



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 2, February 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512

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Comparative Study of Micro strip Patch Antenna For Probe Feed Line and Rogers R04350 and Taconic TLE Substrate

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ABSTRACT: This paper describes probe/coaxial feeding technique for Rogers R04350 and Taconic TLE 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 Probe feed technique for Rogers R04350 and Taconic TLE 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: Bandwidth, 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 probe feeding techniques for Rogers R04350 and Taconic TLE 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. PROBE FEED

The probe 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 probe 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. 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.

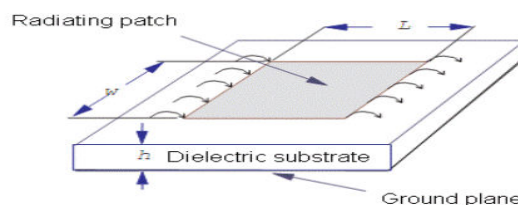


Fig.1 Structure of Microstrip Patch Antenna

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) ROGERS R04350
- b) Taconic TLE

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].

V.I 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

$$W = \frac{c}{2f_0} \sqrt{\frac{2}{\epsilon_r + 1}} \tag{1}$$

- (b) Calculated effective dielectric constant

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

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

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

- (d) Calculated the patch effective length Leff

$$L_{eff} = \frac{c}{2f_0 \sqrt{\epsilon_{reff}}} \tag{4}$$

- (e) Calculated the patch actual length

$$L = L_{eff} - 2\Delta L \tag{5}$$

- (f) Calculated Wavelength

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

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

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

ROGERS RO4350 as the substrate with dielectric constant of 3.66. The rest of the basic parameters are: Resonant Frequency: $f_0 = 2.4$ GHz, Substrate Permittivity: $\epsilon_r = 3.66$ (ROGERS RO4350), Substrate Thickness: $h = 1.6$ mm, Loss tangent: $\tan \delta = 0.004$

TACONIC TLE as the substrate with dielectric constant of 2.95. The rest of the basic parameters are: Resonant Frequency: $f_0 = 2.4$ GHz, Substrate Permittivity: $\epsilon_r = 2.95$ (TACONIC TLE), Substrate Thickness: $h = 1.6$ mm, Loss tangent: $\tan \delta = 0.0028$

VI. DESIGNING

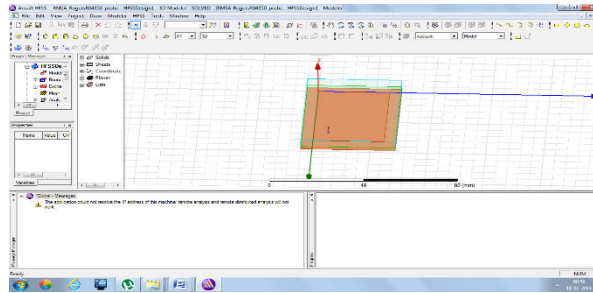


Figure 2: RMSA Design of Rogers R04350 Probe feed

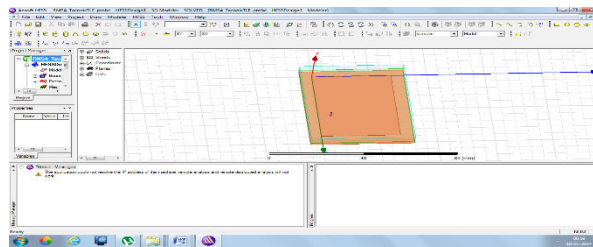


Figure 3: RMSA Design of Taconic TLE Probe feed

VII. SIMULATION RESULT

VII.I Probe Feeding Result

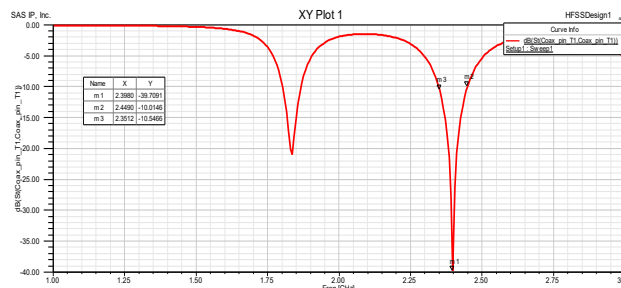


Figure 4: S11 graph of Rogers R04350

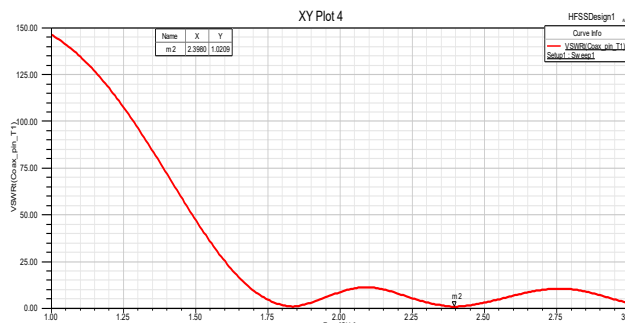


Figure 5: VSWR Graph of RO4350

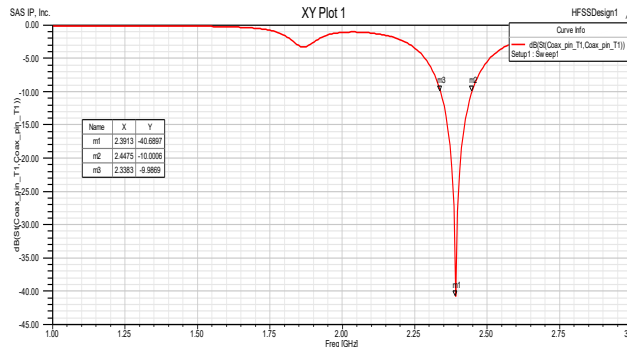


Figure 6: S11 graph of RMSA Taconic R04350

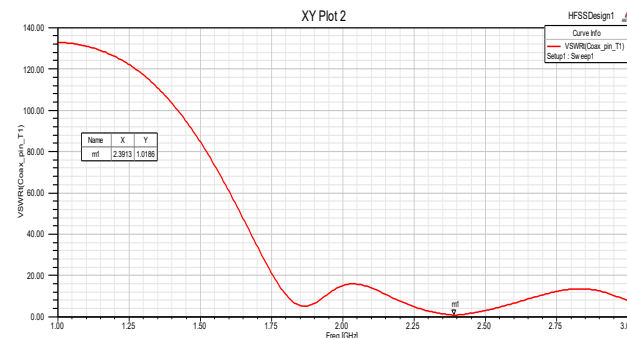


Figure 7: VSWR Graph of Taconic R04350

VIII. RESULT OF PROBE FEED FOR DIFFERENT SUBSTRATES AT 2.4GHZ FREQUENCY.

Substrate	Resonant Freq(s) [GHz]	VS WR	BW (MHz)	Gain (dB)	Impedance R+jX
Rogers RO4350	2.40	1.045	97.8	1.580	49.61-j1.864
Taconic TLE	2.40	1.113	109.2	1.870	46.64-j3.725

IX.CONCLUSION

Taconic TLE is the best among the 2 substrates chosen as it has lowest loss tangent
 Taconic TLE gives best result in comparison to all the 2 substrates with co-axial probe feed.
 Probe/Co-axial feed is a better match is achieved resulting in better BW and gain.

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