DESIGNING AND ANALYSIS OF QUAD BAND CIRCULAR AND Y-SHAPED SLOTTED MICROSTRIP PATCH ANTENNA

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INTRODUCTION

The microstrip antenna is an antenna formed on the substrate which is pasted on the back surface of a dielectric substrate which acts as a conductor. Compared with the commonly used microwave antenna (parabolic antenna and phased array antenna), microstrip antenna has the advantages of small volume, light weight, low profile, is conformal with carrier, linear and circular polarization and is easy to realize and implement dual band, dual polarization and multi-function.

The scattering cross section of antenna is small. It can get the direction of a single direction of the wide flap, maximizing radiation direction in the normal direction of the plane and make it easy to integrate microstrip line with low cost, mass production and so on.

Microstrip patch antenna has become an integral part of these devices working in ultra to super high frequency ranges. The patch and slot are the two parameters which affect the overall antenna’s performance. Recently, the growth of

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The proposed antenna can be suitably employed for Bluetooth and WLAN. The proposed antenna covers the S-band satellite downlink as well as uplink frequency bands making it suitable to be employed for S band WLAN, Bluetooth, cellular phones, Wi-Fi communication applications. The specified frequency ranges of 2.4 GHz (S-band) can also be employed for WLAN, Bluetooth, cellular phones, Wi-Fi purposes. In this Paper, a microstrip patch antennas for a Quad frequency 2.24, 4.73, 6.66 and 8.79 GHz (that cover S-Band, C-Band and X-Band) with only microstrip line feeding technique is presented. The various parameters like return loss, radiation pattern, smith chart, electric field and VSWR are plotted for each antenna. The affect of various parameters like patch length, MSL length have been studied.

Keywords: Single band and Quad Band, Y-shaped microstrip patch antenna, S-Parameters, smith chart, radiation pattern, bandwidth, VSWR, resonant frequency, HFSS
wireless systems leads to a lot of innovations in the Microstrip antenna designs (Ramesh Garg et al., 2008).

Microstrip patch antenna is basically made of thin sheet of insulating material called dielectric substrate. It is back bone of circuit because it provides a support to strip and patch. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. Microstrip patch antennas radiate primarily because of the fringing fields between the patch edge and the ground plane. One major drawback of microstrip patch antennas is their narrow bandwidth and low gain. It has been established that the slotted patch can significantly improve the bandwidth of the microstrip antenna. The slotted patch antenna can be designed not only for wideband applications, but also for dual-band and, triple-band application with small and wide frequency ratios. The IEEE 802.16 standard allows data transmission using multiple broadband frequency ranges. The original 802.16a standard specified transmissions in the range 10 - 66 GHz, but 802.16d allowed lower frequencies in the range 2 to 11 GHz. The lower frequencies used in the later specifications means that the signals suffer less from attenuation and therefore they provide improved range and better coverage within buildings.

Microstrip antennas have several advantages over conventional microwave antenna and therefore are used in a variety of practical applications. Microstrip antenna in its simplest design. It consists of a radiating patch on one side of dielectric substrate, with a ground plane on other side (Ramesh Garg et al., 2008). Since then, microstrip antennas are the most common types of antennas with wide range of applications due to their apparent advantages of light weight, low profile, low cost, planar configuration, easy of conformal The concept of microstrip antenna was first proposed by Deschamps in 1953.

The patch is generally made of conducting material such as copper or gold and can take any possible shape. The radiating patch and the feed lines are usually photo etched on the dielectric substrate. In order to simplify analysis and performance prediction, the patch is generally square, rectangular, circular, triangular, and elliptical or some other common shapes. Rectangular patches are probably the most utilized patch geometry. It has the largest impedance bandwidth compared to other types of geometries, and is the main research interest in this project. Circular and elliptical shapes are slightly smaller than of rectangular patches. Thus it will have smaller bandwidth and gain. This circular geometry patches were difficult to analyze due to its inherent geometry.
FEEDING METHOD USED

Microstrip Line Feed

A Microstrip Feed uses a transmission line to connect the radiating patch to receive or transmit circuitry. Electromagnetic field lines are focused between the microstrip line and ground plane to excite only guided waves as opposed to radiated or surface waves. Guided waves dominate in electrically thin dielectrics with relatively large permittivities. For the patch antenna, radiated waves at the patch edges are maximized using electrically thick dielectric substrates with relatively low permittivities (Ramesh Garg et al., 2008; and Ahmed Fatthi Alsager, 2011).

Hence, it is difficult to meet substrate height and permittivity requirements for both the microstrip transmission line and patch antenna. Dielectric substrates selected to satisfy the two conflicting criteria increase surface waves, reduce radiation efficiency due to increased guided waves below the patch, and increase side-lobes and cross-polarization levels from spurious feed line radiation. A microstrip line feed is generally used in two configurations namely directly fed and Inset feed.

DESIGNING

Design of Single Band Antenna of Y-shaped Patch
RESULTS

a) Observation from -10dB return loss
1. Bandwidth at frequency 2.4 GHz is 376.4 MHz and Return Loss is -48.53 dB

b) Observation from VSWR

VSWR at resonant frequency 2.4 GHz=1.0075.

d) Smith Chart: The smith chart gives 1.0074×50= 50.37 ohm impedance which is good as near to match the characteristic impedance of value of 50 ohm.

Figure 4: Return Loss Graph of Y-shaped Single Band Antenna

Figure 5: VSWR Graph of Y-shaped Single Band Antenna
Design of Proposed Quad Band Antenna using Circular and Y-Shaped Slots in Patch

In this design we have cut three circular shaped slots in the patch to get desired quad bands to design a effective quad band antenna.

In this technique, microstrip patch antenna is designed using microstrip line feed and some changes in boundary conditions of above antenna to get desired results:

**RESULTS**

a) Observation from –10dB return loss

1. Bandwidth at frequency 2.24 GHz is 130 MHz and Return Loss is -19.75 dB
2. Bandwidth at frequency 4.73 GHz is 370 MHz and Return Loss is -14.25 dB
3. Bandwidth at frequency 6.66 GHz is 300 MHz and Return Loss is -19.22 dB
Bandwidth at frequency 8.79 GHz is 570 MHz and Return Loss is -25.75 dB.

b) Observation from VSWR
1. VSWR at resonant frequency 2.24 GHz=1.22.
2. VSWR at resonant frequency 4.73 GHz=1.48.
3. VSWR at resonant frequency 6.66 GHz=1.24.
4. VSWR at resonant frequency 8.79 GHz=1.10.

d) Smith Chart: The smith chart gives 1.1070×50= 55.35 ohm impedance which is good as near to match the characteristic impedance of value of 50 ohm.
CONCLUSION

In this paper initially single band antenna is designed, which can be suitably employed for Bluetooth and WLAN. The proposed antenna covers the S-band satellite downlink as well as uplink frequency bands making it suitable to be employed for S band WLAN, Bluetooth, cellular phones, Wi-Fi communication applications. The specified frequency ranges of 2.4 GHz (S-band) can also be employed for WLAN, Bluetooth, cellular phones, Wi-Fi purposes.

In this paper, Quad Band Antenna also covers the C-Band as well as X-Band applications. Results show good impedance matching, good radiation patterns in the operating band. Thus, this antenna is a good applicant for wireless communication applications which includes long distance radio telecommunications like cordless telephones, some Wi-Fi devices, weather radar systems, direct broadcast satellite. A microstrip patch antennas for a Quad frequency 2.24, 4.73, 6.66 and 8.79 GHz (that cover S-Band, C-Band and X-Band) with only microstrip line feeding technique is presented. The various parameters like return loss, radiation pattern, smith chart, electric field and VSWR are plotted for each antenna.

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Communication and Signal processing


