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Band Notched Ultra Wide Band MIMO Antenna with Inverted F isolated Structure

Arya S[1], Dr.Sindhu R[2], Rekha G Nair[3]
Department of Electronics and Communication Engineering[1,2,3], *PG student*[1], Professor[2], Assistant Professor[3]
Email: arya.santhakumar@gmail.com[1], *rsindhu@gmail.com*[2], *rekhagn2010@gmail.com*[3]

Abstract- The paper describes a band notched ultra wide band (UWB) multiple input multiple output (MIMO) antenna. An MIMO antenna is designed with two symmetrical G shape elements each of 8 x 8 mm^2 operating between 2.2 GHz and 13.3 GHz. By using G shaped antenna, the frequency range of 4.4 GHZ to 6.2 GHz which is important for wireless local area network (WLAN) is notched. Each antenna is fed through a 50 Ω microstrip transmission line (MTL) and a thin strip is provided at the end of the transmission line for impedance matching. An inverted F shaped strip is provided at the ground level in order to reduce the mutual coupling. This antenna is printed on the FR4-Epoxy substrate. The output is simulated on Ansoft HFSS (High Frequency Structure Simulator). The performance of the antenna was measured in terms of return loss, VSWR and MIMO parameters.

Index Terms- Ultra wide band; MIMO; FR4-Epoxy; return loss; VSWR; HFSS.

1. INTRODUCTION

Ultra wide band (UWB) systems have received a growing interests due to the applications in high data transfer rate, multimedia streaming, radar and biomedical imaging. UWB communication systems get attention in wireless world because of its advantages. Some of the advantages of UWB systems are high data rate, low spectral power density, high precision ranging, low cost, large channel capacity, high immune to multipath interference [1]. Federal Communications Commission (FCC) has approved the use of the frequency range of 3.1–10.6 GHz for UWB communication systems.

In today world, massive MIMO is used in 5G communications. For that the UWB antenna should operate on the upper UWB frequency. In order to increase channel capacity of the SISO systems to meet increasing demands for high-speed communications, the bandwidth and transmission power have to be increased significantly. MIMO systems could substantially increase the capacity in wireless communication without increasing the transmission power and bandwidth. MIMO systems exploit multipath. A MIMO system employs several transmit and receive antennas at each end of the radio link, and in order to achieve a high capacity, different signal paths between them should be uncorrelated.

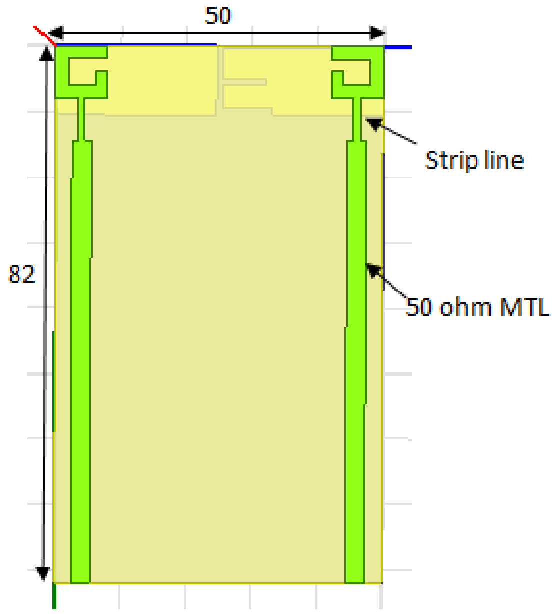
2. ANTENNA DESIGN

The antenna is designed on FR4-epoxy substrate of 82 x 50 mm^2 and thickess of 1.6 mm. FR4-epoxy has a relative permittivity of 4.6. The square patch has the dimension of 8 x 8 mm^2 and it is fed through 50 ohm microstrip line (MTL) of width 3mm. At the end a strip line is designed to provide an impedance matching. Strip line has a dimension of 67.5mm length and 1mm width. An isolation of shape inverted F is placed in between the antenna in the ground plane and is shown in figure 1.

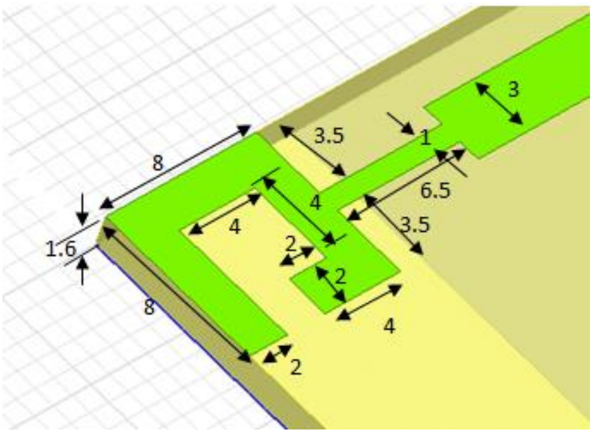
The G shape antenna is one of the split ring resonator which yields band rejection operation. Thus by optimization, it rejects a band of 5 GHz to 7 GHz in the reflection coefficient. The impact of the isolation on the s parameter is investigated on figure 3. Various isolation structures like T shaped [2], plus shaped [3] and various structures [4-8] are used. By using inverted F structure, a satisfactory result has been achieved. Inverted F isolation structure gives a better isolation of -20dB. VSWR is also plotted in the figure 4 and 5. The value is in between 1 and 2 where the reflection coefficient is below -10dB.

3. SIMULATION RESULTS

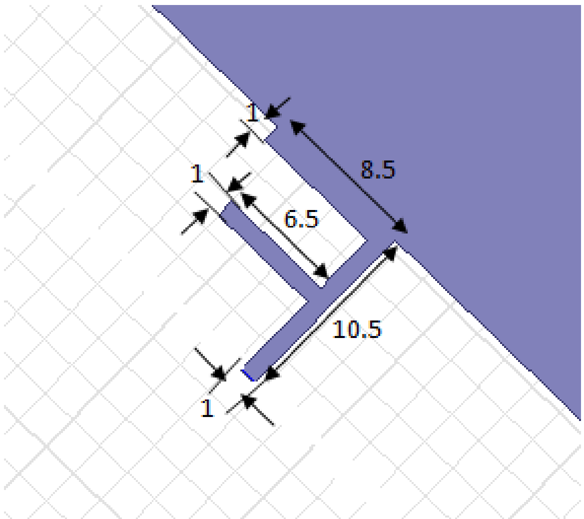
The MIMO antenna is designed and simulated in Ansoft HFSS. Return loss and VSWR for above antenna is shown in the figure 2 and 3.



(a)

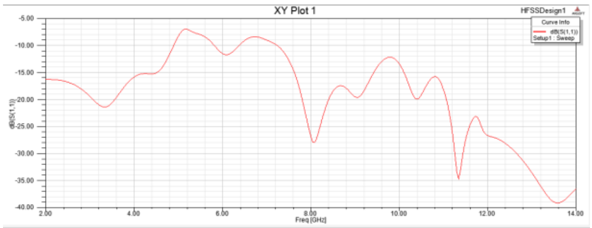


(b)

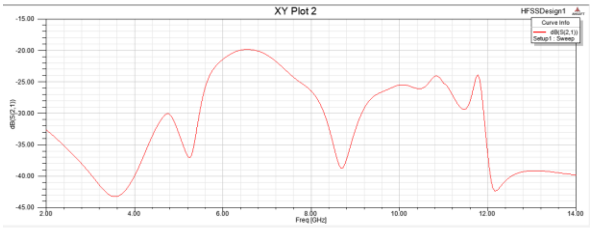


(c)

Fig. 1. 3D structure of MIMO antenna (a) overall view, (b) detailed view of G shape antenna (c) detailed view of isolation. (dimensions are in mm)

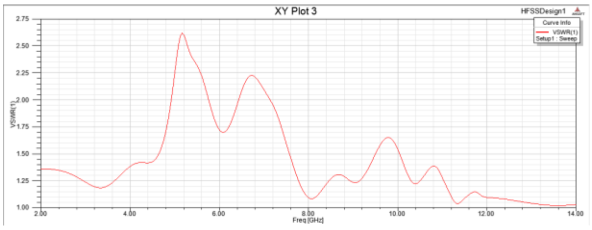


(a)

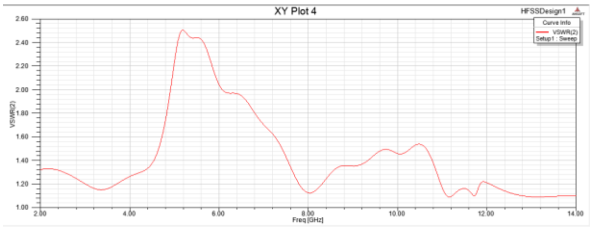


(b)

Fig. 2. Return loss (a) S11 parameter (b) S21 parameter



(a)



(b)

Fig. 3. VSWR (a) VSWR 1 (b) VSWR 2

From the figure 2 (a), the antenna rejects a band from 5GHz to 7GHz since G shape antenna act as a split ring resonator which yields a band rejection operation in order to reduce the interference in UWB MIMO antenna. The S11 parameter in the frequency range 2 to 14 GHz is less than -10dB except 5 to 7 GHz band. The impact of inverted F isolation on S parameter is shown in figure 2 (b). By using inverted F isolation structure in ground, it provides an isolation of -20dB.

VSWR 1 and VSWR 2 are shown in the figure 4 and 5 respectively. VSWR 1 corresponds to S11 parameter and VSWR 2 corresponds to S22 parameter. VSWR is in between 1 and 2 where S parameter is less than -10dB.

4. CONCLUSION

A MIMO antenna system is proposed in this study for UWB applications. The two G shaped antenna elements are fed through 50Ω MTL with a strip line for impedance matching. Frequency range of 5 GHz to 7 GHz which is suitable for WLAN application was successfully rejected. Inverted F isolation structure is employed on the ground plane to improve the isolation. And it gives a better isolation of -20dB. These results show that the systems have excellent antenna characteristics.

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