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Band Rejecting UWB MIMO Antenna to Reduce Mutual Coupling

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Abstract

This paper presents an ultra-wideband two element Multiple Input Multiple Output (MIMO) antenna with a band rejection structure. The structure reduces the mutual coupling between the two elements to provide efficient gain. A slot is etched on both the rectangular patches to provide a notch frequency of 6GHz. The resonance of proposed UWB MIMO antenna ranges from 3.2 GHz to 10.2 GHz beneficial for Wi-MAX applications.

Keywords— *MIMO, Ultra-Wideband, Mutual Coupling, Notch Band, Band Rejection, Decoupling*

I. Introduction

Ultra-wideband (UWB) and Multiple Input Multiple Output (MIMO) antennas are acquiring great importance and recognition in modern wireless communication systems. Increasing demands for the high data rate, low power consumption and low cost, gave rise to research and development of UWB MIMO Antennas. An Ultra-wideband (UWB) is a communication technology which is used for short range communication systems operating at high bandwidth of radio spectrum. The bandwidth of UWB is greater than equal to 500MHz and frequency range lies between 3.1GHz to 9.1GHz. The basic concept of MIMO is to use multiple radiating elements to transmit or receive signals with different fading characteristics. But designing a MIMO with multiple radiating elements and low mutual coupling is a great challenge. The size of the UWB antennas is usually smaller than traditional antennas due to the increase in the operating frequency. Designing such multiple radiating antenna elements on the small space available in portable devices causes severe mutual coupling and degrades the performance. Many MIMO antennas have been proposed for UWB systems which have large bandwidth and are better immune to multipath propagation and narrowband interferences.

II. Literature Survey

"Ultrawideband MIMO/Diversity Antennas With a Tree-Like Structure to Enhance Wideband Isolation", [1] the main challenges faced by design of UWB MIMO antennas are reducing the size of radiating elements in MIMO and enhancing the isolation between these radiating elements to reduce the mutual coupling to get better gain and radiation pattern. To conquer these challenges and overcome drawbacks many design designs and methodologies are proposed. One way to achieve isolation between radiating element is to introduce decoupling structures between two radiating elements. One UWB MIMO antenna of 3.1–10.6 GHz is designed with tree-like structure on the ground plane. The effectiveness of the tree-like structure is analyzed in reducing the mutual coupling between the radiating elements. " Compact MIMO Antenna forPortable Devices in UWB Applications", [2] in this paper Similarly another antenna consists of two planar-monopole antenna elements placed perpendicularly to each other to achieve good isolation. To enhance isolation, two

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long protruding ground stubs are added to the ground plane on the other side and a short ground strip is used to connect the ground planes of the two monopoles together to form a common ground. In this paper two-element MIMO antenna is designed a band rejection structure is introduced on ground to reduce coupling effect and enhance the isolation.

III. Design and Specifications

Design of antenna plays a vital role in determining the parameters of the antenna. The precision of antenna depends on the design specifications of the antenna. The proposed antenna consists of two uniform radiating elements designed on FR4 substrate. The dielectric constant of FR4 substrate is 4.3 and thickness is 0.8mm. Each radiating element is a rectangular monopole antenna. The dimension of absolute antenna is 26 x 31 mm2. The two identical radiating elements of the antenna are rectangular patches with individual feed lines. A single partial rectangle slot is cut in each patch which obtains a notch band at 6GHz. The ground plane of the antenna is a partial copper annealed plane. A band rejection structure is printed on partial ground plane to enhance the isolation between two monopoles which reduces mutual coupling. The band rejection structure consists of 3 stumps. Two stumps on the outer sides are inverted L shaped. Given below are the designs of the proposed antenna. Fig.3.1 shows the antenna without the band rejection structure. Fig3.2 shows the antenna with band rejection structure.

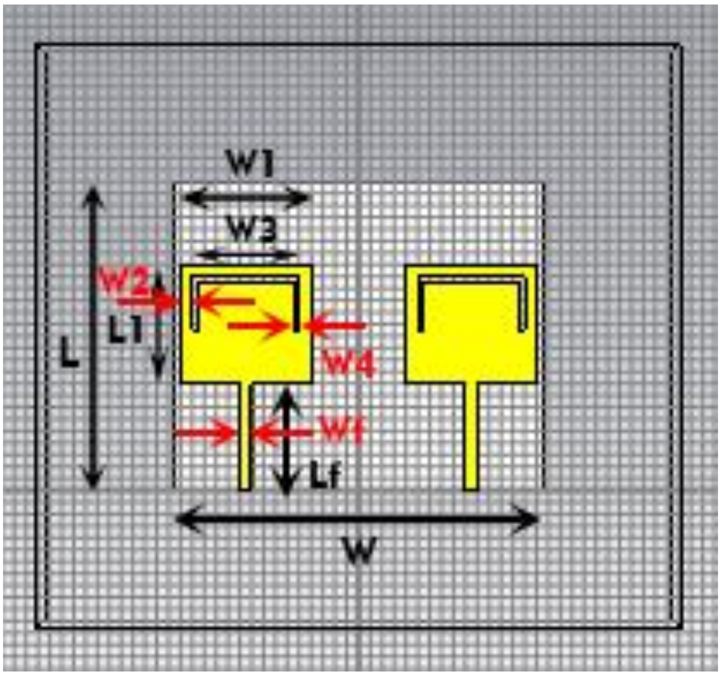

Fig. 1 Antenna without band rejection structure

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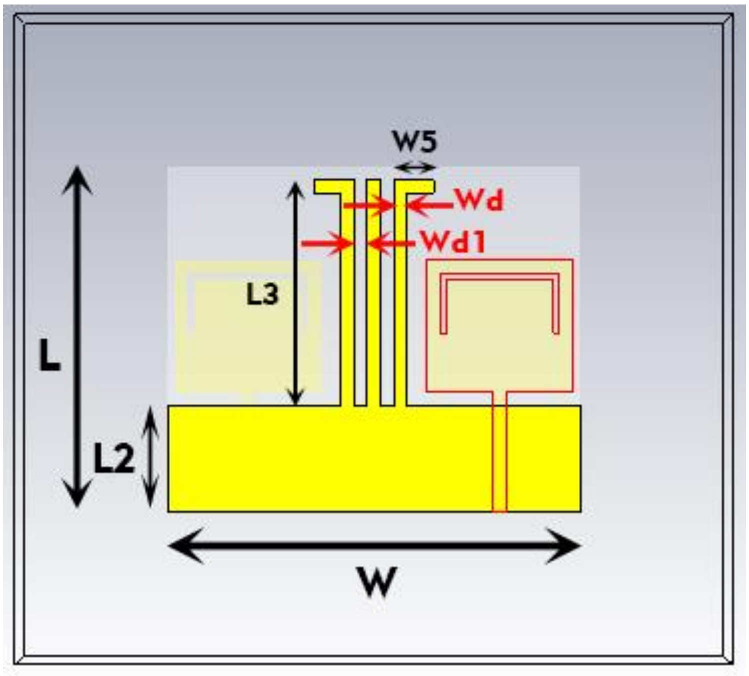

Fig. 2 Antenna with band rejection structure

IV. Results and Discussions

The simulated antenna performances are investigated by carrying simulation on CST Microwave Studio software. Fig.5.1 shows s-parameters |S11| and |S12| for the antenna in Fig. 3.1. |S11| which represents return loss shows that antenna resonates in the frequency band from 3.4 GHz to 9.6 GHz with the band rejection at 5.9 GHz i.e from 5.6 GHz to 6.2 GHz.

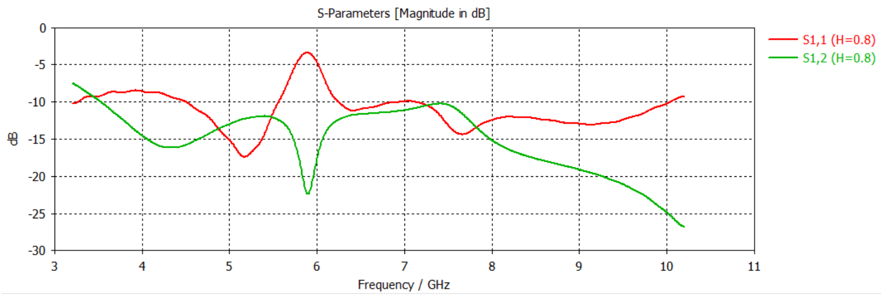

Fig. 3 S-Parameter without Stub Structure (|S11|, |S12|)

Fig.5.2 shows s-parameters |S11| and |S12| for the antenna in Fig.3.2. |S11| which represents that antenna resonates in the frequency band from 3.4 GHz to 9 GHz with a band rejection at 5.7 GHz i.e. from 5.4 GHz to 6.2 GHz.

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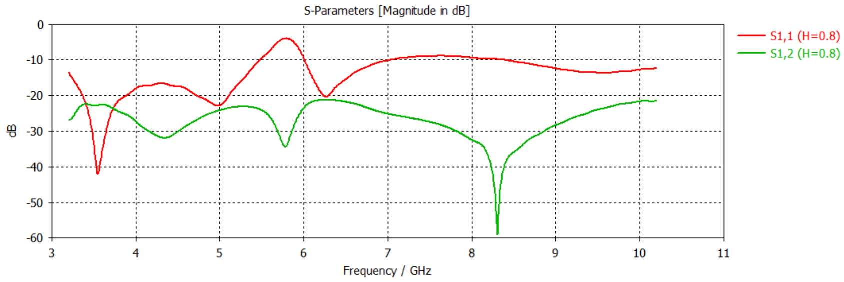

Fig. 4 S-Parameters with Stub Structure (|S11|, |S12|)

Since two antenna elements are identical |S22| and |S21| are same as |S11| and |S12| respectively.

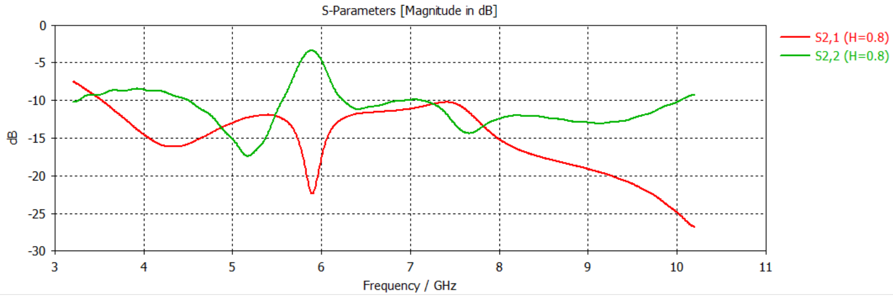

Fig. 5 S-Parameters without Stub Structure (|S22|, |S21|)

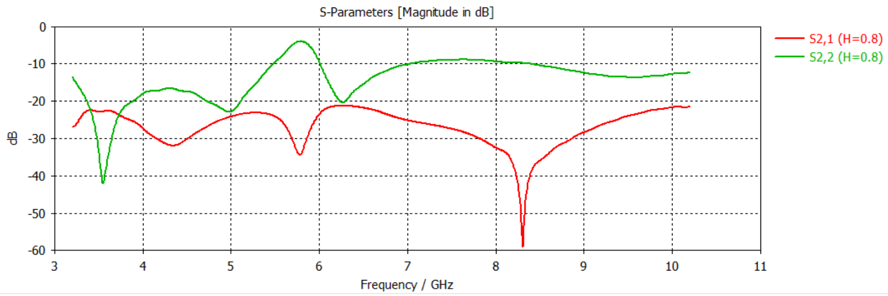

Fig. 6 S-Parameters with Stub Structure (|S22|, |S21|)

V. Conclusion

The design is implemented on CST Microwave Studio Suite Software. Antenna performance is investigated by observing the results such as VSWR, S-Parameters and Efficiency with and without the band rejection structure. The antenna resonates at frequency range 3.2GHz to 10.2GHz. The radiation patterns at three different frequencies (3.2 GHz, 6.7GHz, 10.2GHz) are analyzed. Improved Impedance Matching is observed along with the wideband characteristics by comparing the design without band rejection structure with design containing the structure. Thus the proposed design is proved to be efficient in reducing mutual coupling between two elements of MIMO antenna

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