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Design and Implementation of Dual and Triple Band Microstrip Patch Antenna for Wireless Communication

Siddhesh Uttam Chavan
Department of E&TC
SCOE, Pune

Prof. Mr. V. V. Dixit
Department of E&TC
SCOE, Pune

***Abstract* – In today's communication industry, antennas are the most needed to create a wireless link. For mobile applications its need to have portable antenna with light weight. They can be designed in a many shapes depends on required frequency of operation. In order to have an antenna suitable for lower band and higher band of frequencies, we are working on dual band microstrip antenna. With same approach and theory of dipoles we succeed to add one more band. This paper concentrates on dual band and triple band antenna. This antenna operate in UMTS Bands of 800 MHz, 1200MHz, 2400MH and 2600MHz frequencies. HFSS is used to design antenna. Antenna design on FR4 substrate with size of 50 mm x 50 mm, thickness of 1.6 mm and relative permittivity of 4.4.**

Keywords- Dual Band, Triple Band, λ/4 principle.

I. INTRODUCTION

This chapter explains introductory part related to design of dual band antenna through single feed. Achieving multiple bands using a microstrip antenna opens many designs for antenna. Changing antenna design changes its radiation pattern also the operating bandwidth and gain in case we change ground. Microstrip antenna has application for low cost, light weight, portable device. Small change in length can vary few parameters of antenna including frequency of operation. Considering those deigns are made.

For next generation mobile communication [1] there is needed to transfer high data, within less time. Considering this, we have to deal with antenna to achieve high bandwidth. Hence there is need to have a single antenna which would operate over wide band. One of the ways is explained in this paper. For lower frequencies patch antennas are very bulky, so dipoles are attractive in use.

This antenna is unique, because it follows the principle of folded dipole antenna and it is made on printed circuit board.

MIMO is key techniques in current 3G and future 4G wireless systems [2] such as Worldwide Interoperability for Microwave Access (WiMAX) and the Third Generation Partnership Project (3GPP) Long Term Evolution (LTE). Previous research on MIMO mainly aims to increase bandwidth but rarely concerns this type of approach. Thus how to design of significant design with wide band antenna is very important. This chapter is providing an overview on the state of the art on this issue along with design strategies for wide band microstrip antenna.

II. DESIGN STRATEGY AND SIMULATION

Design strategies are always among the hot topics in cellular communications. However early work in this area is mainly focused on bandwidth, coverage, spectral efficiency and capacity. Recently as energy consumption has become a primary concern low power antenna design with multi bands attracted increasing interest.

There are many resonant frequencies of an antenna which depends on matching impedance. Generally it is easier to find first resonant frequency of antenna, for folded dipole with length of λ/4 approximately. Adding stub is a better technique, but for a wideband we have to deal with antenna shape and radiation pattern accordingly [4].

In HFSS we have created substrate of FR-4 epoxy with thickness 1.6mm, c = 4.4 and dimensions as 50mm x 50mm.Ground plane is of 50mm x 11mm as a perfect electric conductor. Patch is also perfect electric conductor. Figure 1, shows the design of continuous ground microstrip antenna.

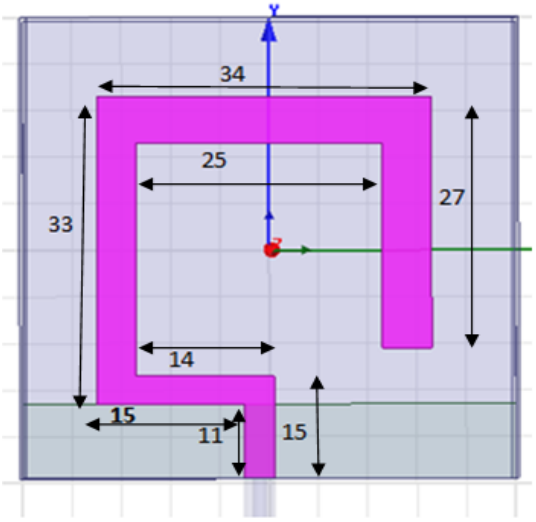

Figure 1: Design for dual band

Here continuous ground is used for design and the simulation results are as shown in figure 2.

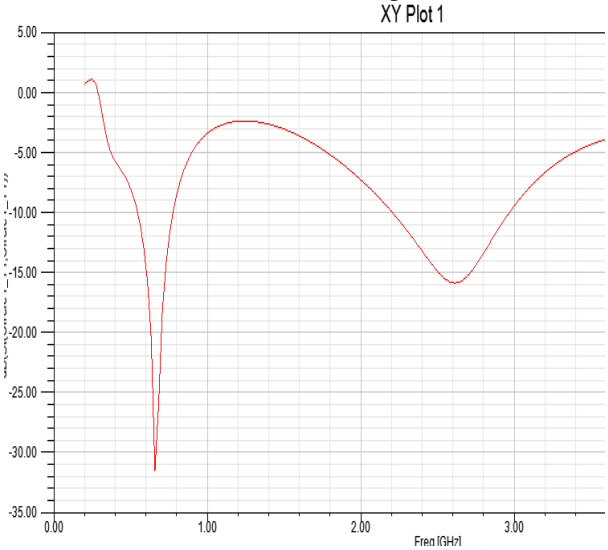

Figure 2: Simulation results of design for dual band

As seen in figure 2 , S11 is good at 700MHz and 2.6GHz. Second band is getting more bandwidth. And this is because stub is very near to ground and that is first to get power.

III. ANTENNA WITH TRIPLE BANDS

The basic idea behind triple band is to add one more stub in double band antenna without sacrificing previous to frequency bands. The width of stubs is less than 0.05λ. Portion towards ground is specially added for antenna behavior. As we know the shape of Folded dipole the 27mm length is added here vertically to enhanced the performance of antenna. It is terminated just above the radiative element in the given antenna, so as to avoid the mutual coupling between two microstrip.

All microstrip radiative elements in the antenna are kept diagonally inline. And the gaps between these stubs are proportional to the difference between the frequency bands for which it work.

Figure 3, shows the triple band antenna. Basic bands are following concept of λ/4.

Return loss for antenna is increased as seen in Fig. 4. -10dB return loss we use for practical purpose. As compared to previous simulation results, we can easily say that this new approach is attractive to increase new bands without sacrificing the old bands. The width of stub is proportional to the power it can handle. So the middle band can be increase with widening the width of stub.

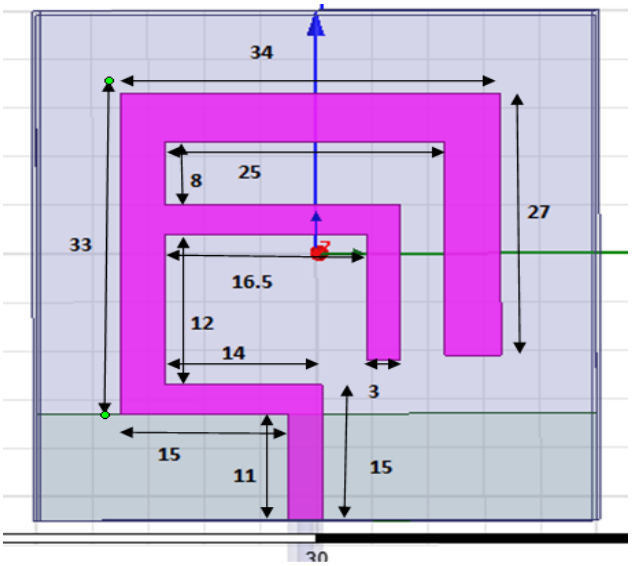

Figure 3: Design for triple band

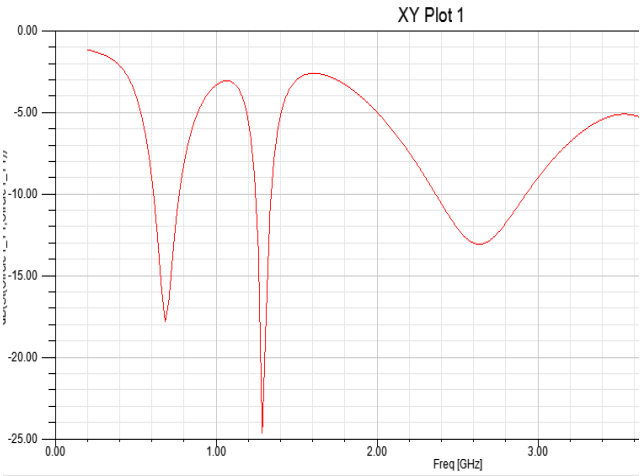

Figure 4: Simulation result for triple band

IV. HARDWARE OF ANTENNA AND TESTED RESULTS ON VNA

Hardware of antenna is PCB made on FR-4 substrate, with copper clad with thickness 1.4 mils. The ground of antenna is also copper with maximum length more than longest microstrip.

Microstrip line feed is used here with the coaxial feed inline with that. So as to get better results. As this is a kind of dipole so the feed we give must be in plane of the antenna, not to the perpendicular to the PCB.

Figure 5: Hardware design for antenna microstrip top

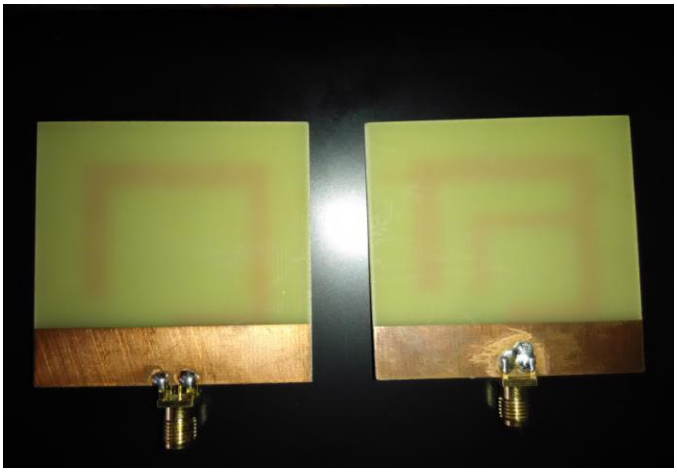

Figure 6: Hardware design for antenna ground bottom

These antennas are tested on VNA. The results as shown below.

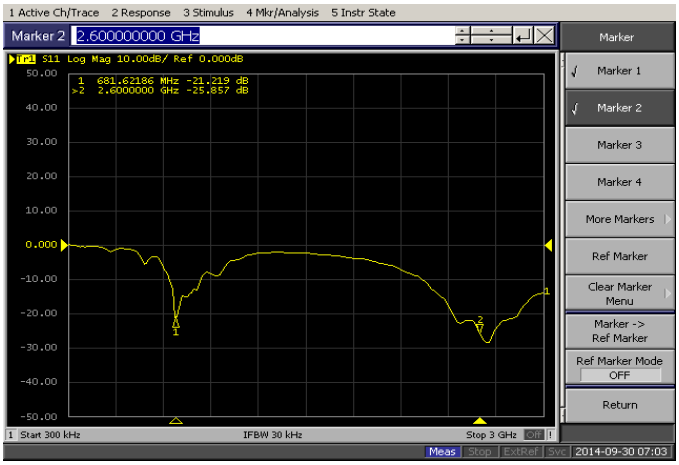

Figure 7: VNA results of design for dual band

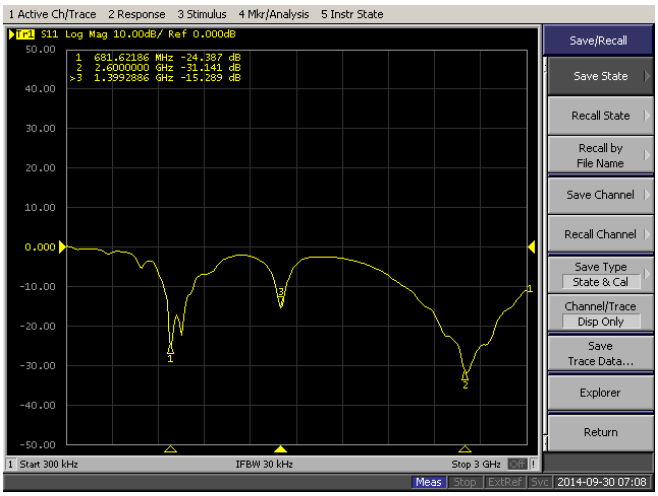

Figure 8: VNA result for triple band

V. CONCLUSION

The unique fact in this paper is we are adding new lengths of dipoles/stubs is without changing the outer shape and it is it inline with previous lengths. Diagonally all stubs are inline. To increase the usable bandwidth of antenna was a challenge, but comparative study tells the solution for that. All of these are done with HFSS 13.0. The design is simple for fabrication. Application for mobile handsets with multiple bands is suitable. Hence, these results prove that, the new approach is better over a traditional way.

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