Design of Multiband Reconfigurable Micro Strip Antenna

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ABSTRACT:

This paper presents the design of reconfigurable antenna for multiband signals. The proposed antenna system design supports the frequency range of 5-15GHZ. MEMS switches are used here to switch between the different frequencies i.e. reconfigurability of both operating frequency and bandwidth. The patch is made with the FR4 substrate dielectric material with a dielectric constant of 4.3. The proposed work reduces the size of the antenna and it can be used in many applications like cognitive radio, Wi-Fi, Wi-max, etc,.

INTRODUCTION:

Wireless communication systems have lead to the need for multi-functional antennas. These antennas help the users to use different wireless services at different times. A single antenna element must satisfy all the needs of the multi-band. The reconfigurable antenna is the only solution to achieve multiple bands. Reconfigurable antenna can be used as an alternative to the multiband antenna. The antenna with an ability to modify its characteristics namely operating frequency, radiation pattern, is known as reconfigurable antenna. They are used to reduce the number of antennas required for the design. Microstrip antennas are becoming more popular now, because they can be printed directly on to the circuit boards. Microstrip patch antennas are of low cost and can be easily fabricated. FR4 substrate has been used to make the patch, because it supports high frequencies and provides less loss while compared to the other materials. CST studio site tool is used to design the Microstrip antenna and analyze the parameters of the antenna. Re-configurability can be achieved by using configuration of the rectangular patch antenna by using the switches connected to them with ON or OFF state. Micro electro mechanical switch (MEMS) is the switch used for switching purpose. Copper is the material used to make the ground plane. It has the different wireless applications like Wi-Fi, Wi-max, Cognitive radios, etc., Reconfigurability can be achieved in terms of frequency, bandwidth and radiation pattern. It gives more advantages like compactness and flexibility.

ANTENNA GEOMETRY:

The proposed design of multiband Microstrip patch antenna covers the frequencies (5-15GHZ) in electromagnetic spectrum. The Microstrip patch antenna basically has three layers. The bottom most layer is the ground plane and is made with the copper material in the rectangular shape. The second layer is the substrate which is made of FR4 substrate with a dielectric constant of($\varepsilon_r = 4.3$). The top most layer is the patch and is made with pure copper. The feed is given to the patch and it is also made with the pure copper material. The design parameters of the antenna are designed and calculated based on the following formulae.

Calculation of width:

The width of the Microstrip patch antenna is given as,

$$W = \frac{c}{2f_r}\sqrt{\frac{2}{\varepsilon_r+1}}$$

C – Speed of light
ε_r - Dielectric constant of the substrate
f_r - Resonant frequency of the antenna

Calculation of length:

The length of the patch can be calculated after calculating the effective length and extension length

Effective length:

$$L_{eff} = \frac{C}{2f_r\sqrt{\varepsilon_{eff}}}$$

$$\varepsilon_{eff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left[\frac{1}{\sqrt{1+\frac{2h}{w}}}\right]$$

Where ε_{eff} – Effective permittivity.

Extension length:

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

Resonant frequency:

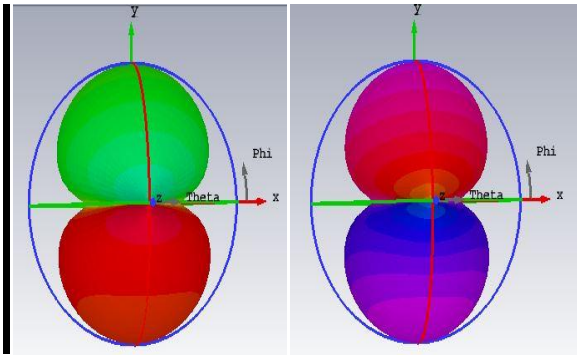
$$f_r = \frac{C}{2(L+2\Delta L)(\varepsilon_e)^{1/2}}$$

Expansion length:

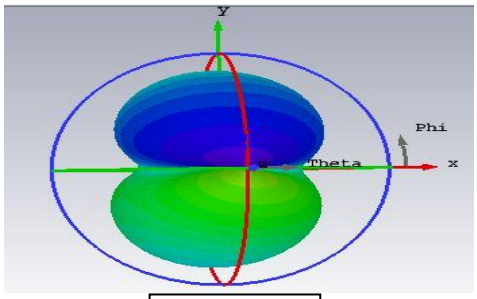
$$\Delta L = h * 0.412 * \frac{(\varepsilon_{eff}+0.3)\left(\frac{w}{h}+0.264\right)}{(\varepsilon_{eff}-0.258)\left(\frac{w}{h}+0.8\right)}$$

OPTIMIZATION OF ANTENNA STRUCTURE:

The dimension of the proposed antenna system is suitable for the frequencies between 5GHz-15GHZ. The different parameters like Gain, Directivity, Power, Radiation pattern, S-parameters, Antenna efficiencies are to be analyzed.



A B



C

fig. 1. Radiation pattern at a)5.5 GHZ b) 6.5 GHZ c) 7.5GHZ.

Name	Value	Description
l	32.41	length of the substrate
w	18.42	Width of the substrate
Lg	1	Length of the feed line
Wf	4.65	Width of the feed line
ΔL	0.07	Expansion length
L	8.10	Length of the patch
W	9.21	Width of the patch

RESULTS AND CONCLUSION:

The designed multiband reconfigurable antenna supports the multiple frequencies from 5GHZ to 15GHZ. This antenna shows the good radiation pattern with the high gain and very small fading. The antenna performance will be good as FR4 substrate is used as patch material. Radiation pattern will be 80% high. The CST Microwave studio software is used to design this antenna and can be used in many applications like cognitive radio, Wi-Fi, Wi-max, etc,.

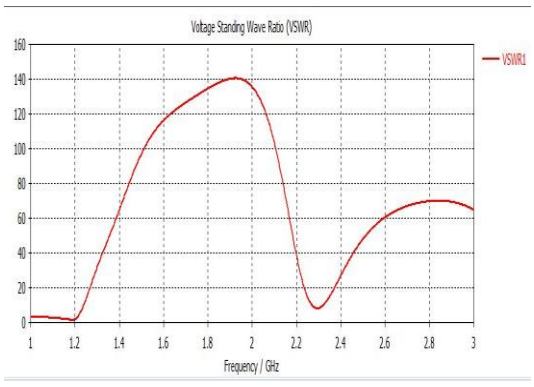


fig. 2. Plot of VSWR

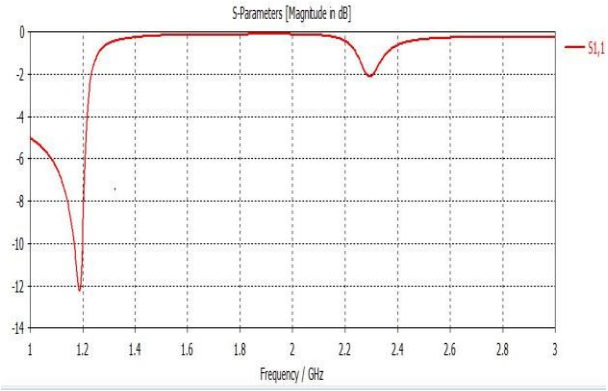


fig. 3. Scattering parameter

REFERENCES:

1) Nishant kumar, P. Ananda Raju, Santanu Kumar Behera, Senior Member IEEE, "Frequency Reconfigurable Micro strip Antenna for Cognitive Radio Applications"(2010).

2) Muhammad Sani Yahya and S.K.A. Rahim," A 16 GHz FR-4 Compatible Phased Array Antenna for Mobile Phone Applications" (2012). Volume58, Issue12

December 2016.

3) Suraj Manik Ramteke1, Shashi Prabha2 "Dual band patch antenna for wireless communication system" (2014).

4) Huda A. Majid, Mohamad K. A.Rahim*, Mohamad R. Hamid, and Muhammad F.Ismail "Frequency Reconfigurable Microstrip Patch-Slot Antenna with Directional Radiation Pattern," Progress In Electromagnetics Research, Vol. 144, 319-328, 2014.

5) Dimitrios peroulis, Kamal Saraland and Linda P.B.K presents "Microstrip patch antenna for wireless communication system (2016)".

6) Angus C.K.Mak, Corbett R. Rowell, Ross D. Murch "Reconfigurable Multiband Antenna Designs for Wireless Communication Devices" 09 July 2007.

7) Pei-Yuan Qin, Member, IEEE,Y.Jayguo, Senior Member, IEEE, And Canding, Student Member, IEEE" A Dual-Band Polarization Reconfigurable Antenna For WLAN Systems" IEEE Transactions On Antennas And Propagation, Vol. 61, No. 11,

November 2013.