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A Dual Band- Notched Rectangular Patch Antenna with E and H- Slots

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Abstract: **- In The designed antenna is consisting of E and H-slots which is cut inside the radiating rectangular patch and the patch is mounted on the RogerRT5880 substrate. Designing of antenna is done in such a way that it will resonate at two different frequencies i.e., 5.559GHz (4.922- 6.1958GHz) and 14.3855GHz (13.008- 15.717GHz) that is why it is also called a dual band antenna. This antenna is compact in size having dimension 18*19mm2 with patch dimension 10*12mm2. At these resonant frequencies the antenna has Voltage Standing Wave Ratio (VSWR) less than 2 and less than -10dB return loss. The configured antenna is used in WLAN/ WiMAX/ C-band/ Ku- band wireless applications.**

Key Words: Slots, Rectangular patch, Dual band, Return loss, Gain.

1. INTRODUCTION

As the demand of wireless communication increases, it also increases the demand of compact sized antenna because without antenna communication is not possible [1]. Therefore, the demand of multifunctional- small sized antenna increases. For this requirement Microstrip Patch Antenna is a good candidate because it has small size, work at high frequency, simple design and easy to fabricate [2].

WLAN (Wireless Local Area Network)- 802.11 devote five discrepant frequency ranges for WLAN i.e.,5.6GHz, 5GHz, 4.9GHz, 3.6GHz and 2.4GHz [3]. WLAN networking is used in all industries, hospitals, retailer shops, banks etc..C- band [4]- The frequency range for this band is 4-8GHz and is used in many satellite communication transmissions, some WIFI devices/ cordless phones as well as in some surveillance and weather radar system. Mostly communication satellite uses 5.525 to 6.425GHz as its uplink frequency. C-band also include the 5.8GHz (5.725-5.875GHz) ISM band for medical and industrial application and in many unlicensed short-range microwave communication systems [5]. Presently it uses 3.4-3.69GHz, 2.5-2.69GHz and 5.25-5.85GHz ranges as licensed frequencies. Ku- band- it has frequency range of 12.5-18GHz. This band is used in Fixed Satellite Service (FSS), terrestrial earth exploration [7], military radars, mobile stations [8], radio navigation etc. Ku band is mostly used in radars.

In this paper, the proposed antenna will consist of E and H- slots which is cut on the radiating rectangular patch. With the help of these slots, we should achieve the optimized outputs like large bandwidth and significant gain.

2. Antenna Configuration

The radiating copper (lossy) patch is imposed on one side of the substrate with 50Ω impedance feed line while half ground is printed on the reverse side of the substrate. The substrate we used here are made up of RogerRT5880 (lossy) material with height 1.6, with 0.0009 as loss tangent and the dielectric constant of the material is 2.2. The length- represented by 'X' and width is represented by 'Y' in the front and back view of antenna as shown in Figure 1 and 2. The height of the copper patch, feed line and ground is 0.035mm.

Table 1 Demonstrate the dimensions of the antenna.

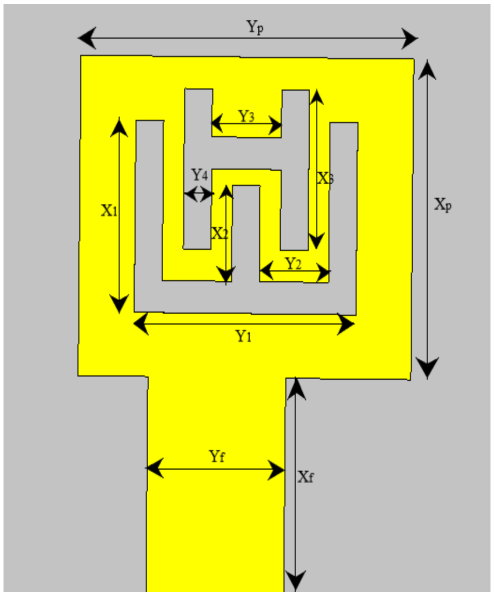

Figure1: Front View

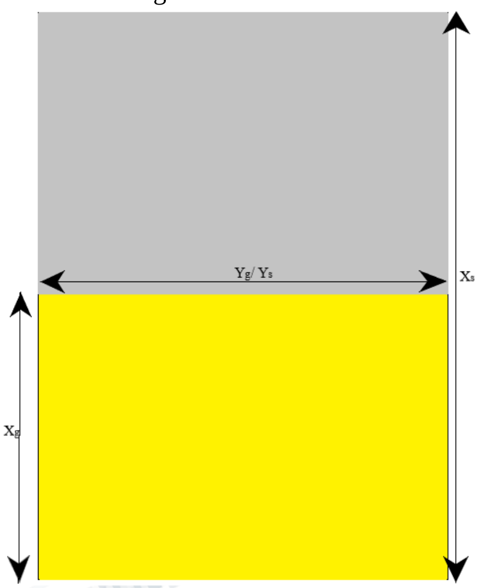

Figure 2: Back View

iParameters	Variables	iDimensions (mm)
Patch and slots	X_p Y_p X_1 iX_2 X_3 X_4 iY_1 Y_2 Y_3	10 12 5 3 5 1 8 2.5 2.5
Feed line	X_f Y_f	7 4.971
Roger RT5880 Substrate	Xs Ys	19 18
Ground	Xg Yg	8 18

Table 1: Dimensions of Antenna

3. Results

3.1 Return Loss (S- parameter):

During the designing of antenna return loss is one of the most important parameter. Good return loss means that antenna has more power as well it cannot radiate RF energy. The S-parameter of the antenna should be less than -10. The antenna will resonate at two different frequencies i.e., 5.559GHz (4.9222- 6.1958GHz) and 14.3855GHz (13.008-15.767GHz) and bandwidth is 1.27GHz and 2.759GHz respectively with reference to -10dB line. The S-parameter at first frequency is -18dB and -26dB at other resonant frequency. Fig. 3 demonstrates the S-11 characteristic of the designed antenna. If S-11 is zero these means no power is reflected from antenna and also cannot radiate.

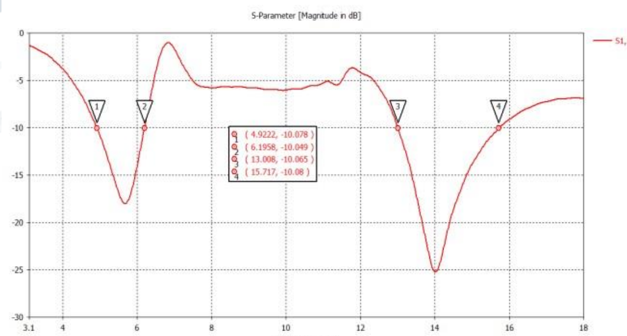

Figure 3: Gain Plot

3.2 VSWR Plot-

One of the most important parameter to know how well the antenna impedance is matched with the radio and transmission line which it is connected. VSWR stands for voltage standing ratio and it is also a non linear function of reflection coefficient. For a good antenna designing VSWR must be kept less than 2. If we talk about the VSWR one cannot forget about the Bandwidth which is defined in terms of VSWR. Reflection from the antenna must be reduced if the value of VSWR is small. VSWR characteristic of the configured antenna is seen in figure 4.

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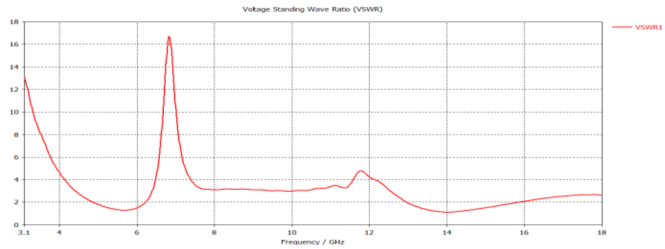
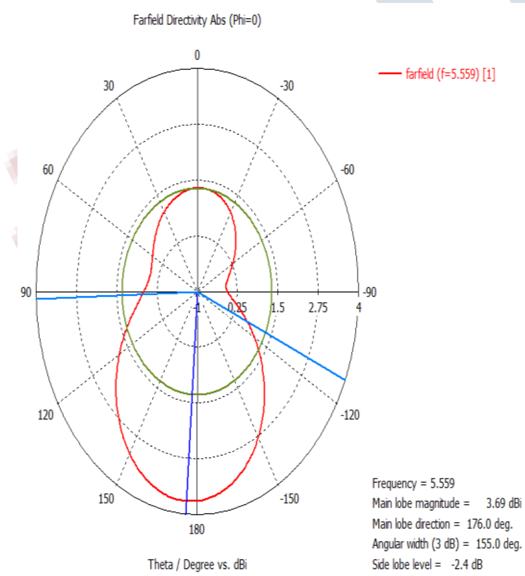


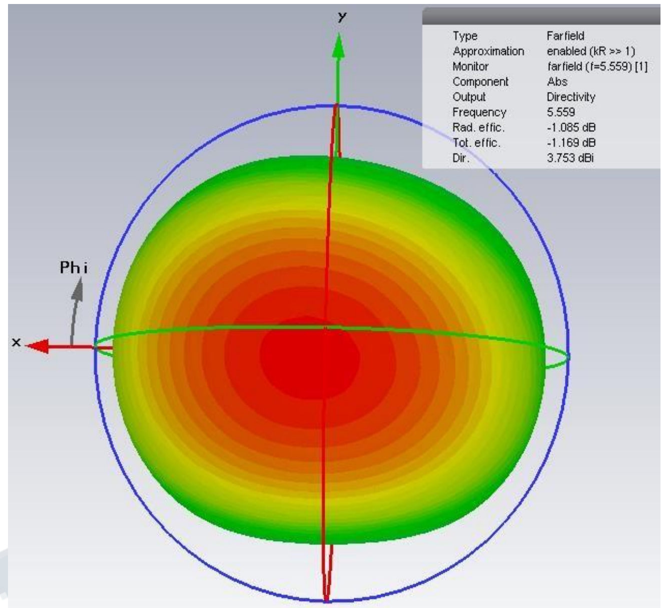
Figure 4: VSWR

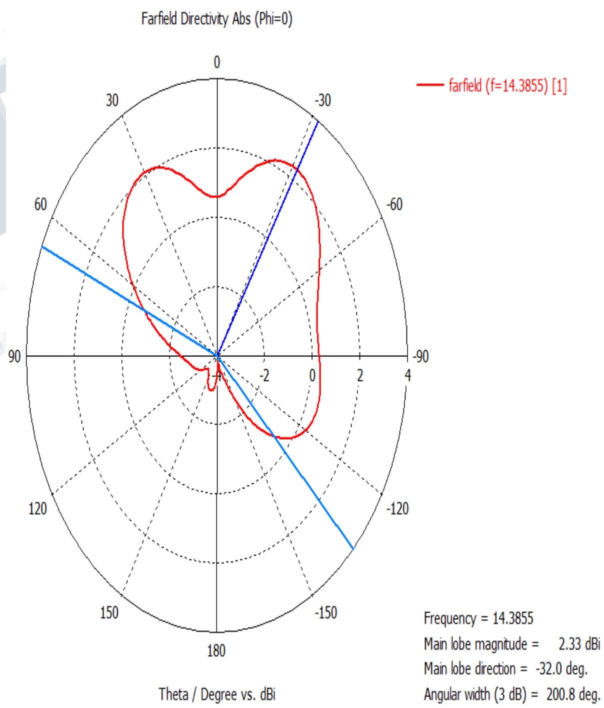
3.3 Radiation Pattern-

Radiation Pattern shows the spatial distribution of electromagnetic field radiate by an antenna. The radiation Pattern at each resonant frequency is directional. When in one direction more power is radiated in collation with other direction the pattern we achieved is Directional Pattern. So here for the designed configuration of antenna it is observed that the far field pattern at the first resonant frequency is directional with minor side lobes and the directivity is 3.753 db. Similarly, at second resonant band radiation pattern is directional with 2.33 db. Main lobe and side lobe are also present and the directivity is quite high at this resonant frequency i.e. 5.025 db. This is shown in figure 5(a) and (b) which shows radiation pattern at 5.5559GHz and 14.3855GHz resonant frequencies.



(a)





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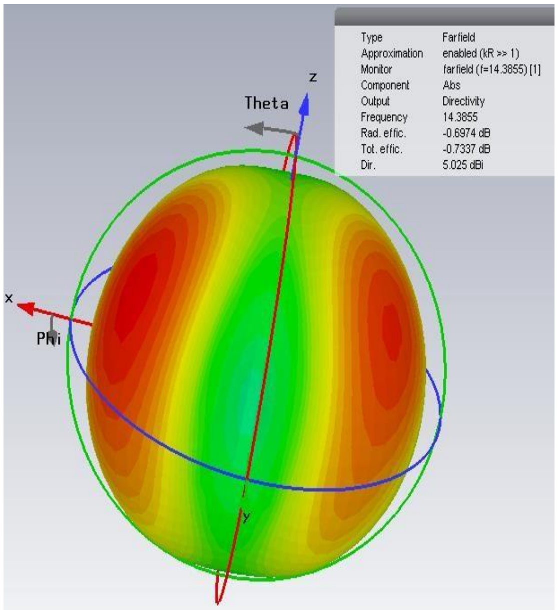

(b)

Figure 5: Radiation Pattern at (a) 5.559GHz and (b) 14.3855GHz frequencies

3.4 Gain-

Gain of the antenna measures how much better the antenna is in some direction than an isotropic antenna (i.e., radiation is same in all direction).The gain of the antenna at first resonant frequency band (4.9222- 6.1958GHz) is between 2.9- 3.2dB and gain at second resonant frequency band (13.008- 15.767GHz) is between 2.8- 5.7dB. The gain of the antenna at these two frequencies is high and is shown in figure 6.Gain of an antenna should be high because it represents the efficiency of the antenna which means if the gain increases the efficiency of antenna also increases.

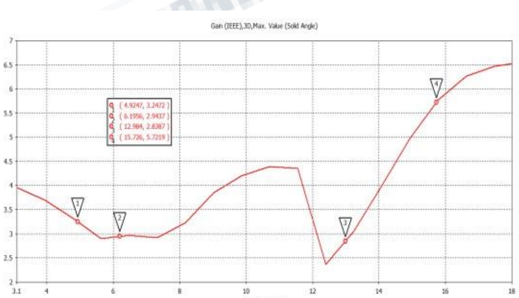

Figure 6: Gain Plot

4. Conclusion

The designed antenna is resonating at two different frequency band i.e. 4.9222- 6.1958GHz and 13.008- 15.767GHz with bandwidth of 1.27GHz and 2.759GHz. The condition like return loss less than -10 and VSWR less than 2 is satisfied by the configurated antenna with high gain. The designed antenna has many applications like WiMAX/ WLAN/ C-band/ Ku-band wireless applications.

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