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Comparative Study of Micro strip Patch Antenna For Microstrip Feed Line and FR4 and RT Duroid Substrate

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ABSTRACT: This paper describes microstrip feeding technique for FR4 and RT Duroid substrate applicable to Micro strip patch antenna that is one of the very important aspects. A nice impedance matching required between the line and patch without nothing additional comparing elements depends on feeding techniques used and substrate used. After analysis Microstrip feed technique for FR4 and RT Duroid substrate, this paper gives a better understanding of the design parameters of an antenna and their effect on Impedance, VSWR, bandwidth and gain. Finally, simulation is done using design software HFSS.

KEYWORDS: Substrate, VSWR, HFSS, Impedance

I. INTRODUCTION

Microstrip patch antennas consists so many advantages such very low profile, simple to construct and not complicate to mounting hosts as size, bandwidth enhancement and return loss minimization and impedance matching required. Also consider for actual applications of microstrip antennas. The minimum size construction and suitability for integration for microwave integrated circuits are of their advantages. comparison between Microstrip feeding techniques for FR4 and RT Duroid substrate has been done. After that microstrip patch antenna at specific frequency i.e. 2.40 GHz has been designed also simulated done on the design software HFSS.

II. MICROSTRIP FEED

The Microstrip feed is a regular or most demanded technique taken for feeding Microstrip patch antennas. The deep inner conductor for the coaxial connector extends through the dielectric and is soldered to the radiating patch; the external outer conductor is grounded. The main benefit of this type of Microstrip feeding technique is that the feed can be placed at any desired location inside the patch to perfect match with its input impedance. Also, the main disadvantage is that it provides narrow bandwidth and is difficult to model since a hole has to be drilled in the substrate and the connector protrudes outside the ground plane, thus not making it completely planar for thick substrates.

III. MICROSTRIP PATCH ANTENNA

Microstrip antenna consists narrow conducting patch which is built on a ground plane separated by dielectric substrate like RT Duroid etc. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. The conducting patch, theoretically, can be possible to design of any shape, In general rectangular and circular configurations are the most commonly used [1, 5]. The patch is generally made of good conducting material copper or gold and that can be any possible shape [1]. Some of the other configurations used are complex to analyze and require large numerical computations. In its most fundamental form, a microstrip patch antenna consist of a radiating patch on one side of a dielectric substrate which has ground plane on the other side [1] is illustrated in fig 1.

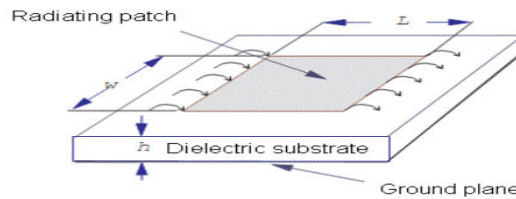


Fig.1 Structure of Microstrip Patch Antenna

IV.SUBTRARE

For Microstrip patch antenna consists the patch which is mounted on the material that material is known as substrate which having the dielectric constant and loss tangent. The Four materials are used to design the Microstrip patch antenna for comparison of parameter.

- a) FR4
- b) RT Duriod

V. DESIGN CONSIDERATIONS

Microstrip patch antenna consists of very thin metallic strip (patch) placed on ground plane where the thickness of the metallic strip is restricted by $t \ll \lambda_0$ and the height is restricted by $0.0003\lambda_0 \leq h \leq .05\lambda_0$. The Microstrip patch is designed so that its radiation pattern maximum is normal to the patch. For a rectangular patch, the length L of the element is usually $\lambda_0 / 3 < L < \lambda_0 / 2$ [1, 6].

VI PROCEDURE FOR MICROSTRIP PATCH ANTENNA

The Performance of the microstrip patch antenna depends on its resonant frequency, dimension. Depending on the dimension, the operating frequency, radiation efficiency, directivity, return loss are influenced. For an efficient radiation, Calculation of Geometrical Dimensions For the calculation of geometrical dimensions of the microstrip patch the fact that the electrical dimensions are larger than geometrical dimensions should be taken into consideration. This is caused by the existence of fringing field beyond the limit, given by the geometrical dimensions of the microstrip patch.

- (a) Calculated patch width

$$W = \frac{c}{2f_0} \sqrt{\frac{2}{\epsilon_r + 1}} \quad (1)$$

- (b) Calculated effective dielectric constant

$$\epsilon_{reff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2} \left[1 + 12 \frac{h}{W} \right]^{-1/2} \quad (2)$$

- (c) Calculated the extended incremental length ‘ ΔL ’ of the patch due to fringing effect

$$\Delta L = 0.412h \frac{(\epsilon_{reff} + 0.3) \left[\frac{W}{h} + 0.264 \right]}{(\epsilon_{reff} + 0.258) \left[\frac{W}{h} + 0.8 \right]} \quad (3)$$

- (d) Calculated the patch effective length Leff

$$L_{eff} = \frac{c}{2f_0 \sqrt{\epsilon_{reff}}} \quad (4)$$

- (e) Calculated the patch actual length

$$L = L_{eff} - 2\Delta L \quad (5)$$

(f) Calculated Wavelength

$$\lambda_0 = \frac{c}{f_0} \tag{6}$$

(g) Calculation of the ground plane dimensions for single patch (Lg and Wg):

$$L_g = 6h+L \text{ and } W_g = 6h+W \tag{7}$$

FR4 as the substrate with dielectric constant of 4.4. The rest of the basic parameters are: Resonant Frequency: $f_0 = 2.4$ GHz, Substrate Permittivity: $\epsilon_r = 4.4$ (FR4), Substrate Thickness: $h = 1.6$ mm, Loss tangent: $\tan \delta = 0.002$

RT Duroid as the substrate with dielectric constant of 2.2. The rest of the basic parameters are: Resonant Frequency: $f_0 = 2.4$ GHz, Substrate Permittivity: $\epsilon_r = 2.2$ (RT Duroid), Substrate Thickness: $h = 1.6$ mm, Loss tangent: $\tan \delta = 0.0009$ from this calculation Microstrip patch antenna design in hfss software for two feed line and four substrate.

VII. DESIGNING

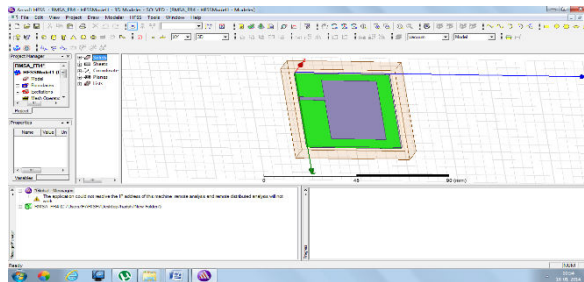


Figure 2: RMSA Design of Rogers FR4 Microstrip feed

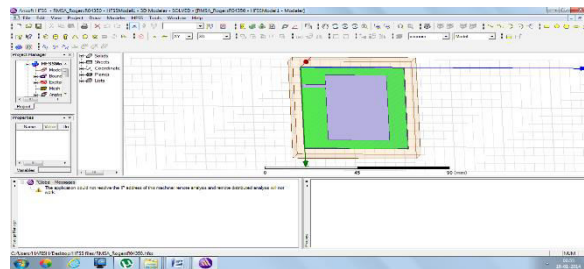


Figure 3: RMSA Design of RT Duroid Microstrip feed

VIII.SIMULATION RESULT

VIII.I Microstrip Feeding Result

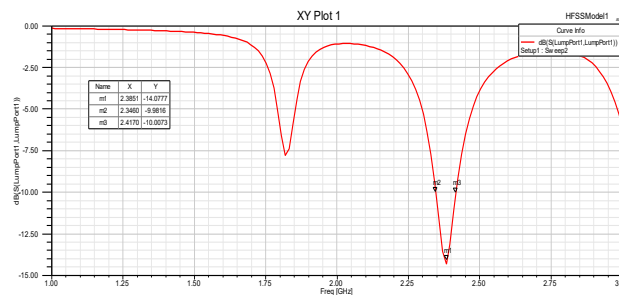


Figure 4: S11 graph of RMSA FR4

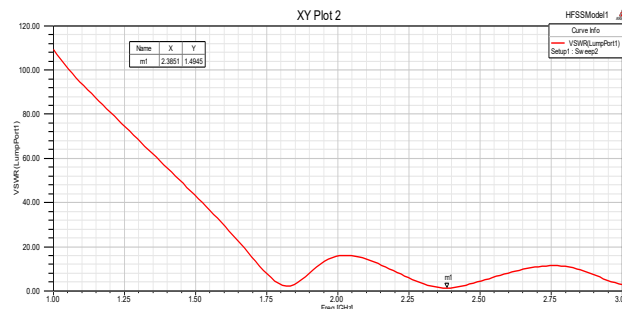


Figure 5: VSWR Graph of FR4

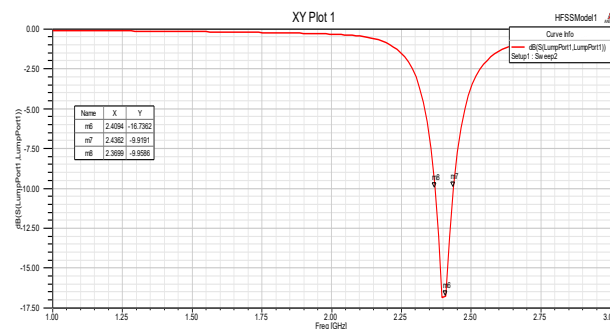


Figure 6: S11 graph of RMSA RT Duroid

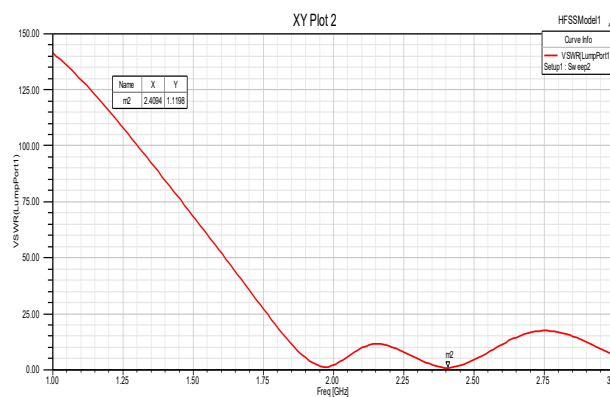


Figure 7: VSWR Graph of RT Duroid

VIII.II Result of Microstrip Feed for FR4 and RT duroid Substrates at 2.4GHz frequency.

Substrate	Resonant Freq(s) [GHz]	VS WR	BW (MHz)	Gain (dB)	Impedance R+jX
FR4_epoxy	2.40	1.631	71	0.33 0	32.75+j9.54
RT Duroid 5880	2.40	1.198	73.5	3.32 3	44.79+j1.258

IX.CONCLUSION

Rogers RT Duroid 5880 is the best among the 2 substrates chosen as it has lowest loss tangent Rogers RT Duroid 5880 gives best result in comparison to all the 2 substrates with co-axial Microstrip feed. Microstrip/Co-axial feed is a better match is achieved resulting in better BW and gain.



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