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Microstrip Patch Antenna for Wi-Fi and Bluetooth Application in the ISM Band

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Abstract

As the technology in wireless communication field is advancing rapidly the need of an antenna with high accuracy is required. This research paper represents Microstrip patch antenna working on L band for satellite communication which resonates at 2.4GHz frequency. For this antenna coaxial feeding method is used. Parameters like Bandwidth, Gain and Return loss are analysed for this antenna. The HFSS 13.0 software is used for design and simulation.

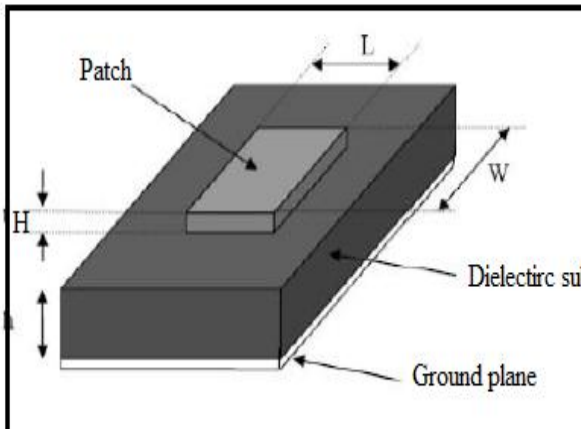
Keywords: *Introduction, Microstrip Patch Antenna, Bandwidth, Return Loss, VSWR.*

I. INTRODUCTION

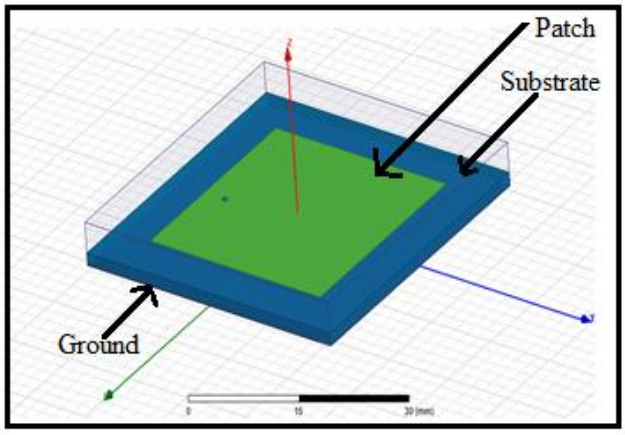
In any wireless communication field the antenna is a primary need. There are several types of antennas available as per application and requirement. Nowadays the integration in electronics and communication field tends to decrease size of communication devices due to which need of compact size of antennas are required. The microstrip patch antennas are most widely used antennas because of their small size, less weight, ease in manufacture and easy to implement in any system. The patch antenna also provides high efficiency and its efficiency is based on the εr of the material used for that patch. As we select the material having low value of εr for patch the efficiency of that antenna increases. There are several methods to feed patch but the most widely used method is microstrip feeder or line feeder and coaxial feeder.

II. ANTENNA DESIGNING

The microstrip Patch antenna consists of a conductive ground plane, dielectric substrate and the conductive patch on the substrate.



There are different shapes of patch like rectangular, circular, ring etc... Here the rectangular patch antenna is designed for ISM band application. The constructional details of patch are shown in figure 1. The antenna is designed with the HFSS 13.0 design software as it is very reliable and most widely used software. HFSS design of patch is shown in figure 2.



Feeding technique for this patch is shown in figure 3.

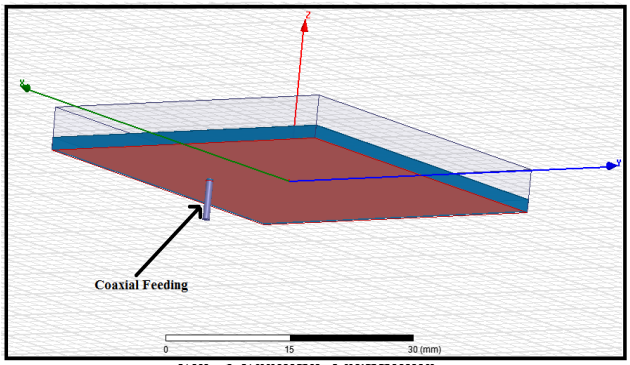


Fig. 3 Feeding Technique

- For efficient radiation the width of patch is given by

$$W = \frac{C}{2fo\sqrt{\frac{\epsilon r + 1}{2}}}$$

Where,

C= Free space velocity of light

ϵr =dielectric constant of substrate

- The length of patch is given by

$$L = \frac{\lambda_o}{2\sqrt{\epsilon_{eff}}} - 2\Delta L$$

Where, the effective dielectric constant of the rectangular microstrip patch antenna is given as

$$\epsilon_{eff} = \frac{\epsilon_r + 1}{2} + \frac{\epsilon_r - 1}{2\sqrt{1 + 12h/W}}$$

And,

$$\Delta L = 0.4h\frac{(\epsilon_{eff} + 0.3)(W/h + 0.27)}{(\epsilon_{eff} - 0.26)(W/h + 0.8)}$$

As per calculations obtained values

- Patch width is 29.53628871 mm.
- Patch length is 28.97851041 mm.
- Substrate width is 42.0362887156 mm.
- Substrate length is 41.4785104164 mm.

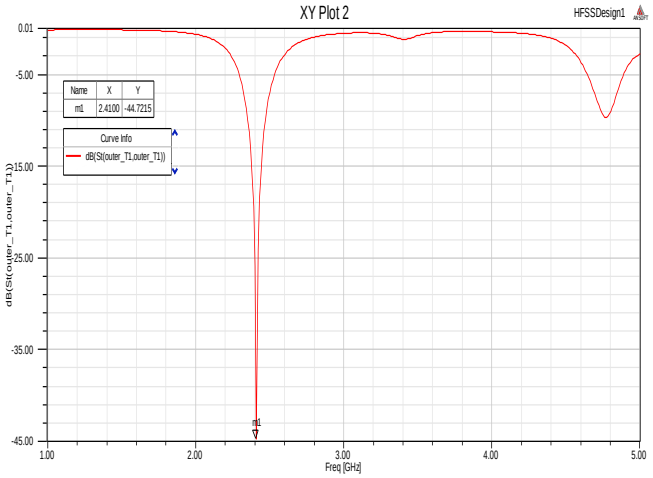
III. SIMULATION RESULTS

A. Resonant Frequency

This antenna is resonating at 2.4 GHZ frequency. And this frequency is used for wireless communication as it is ISM band frequency and L band frequency.

B. Return Loss

The return loss output of this microstrip patch antenna is shown in figure 4. Return loss of antenna atresonating frequency 2.4 GHz, which is below -10 dB and is equal to –44.721dB



C. Voltage Standing Wave Ratio (VSWR)

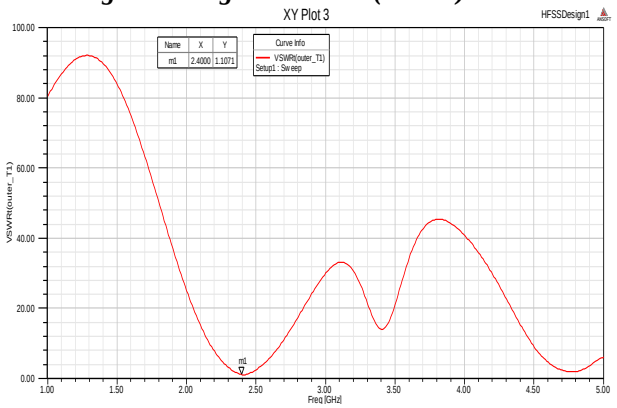


Fig. 5 VSWR plot

D. Bandwidth

Bandwidth is defined as the difference between upper frequency and lower frequency below the -10 dB and divided by the cut-off frequency. For this antenna it is 5% and mathematical expression is given below.

$$BW = 100 \times (F_H - F_L) / F_C$$

E. Gain

The gain of an antenna is 0.645.

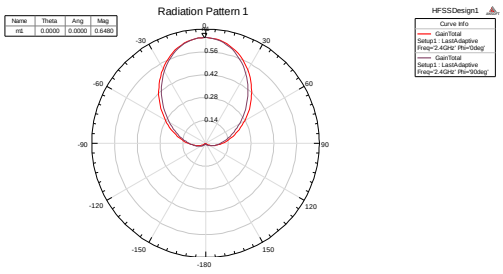


Fig. 6 Farfield Gain

Output Parameters

Resonant Frequency	2.4GHz
Return Loss	-44.721dB
Gain	0.645
VSWR	1.1
Bandwidth	5%

IV. CONCLUSION

Design of microstrip patch antenna for ISM band application is simulated in this article. We havedesigned the microstrip patch antenna which is resonating at the center frequency of 2.4 GHz that is ISM band frequency. Voltage standing wave ratio for this antenna is 1.1 and bandwidth is 5% of the center frequency. The simulated result shows that the antenna could be easily integrated with the existing circuit of the ISM band application.

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