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Rectangular Patch Antennas with H-Slot for WLAN and Wi-Max Applications

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Abstract

Antenna plays a vital role in wireless communica-tion. In this paper 2 dual band H-slot rectangular microstrip patch antennas proposed in order to acquire the required parameter responses at reso-nant frequencies 3.65GHz and 5.75GHz, which is a utilization of WLAN and Wi-MAX. These an-tennas operates on (3.6-3.7) and (5.7-5.8) GHz frequency bands. On account of effortlessness and simplicity of examination the rectangular patch is excited by coaxial probe with 50Ω cha-racteristic impedance and the substrate utilized is Roggers RT-Duroid 5880 having a dielectric con-stant 2.2. Variation of substrate thickness effects with respect to dimensional characterization are analyzed for rectangular patch antenna. The an-tenna parameters such as gain, return loss, radia-tion pattern, VSWR are obtained by using HFSS software.

Keywords: *VSWR, Return loss, Radiation pattern, H-slot patch antenna, Wi-MAX.*

I. INTRODUCTION

Antennas are very crucial additives of conversa-tion systems. In the previous couple of years, there was a massive development in the area of satellite television for laptop and wireless con-versation in which antenna is essential. Thus pretty a few research has been going on in each authorities and commercial enterprise commu-nique systems to growth low profile, less high-priced and minimum weight antennas which may be with out trouble fabricated.[6]

These microstrip antennas may be so designed to radiate over a large form of frequencies and may be with out issues analyzed with the to be had superior layout smooth wares. They have emerge as very sizable inside the cell phone market. One of the big makes use of of an antenna is its dual band nature wherein the identical antenna may be

Used to radiate in two one-of-a-kind frequency bands.This thesis tries to layout and examine twin band antennas and their prospects. Nowa-days an entire lot of clean wares had been de-veloped for design and evaluation of microstrip patch antennas out of which HFSS 15.0 software program software has been used to de-sign those antennas.

II. DESIGN PROCEDURE FOR DUAL BAND MICROSTRIP ANTENNA DESIGN

Based at the hollow area version technique, a layout approach is outlined which leads to rea-listic de-signs of rectangular micro strip antennas of the dominant mode TM010. The technique assumes that the specified statistics consists of the dielec-tric constant of the substrate (εr), the resonant frequency (f0) and the height of the substrate (h).

Design Specifications

To design a rectangular patch antenna we want to specify Dielectric constant of the substrate (εr), resonant frequency (f0), peak of the substrate (h). The three vital parameters for the layout of a square micro strip patch antenna:

- Frequency of operation: The rectangular micro strip patch antennas are designed at fre-quency bands of three.6-three.7GHz and 5.7-five.8GHz which might be used as an application for

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WLAN and Wi-MAX. Dielectric con-stant of the substrate: RT DUROID $\varepsilon r = 2.2$

- Height of the substrate taken as: h = 1.6mm, h=3.2mm

Design procedure:

The design tool of unmarried band microstrip patch antenna the usage of square patch is ac-complished little by little is given underneath;

(a) Substrate Selectivity: Selection of suitable substrate of appropriate thickness is the first step inside the format method of any microstrip antenna. Bandwidth and radiation fundamental typical performance boom with substrate thick-ness. The radiation general overall performance of the microstrip antenna is based totally upon in large element at the permittivity of the dielectric. It affects every the width, in turn the cha-racteristic impedance and the duration resulting in an altered resonant fre-quency and reduced transmission overall performance.

(b) Frequency selectivity: The essential cause is to design a essential microstrip antenna with square shaped patch strolling at a selected frequency. Selecting appropriate geometry consistent with the substrate material dielectric ordinary, loss tangent and thickness is essential in this system. When substrate fabric dielectric consistent is low, fringing fields during the patch will increase and therefore the radiated power. Antenna performance will lower with immoderate loss tangent price. Patch width will affect a good deal a whole lot less on resonating frequency and radiation sample, however it affects the bandwidth considerably. Increase in patch width leads to in-crement in bandwidth and radiation performance. The patch width need to be taken greater than patch length without thrilling undesired modes. The patch duration can be calculated using [5][6][8]

Equation no: 1...... $L_{eff} = \dfrac{c}{2 f_r \sqrt{\varepsilon_{reff}}}$

Equation no: 2 $\Delta L = \dfrac{0.412h(\varepsilon_{reff} + 0.3)(\frac{W}{h} + 0.264)}{(\varepsilon_{reff} - 0.258)\left(\frac{W}{h} + 0.8\right)}$

Relative effective permittivity (ε_{re}):

The relative effective permittivity of quarter wave transformer can be determined by

Equation no: 3......... $\varepsilon_{re} = \dfrac{\varepsilon_r + 1}{2} + \dfrac{\varepsilon_r - 1}{2\sqrt{1 + \frac{12h}{W_T}}}$

Where $W_T = W$

Width of the patch (W):

The width of the Rectangular microstrip antenna is **Equation no: 4** ....$W = \dfrac{c}{2 f_r} \sqrt{\dfrac{2}{\varepsilon_r + 1}}$

Where c = free space velocity of light and f_r = operating frequency

Ground plane dimensions:

The ground plane dimensions are taken as

Equation No: 6 ....
$$L_g \geq 6h + L,$$
$$W_g \geq 6h + W.$$

III. SPECIFICATIONS

By using the above formulae and procedure we simulate rectangular microstrip antenna of sub-strate thickness as specified in table. The length and width of the patch, feed line dimensions are calculated for respective thickness of substrate with resonant frequency of 3.65GHz and sub-strate material used is ROGGERS 5880 RT-DUROID. The values are tabulated as follows

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Table 1 Antenna specifications

Design parameters for height 1.6 mm

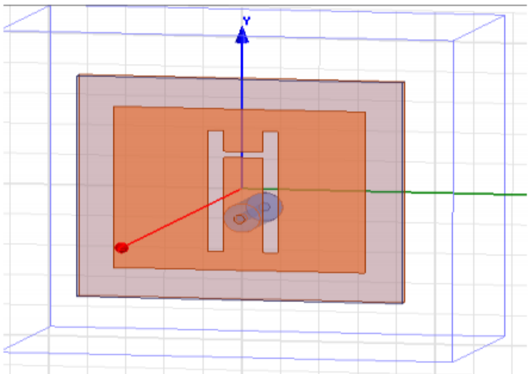
SUBSTRATE MATERIAL	ROGGERS 5880 RT-DUROID
LENGTH OF THE PATCH	26.6mm
WIDTH OF THE PATCH	32.489mm
HEIGHT OF THE PATCH	1.6mm
LENGTH OF THE SUBSTRATE AND GROUND PLANE	36.451mm
WIDTH OF THE SUBSTRATE AND GROUND PLANE	42.089mm
EFFECTIVE DIELECTRIC CONSTANT OF PATCH	$\varepsilon_r = 2.2$
FEEDPOINT	16mm,9.2mm
CO-AXIAL INNER RADIUS	0.69mm
CO-AXIAL OUTER RADIUS	2.36mm

Table 2 Antenna specifications

Design parameters for height 3.2mm

SUBSTRATE MATERIAL	ROGGERS 5880 RT-DUROID
LENGTH OF THE PATCH	26.8mm
WIDTH OF THE PATCH	32.489mm
HEIGHT OF THE PATCH	3.2 mm
LENGTH OF THE SUBSTRATE AND GROUND PLANE	44.906mm
WIDTH OF THE SUBSTRATE AND GROUND PLANE	51.689mm
EFFECTIVE DIELECTRIC CONSTANT OF PATCH	$\varepsilon_r = 2.2$
FEEDPOINT	16mm,1mm
CO-AXIAL INNER RADIUS	0.69mm
CO-AXIAL OUTER RADIUS	2.36mm

IV. SIMULATION RESULTS



Simulation results of rmsa with h-slot h=1.6mm):

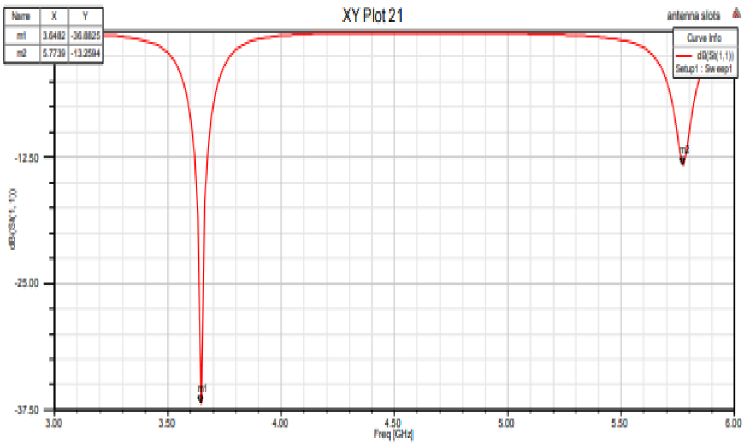


Figure 1. Simulated return loss using H-slot (h=1.6mm)

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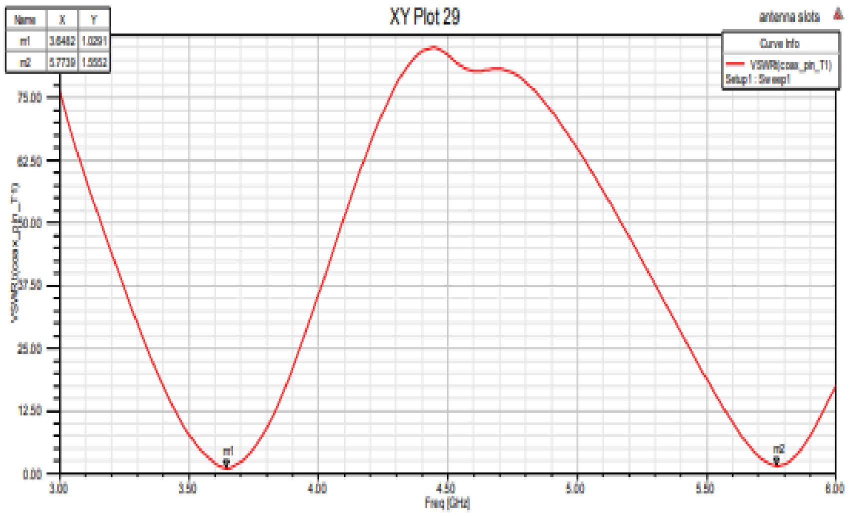

Figure 2. Simulated VSWR using H-slot (h=1.6mm)

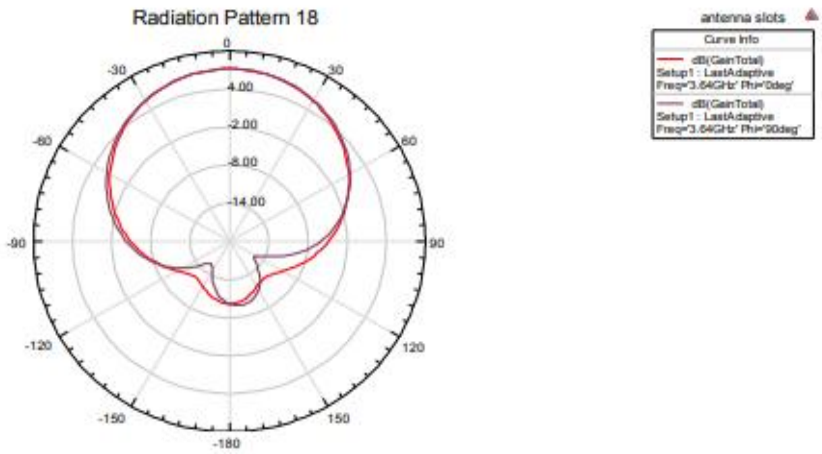

Figure 3. Simulated radiation pattern at 3.64 GHz

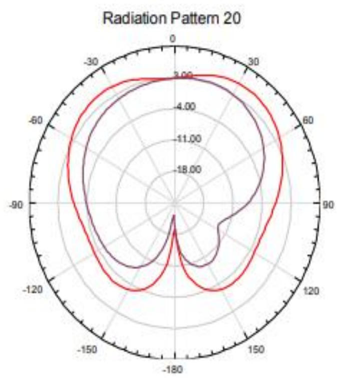

Figure 4. simulated radiation pattern at 5.77 GHZ

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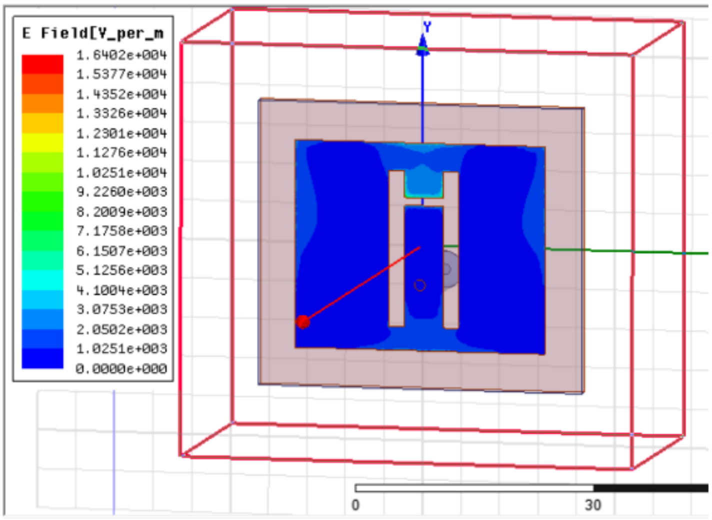

Figure 5. Field overlays plot at height (1.6mm)

Simulation results of RMSA with h-slot (h=3.2mm):

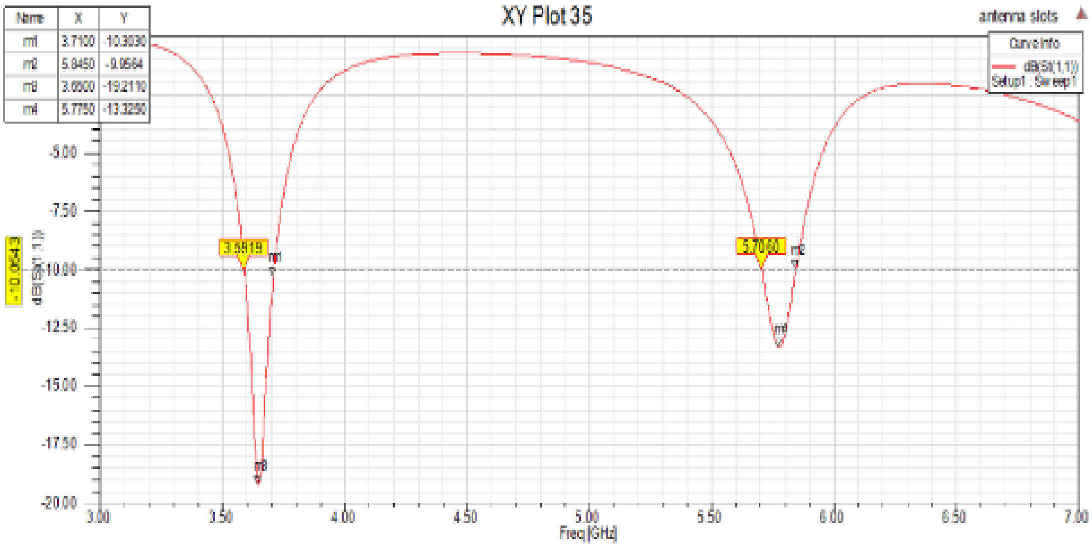

Figure 6. Return loss at height 3.2mm

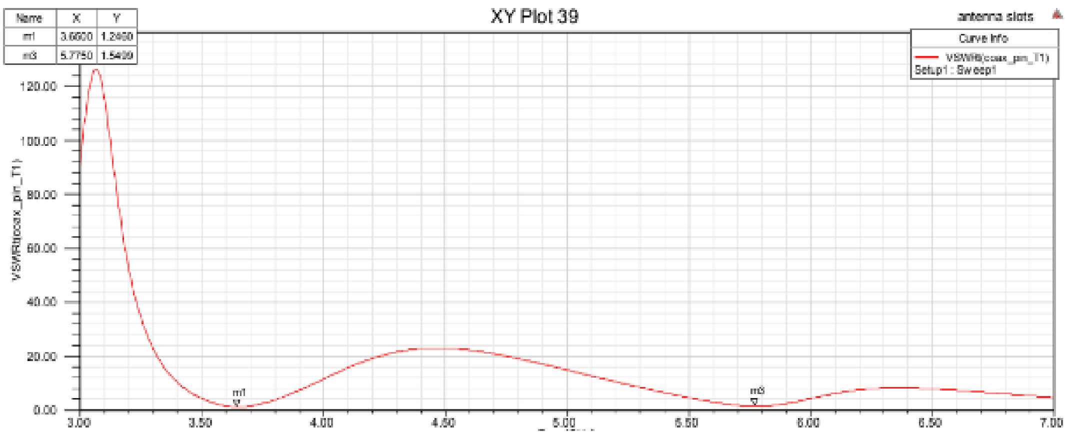

Figure 7. VSWR at height 3.2mm

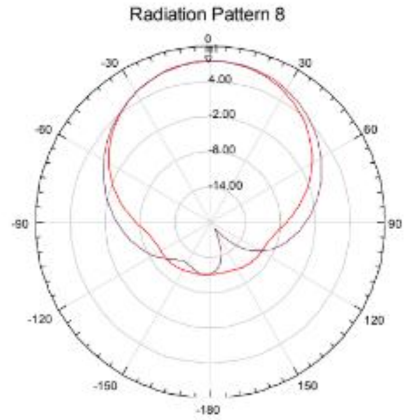

Figure 8. Radiation pattern at 3.65GHz (3.2mm)

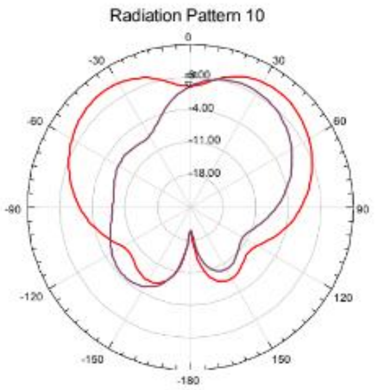

Figure 9. Radiation pattern at 5.77GHz (3.2mm)

Comparison of Results

Table 3 Comparison of Results

Shape of antenna	Return loss(db)	Resonant frequency (GHz)	Operating band(GHz)	Gain(db)	Bandwidth(MHz)	VSWR
R.M.S.A with H-slot at height 1.6mm	-36 at 3.64GHz, -13 at 5.77GHz	3.64 and 5.77	(3.60-3.68)&(5.74-5.80)	7.19 at 3.64GHz, 6.02 at 5.77GHz	77.8 at 3.64GHz, 53.8 at 5.77GHz	1.02 at 3.64GHz &1.55 at 5.77GHz
R.M.S.A with H-slot at height 3.2mm	-19 at 3.65GHZ , -13 at 5.77GHz	3.65 and 5.77	(3.59-3.71)&(5.70-5.84)	7.44 at 3.65GHz, 1 at 5.77GHz	112 at 3.65GHZ , 136 at 5.77GHz	1.24 at 3.65GHz ,1.54 at 5.77GHz

The simulated Antennas have done specific impedance matching, radiation styles and properly cross back Loss. The proposed antenna have the pass again lack of -36 dB at the 3.Sixty 4 GHz and -14 dB at 5.Seventy seven GHz and VSWR rate lesser than 2 at running frequency bands for top 1.6mm. The proposed antenna have the flow again loss of -19 dB at the 3.Sixty five GHz and -13 dB at 5.Seventy seven GHz and VSWR fee lesser than 2 at running frequency bands for top three.2mm.

V. CONCLUSION

The traits of simulated dual-band H-slot micro-strip patch antenna have been analyzed through dif-ferent parametric studies using Ansoft HFSS simulation software program application. The si-mulatedanten-nas have carried out suitable im-pedance matching, radiation patterns and precise cross back loss. As sub-strate top is doubled, the bandwidth moreover doubled with extended ben-efit. The proposed an-tenna has the waft decrease once more loss of -36 dB at the 3.Sixty 4 GHz and -14 dB at 5.Seventy seven GHz and VSWR fee lesser than 2 at the three.6-three.7 GHz and five.7-5.Eight GHz frequency range. Thus, this antenna format may be used for Wi-MAX/WLAN software program within the fre-quency shape of 3.6 to a few.7 GHz and five.7 to 5.Eight GHz.

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