Microstrip Rectangular Patch Antenna for 1.98GHz Wireless Applications

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Abstract: ***Antenna is very important in the field of wireless communication. An Antenna is a transducer that transmits electromagnetic waves. A small Microstrip patch antenna is introduced. An antenna is designed to function in 1.98 GHz frequency wireless Application. It achieves return loss less than -10 dB by using Rogers RT/Duroid substrate under the Patch .The antenna has many practical applications in wireless communication. The patch design is simulated in Ansoft HFSS11 software. The result showed satisfactory performance.***

Keywords: Microstrip patch antenna, Ansoft hfss, Return Loss, VSWR

1. Introduction

Antenna is very useful for mobile communication and in many systems, it is important to design broadband antennas to cover a wide frequency range. The design of an efficient wide band small size antenna for recent wireless applications is a major challenge. Microstrip patch antennas have extensive application in wireless communication system with their advantages such as low profile, conformability, low-cost fabrication and ease of Integration with feed networks.

There are several and well-known methods to increase the bandwidth of antennas, including increase of the substrate thickness, the use of a low dielectric substrate, the use of various impedance matching and feeding techniques, the use of multiple resonators, and the use of slot antenna geometry. However, the bandwidth and the size of an antenna are related to each other properties, that is, improvement in one of the characteristics normally results in degradation of the other. Several techniques have been used to enhance the bandwidth.

2. Antenna Design

The basic structure of the proposed antenna, shown in Fig.1, consists of 3 layers. The lower layer, which constitutes the ground plane, covers the partial rectangular shaped substrate with a side of 62*62 mm. The middle substrate, which is made of Rogers RT/Duroid, has a relative dielectric constant ϵr =2.2 and height 3.2mm. The upper layer, which is the patch, covers the rectangular top surface. The rectangular patch has sides 49*58 mm that covers the middle portion of the substrate. Simulations were performed using HFSS.

Step 1: Calculation of the Width (W)
The width of the Microstrip patch antenna is given as:

$$W = \frac{c}{2 fo\sqrt{\frac{\epsilon_r + 1}{2}}}$$

Where *C* is velocity of light, *f0* is Resonant Frequency & *εr* is Relative Dielectric Constant of Substrate. In this equation c =3.0×10^8 m/s, ϵr =2.2 and *f0* = 1.98GHz, by substituting all this value we get width of patch. From this equation we get the patch width i.e *W*=58mm.

Step 2: Calculating the Length (L)

Effective dielectric constant (ε*re*)
Once we got a W, the next step is the calculation of the length which involves several other computations; the first would be the effective dielectric constant. The dielectric constant of the substrate is much greater than the unity; the effective value of ε*re* will be closer to the value of the actual dielectric constant εr of the substrate. The effective dielectric constant is also a function of frequency. As the frequency of operation increases the effective dielectric constant approaches the value of the dielectric constant of the substrate is given by:

$$\varepsilon_{re} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-1/2}$$

Here we get ε*re* =2.2

Effective length (L*eff*)

In our design for the above mentioned values the effective Length is found to be L*eff*=51mm.

$$L_{eff} = \frac{c}{2 f_0 \sqrt{\varepsilon_{re}}}$$

Length Extension (ΔL)

Length Extension (ΔL), which is a function of the effective dielectric Constant and the width-to-height ratio (W/h).The length extension are:

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

Substituting εre, Width of patch i.e. W and h we get ΔL=0.713mm.

Calculation of actual length of patch (L)

The length is a critical parameter and the above equations are used to obtain an accurate value for the patch length L.

The actual length is obtained by:

$$L_{eff} = L + 2\,\Delta L$$

Here by substituting the value of ΔL and L*eff we get* L=49.57mm

3. Geometry of Proposed Antenna

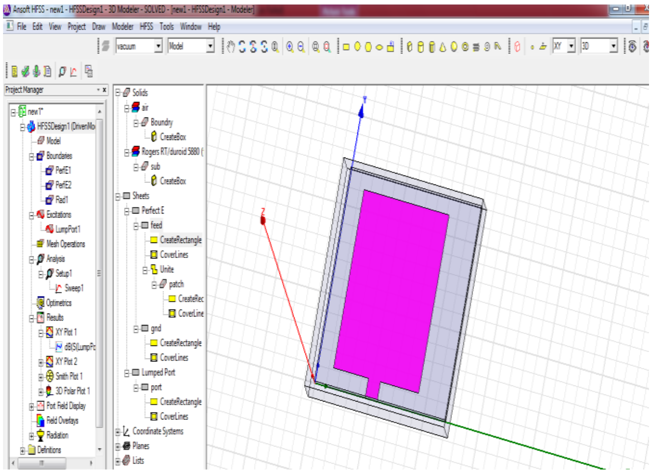

Figure 1: Geometry of Proposed Antenna

4. Result and Conclusion

S parameter

S parameter is the graph of S11 parameter vs Frequency, In S parameter we check the return losses. Here I get return loss which is less than -10db.

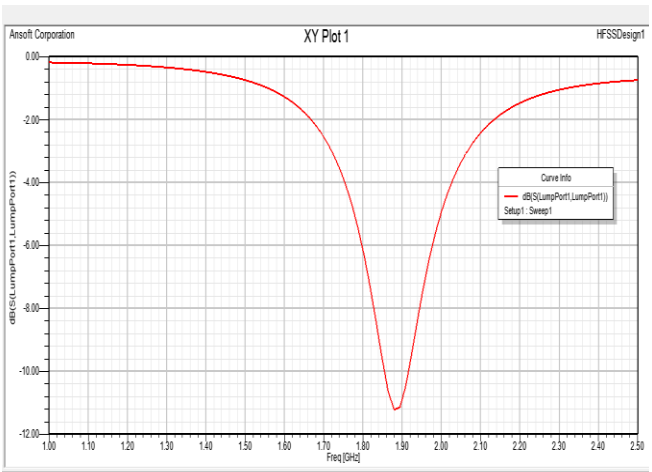

Figure 2: S11 Parameter vs. Frequency plot

VSWR (Voltage Standing Wave Ratio)

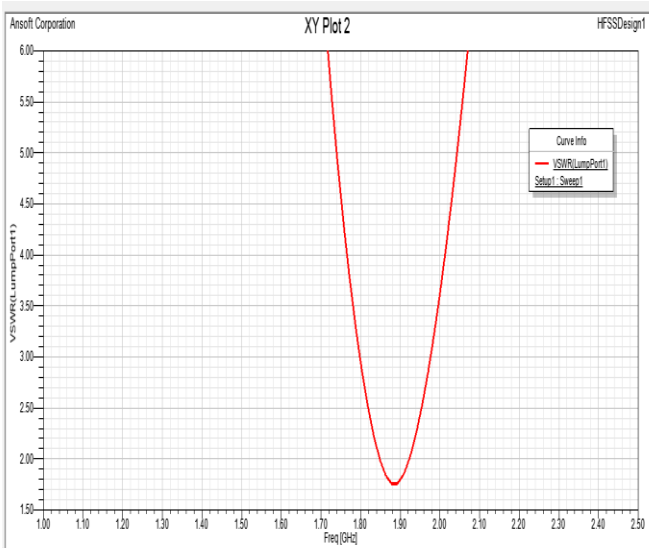

Figure 1: VSWR vs. Frequency plot

The Idle value for VSWR is 1 Means there is no reflection so here I got value of VSWR is 1.7 so here is small reflection of waves from load to generator.

5. Smith Chart

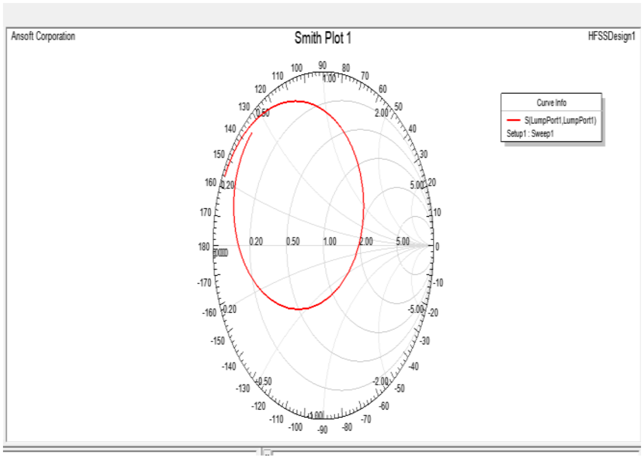

Figure 4: Smith Chart

6. Radiation Pattern:

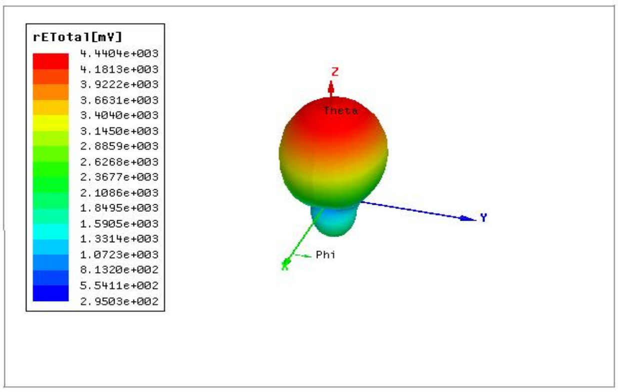

Figure 4: Radiation Pattern

7. Conclusion

Rectangular patch antenna at 1.98GHz with -12 dB return loss is designed on Ansoft HFSS. Also got the VSWR which is less than 2 is achieved. The designed antenna is suitable for Wireless application.

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