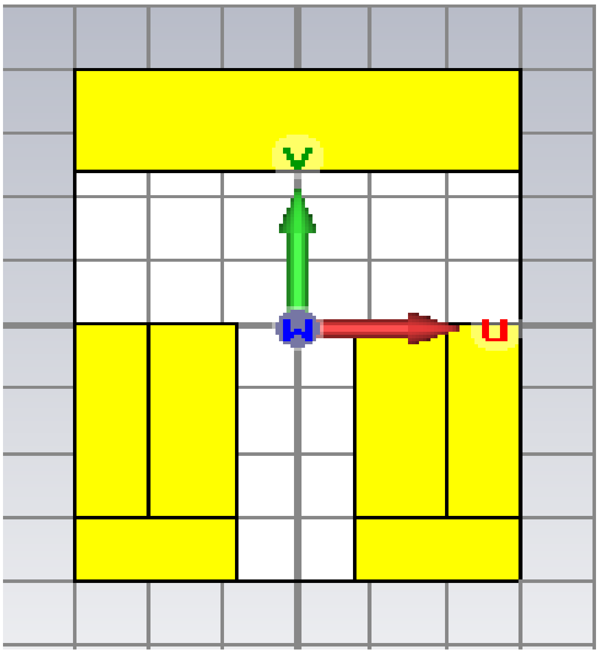

Figure 3 the Antenna Ground Plane

4. SIMULATION & RESULT

The simulated results show that the standing wave ratio (VSWR) is less than 2 figure 4. the Return Loss (S11) is less than -10 dB and the best value of S11 =-31 dB at 1.45 GHz figure 5 . at frequency 2 GHz ,the max power is 3.93 db at 163 deg. and the half power Beamwidth = 73.3 deg. figure 6. The max antenna gain is 5.88 db figure 7.

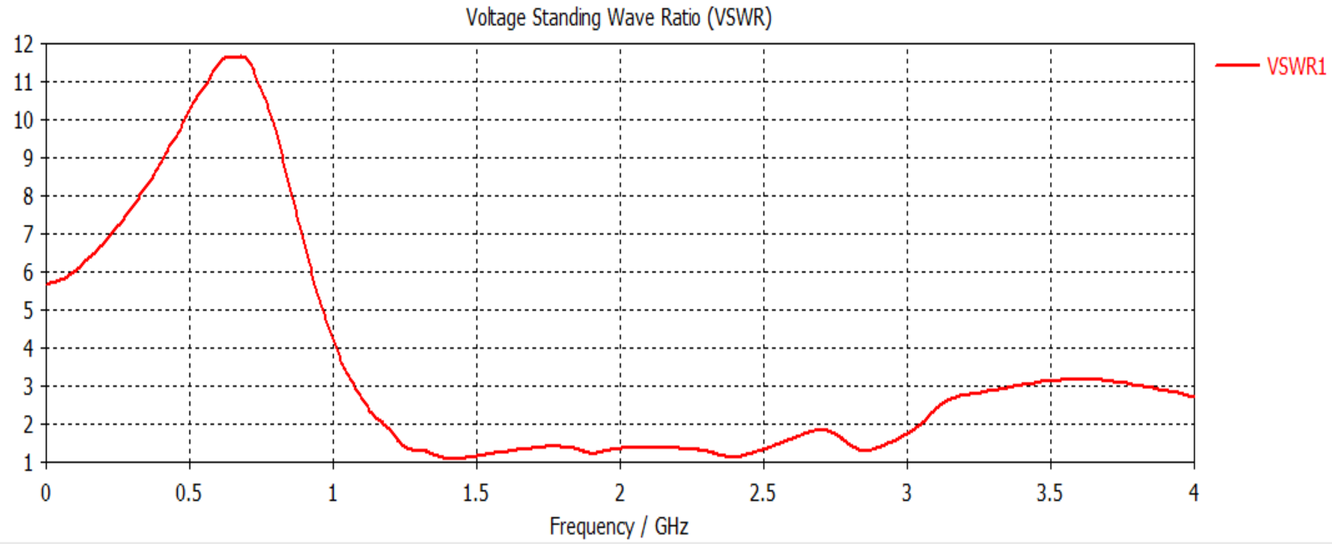

Figure 4 Voltage standing wave Ratio (VSWR) of the proposed antenna

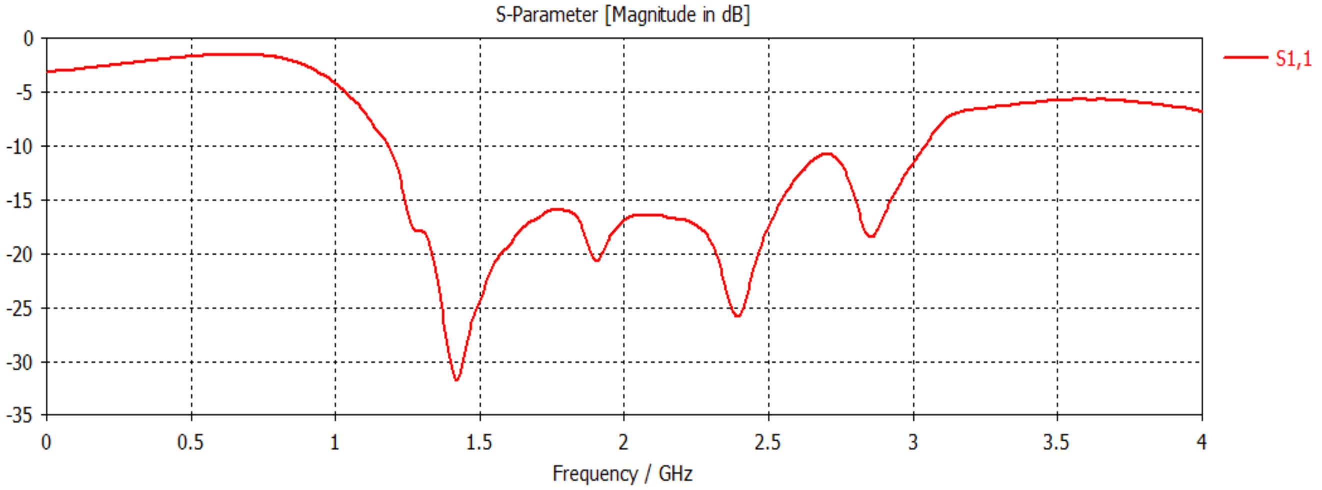

Figure 5 Return Loss (S11) of the proposed antenna

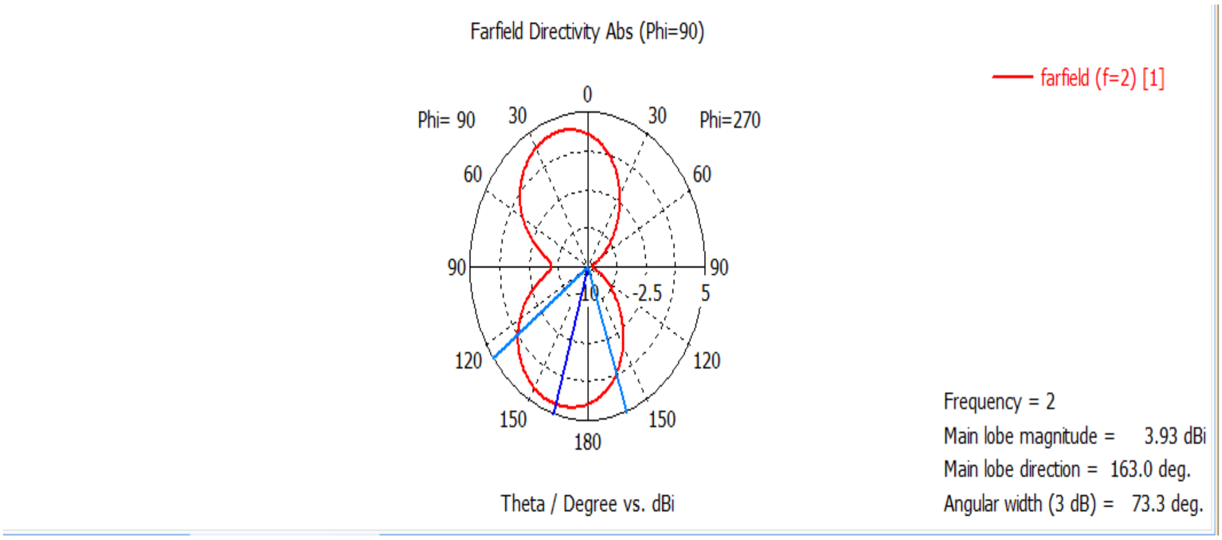

Figure. 6: Polar plot of far field pattern of proposed antenna at frequency 2GHz

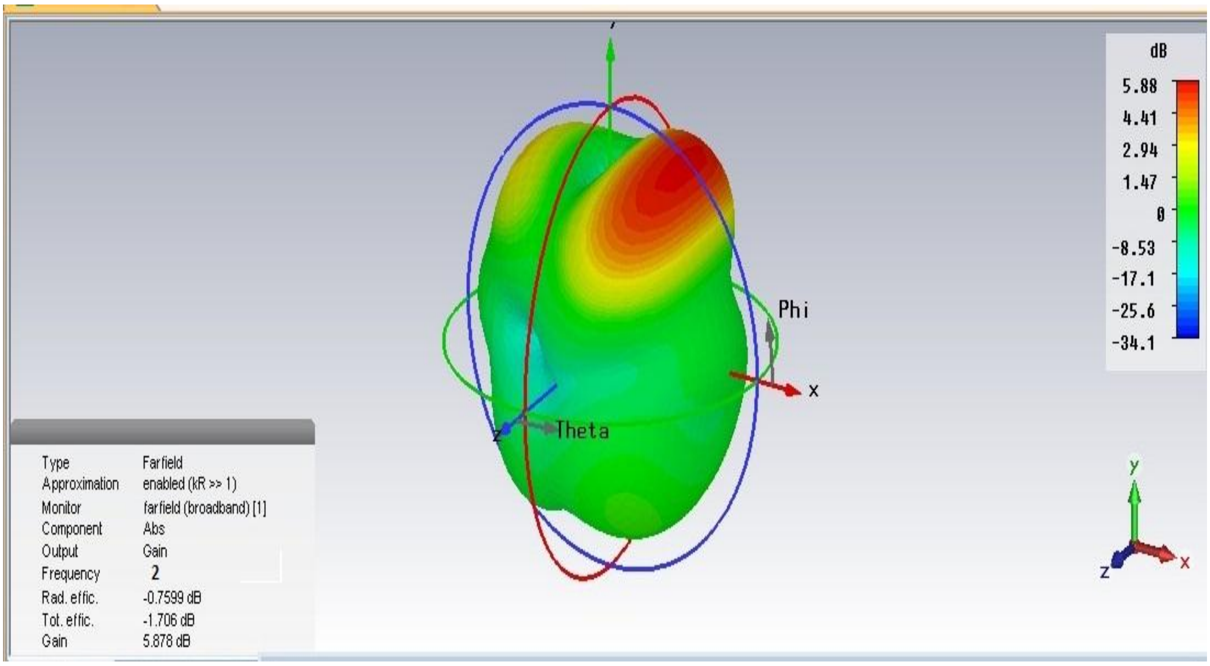

Figure. 7: 3D plot of far field pattern of proposed antenna at frequency 2GHz

5. CONCLUSION

In this paper a microstrip rectangular patch antenna is successfully designed at the range from 1.1 GHz. To 3.1 GHz the antenna simulation shows a gain is 5.88 db, The VSWR of the antenna is less than 2 and the S11 is less than -10 db

6. REFERENCES

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