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DESIGN OF DUAL BAND MICROSTRIP PATCH ANTENNA FOR WLAN APPLICATION

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ABSTRACT
With the advancement of wireless communication; multiband antennas are in demand. Due to such antennas the complexity and cost of hardware decreases. Dual-band microstrip patch antenna with quarter-wave microstrip feed is designed. The original frequency is 2.4 GHz. The designed antenna resonates at 2.2 and 4.7 GHz. A slot is used in the middle to decrease the current flow and to reduce the VSWR, return loss. The antenna is simulated using High Frequency Structural Simulator (HFSS).

KEYWORDS: Microstrip Patch, Quarter-Wave Transmission Line Feed, HFSS, Slot

INTRODUCTION
With the rapid development of mobile communication systems, multiband patch antennas are of great interest. They are used in wireless communication systems, wireless local area networks (WLAN), worldwide interoperability for microwave access (WiMAX), and long term evolution (LTE) applications. Therefore multiband antennas which operate at 2.4-2.484 GHz, 5.15-5.825 GHz, 2.5-2.69 GHz, 3.4-3.69 GHz, 5.4-5.85 GHz, and 2.5-2.69 GHz are required [8]. Patch antennas are used in mobile communication systems because they have high efficiency and more mechanical reliability [11].
The advantages of microstrip patch antenna are light weight, small size, less fabrication cost. Some of the disadvantages are surface wave excitation and narrow bandwidth. The bandwidth can be improved by using slots, multilayer structure, multiple resonators, low dielectric constant, increasing substrate height [10]. For efficient radiation the size of the microstrip antenna should be half-wavelength. If the size is less than the half-wavelength then the radiation efficiency of the antenna decreases [9].
Frequency reconfigurable and multiband antennas are used in satellite, mobile and RADAR communication. Such type of antenna reduces interference and jamming effect [4].Multiband antennas are required for reducing the number of antenna units and minimizing the installation area for base station. Different methods to achieve multi-band operation are U-shaped strip, E-shaped monopole, V-shaped slot, fractal antenna, dielectric resonators [3].
The advantages of slot antenna are simple structure, light weight, easy impedance matching, wide bandwidth and good radiation efficiency. The length of the slot is quarter-wavelength and radiation from the slot is linearly polarized [2]. The location, length and width of the slot are sensitive to the operating frequency and the bandwidth [8]. The slot modifies the resonance frequency of the higher order mode and orthogonal modes of the patch. The slot changes the direction of surface currents at modified higher order and therefore gives broadside direction [3].
Many multiband antennas such as inverted-F antenna, slot antenna, planar antenna have been investigated for wireless local area network (WLAN), worldwide interoperability for microwave access (WiMAX) and universal mobile communication systems. The drawbacks of these antennas are the size of the antenna and complexity increases at the required operating frequency bands [6]. Reconfigurability can be achieved by using varactor diode, PIN diode, microelectromechanical switch (MEMS), photoconductive device, variable capacitors, relays, transistors, dielectric adjustment using fluidic movement [7]. The ground plane can be used for impedance matching circuit. It tunes the resonant frequency. The electromagnetic coupling between the lower edge of the patch and the ground plane can be controlled by adjusting the substrate height [5].

ANTENNA DESIGN
The patch antenna is designed using RT/Duroid 5880 substrate. The dielectric constant is 2.2 and loss tangent is 0.0009. The size of the substrate is 88 * 50 * 0.035 mm. The size of the patch antenna is 42 * 42 * 0.035 mm. The antenna is fed using quarter-wave transmission line feed. The dimension of quarter-wave transmission line is 21 * 2 * 0.035 mm. The dimension of microstrip feed is 21 * 10 * 0.035 mm.

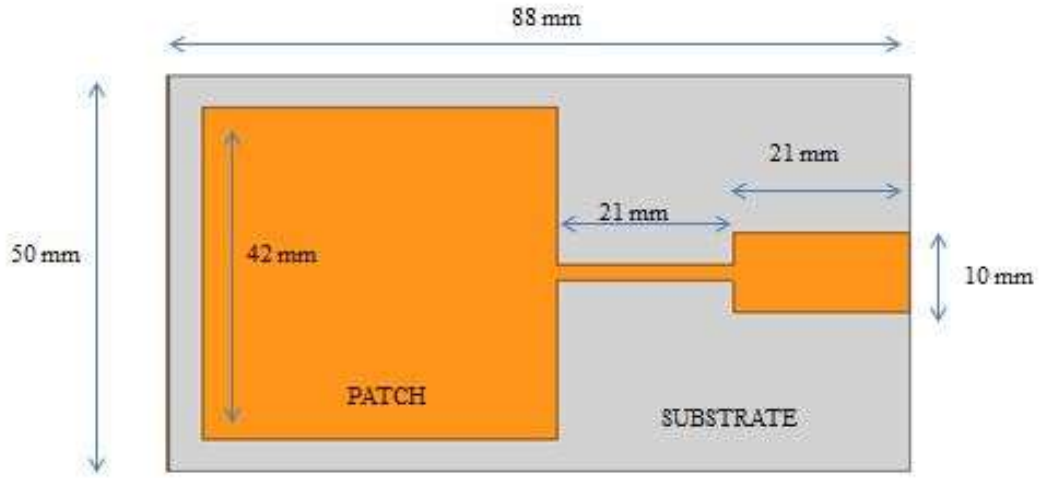

Figure 1 – Quarter-wave feed microstrip patch antenna

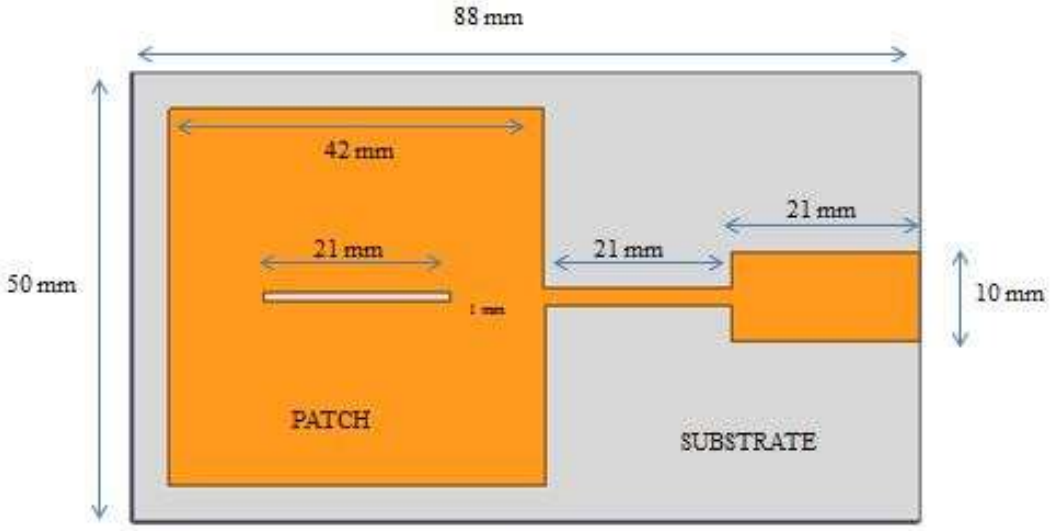

Figure 2 – Slot antenna with quarter – wave feed

The antenna is designed using HFSS (High Frequency Structural Simulator) software. The patch and ground plane is assigned E-plane boundary. The microstrip feed is fed using lumped port.

RESULT AND DISCUSSION

Microstrip patch antenna without slot

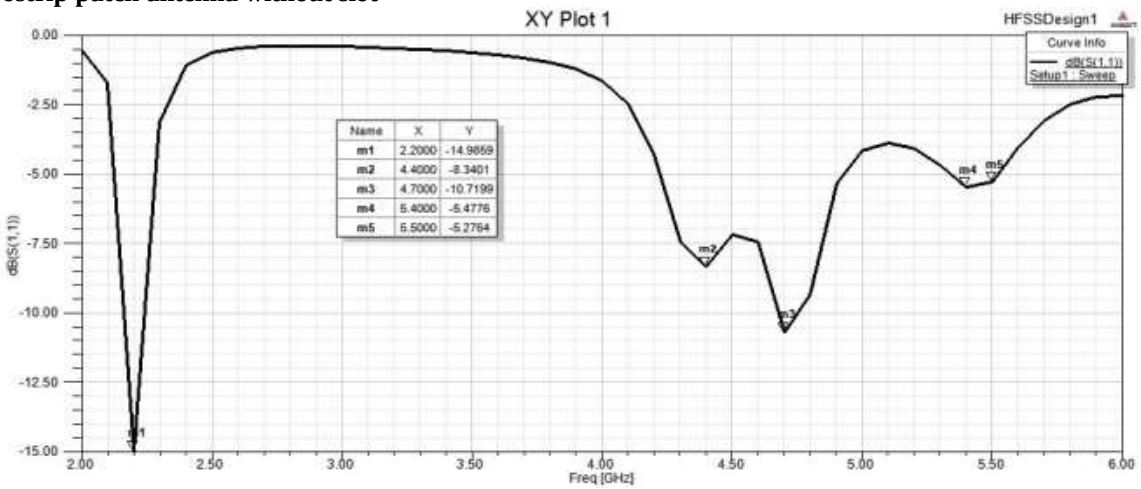

Figure 3 – Graph between S_{11} and frequency

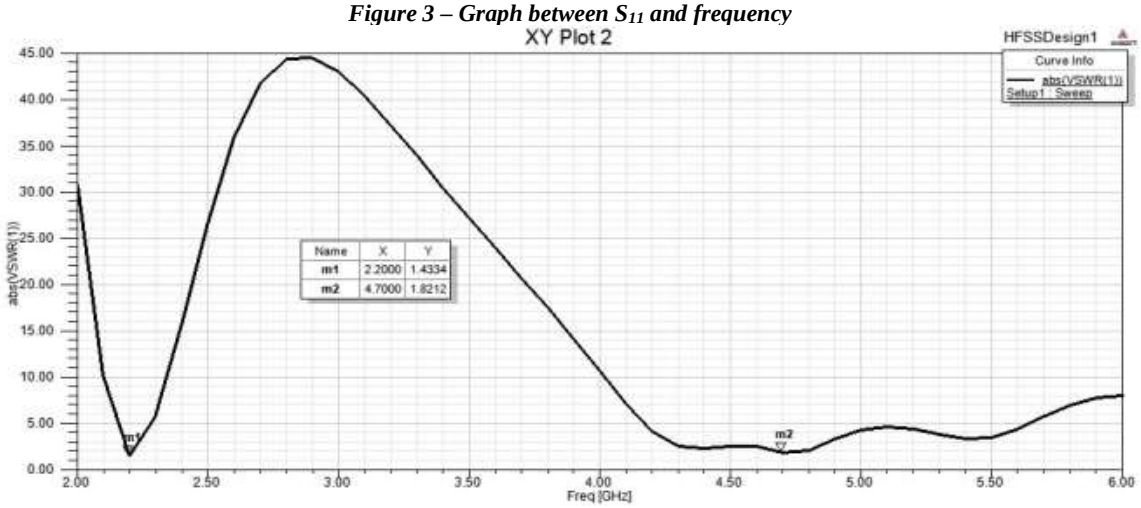

Figure 4 – Graph between VSWR and frequency

Microstrip patch antenna with slot

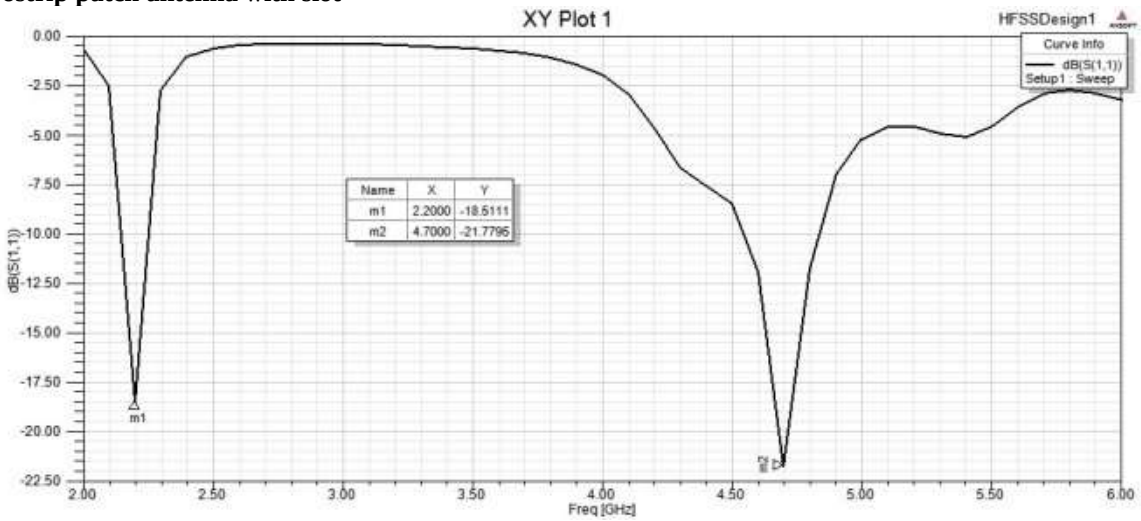

Figure 5 – Graph between S_{11} and frequency

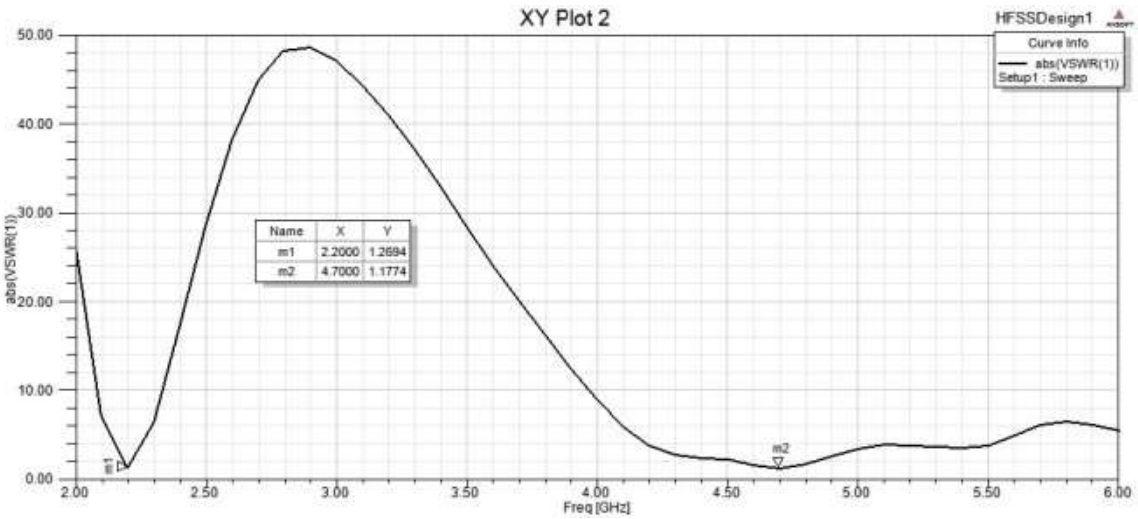

Figure 6 – Graph between VSWR and frequency

Without Slot

Table 1 Result of S_{11} and VSWR at 2.2 GHz and 4.7 GHz without slot

	At 2.2 GHz	At 4.7 GHz
S_{11} (dB)	-14.98	-10.71
VSWR	1.43	1.82

With Slot

Table 2 Result of S_{11} and VSWR at 2.2 GHz and 4.7 GHz with slot

	At 2.2 GHz	At 4.7 GHz
S_{11} (dB)	-18.51	-21.77
VSWR	1.26	1.17

CONCLUSION

A patch antenna is designed using quarter-wave transmission line feed. In literature RF switches are used to obtain multi-band operation. In this paper, dual-band is obtained without RF switches. The length of the patch is half of the wavelength, length of the microstrip feed and the length of the quarter-wave transmission line is quarter of the wavelength. Due to this the antenna resonates in two frequencies. It has been observed that with the use of slot VSWR and return loss decreases. Theoretically VSWR should be less than 2 and the return loss should be less than -10 dB.

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