Design and Simulation of a Compact Microstrip UWB Antenna with Notched Band Employing Defected Microstrip Structure

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Abstract— *In this paper, we have investigated a circular patch antenna with Defected micro strip Structure (DMS) for UWB applications. The proposed antenna covers the entire UWB band (i.e.3.1GHz to 10.6GHz) except the frequency band from 5.221-5.466 GHz to avoid interference within this frequency range. Simple CPW feed line is used for feeding the printed antenna. We have simulated this circular patch antenna with DMS using CST Studio 2014 software and it has been observed that the notch frequency response can be obtained by introducing a Defect in feed line. Defected Microstrip Structures (DMS) are proposed to increase the effective inductance. So the cutoff frequencies of Notch band made by DMS can be controlled.*

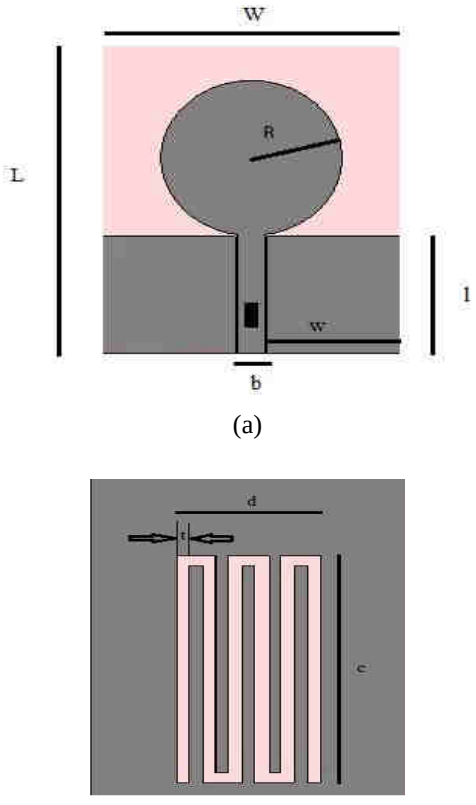
Keywords— DMS,UWB.

I. INTRODUCTION

The rapid growth of communication systems employing ultra wide band (UWB) and narrowband antennas has in- creased the demand for compact, low-cost antennas with interference rejection capabilities. UWB antennas with frequency notches to suppress radiation from other narrowband systems overlapping within the UWB spectra have emerged as a challenging research area. Several designs available in open literature use techniques adopted by modifying the radiator with different type of slots or by parasitic loading [10]. In antenna terminology, this basically means that we will design an antenna which has a return loss less than -10dB throughout the UWB frequency 3.10-10.6GHz except at the frequency region 5.221-5.466 GHz where the return loss should be greater than -10dB. In recent years, there is a lot research works carried out in this area. Most of these methods incorporate slots and defects on the radiator or the ground plane. In this paper authors proposed a method to obtain a notch in the UWB frequency spectrum by introducing a DMS structure in feed line.

II. ANTENNA DESIGN

Figure 1 shows the geometry of the proposed UWB antenna with DMS, The radiator is a circular monopole having radius R fed by a coplanar waveguide consisting of ground planes having equal widths w and lengths l and a signal line having width b and length l+s. The antenna is printed on substrate having thickness h and dielectric constant ε. The signal line is etched with a structure as shown in figure 1 . The total length of the etched structure is e and its width is d and this structure having strips of thickness t .The feed point location is so chosen to get perfect matching condition.



(a)

(b)

Fig. 1: Configuration of proposed antenna
(a) Top View (b) Proposed DMS

he design specification of the proposed antenna is given in Table : 1-

Table : 1

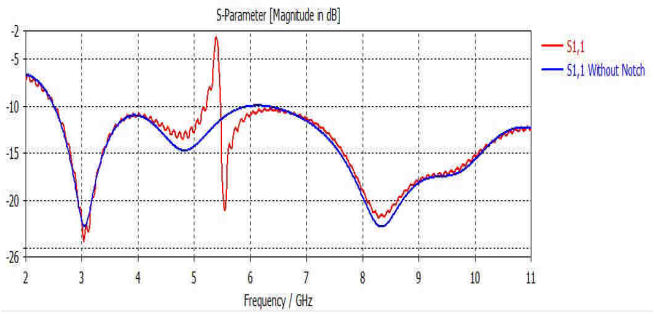
Dielectric constant of Taconic (ε)	2.33
Height of substrate (h)	1.575mm
Width of substrate (W)	50mm
Length of substrate (L)	60mm
Microstrip feed line width (b)	4.8mm
Microstrip feed line length	22.5mm
Width of ground plane (w)	22.35mm
Length of ground plane (l)	22mm
Circular ring radius (R)	15mm
Total length of the DMS (c)	4.62mm
Total width of the DMS (d)	2.2mm
Thickness of each strip (t)	0.20mm

III. SIMULATION RESULTS AND DISCUSSION

The proposed antenna is simulated using CST STUDIO 2014 suite and the results of proposed antenna is analyzed using various parameter such as VSWR , return loss, and Gain at different frequencies. We have chosen three sample frequency 2Ghz, 3.1Ghz and 5.34Ghz. Among these sample frequencies 2Ghz frequency lies outside the UWB spectrum, 3.1Ghz frequency lies inside the UWB region and 5.37 Ghz lies in notch band. Far field parameters of proposed antenna are analyzed using these three frequency samples which cover the region outside the UWB spectrum, region inside UWB spectrum and region inside notch band. Return loss and VSWR parameters are analyzed in frequency range from 2 Ghz to 11 Ghz.

a) S parameter Plot

The simulation result of return loss of the proposed antenna is shown in figure 2 . This return loss plot tell us that the amount of reflected power at different frequencies. For an antenna operating in any band this reflected power should not exceed -10 db.



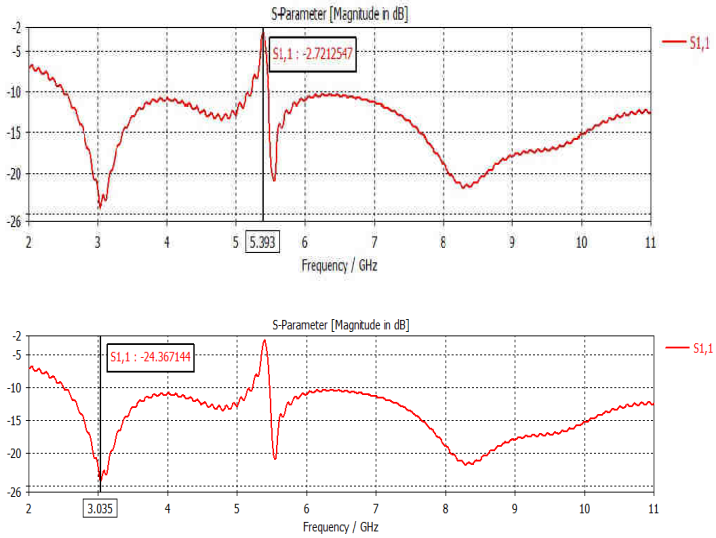


Fig. 2 (a) *S parameter plot of proposed antenna with and without DMS* ***(b)*** *S parameter plot of proposed antenna with DMS showing notch band cut off frequency****(c)*** *S parameter plot of proposed antenna with DMS showing minimum return loss*

It is clear from the above figure that the proposed antenna have return loss less then -10db from 2.5 Ghz to 11 Ghz which cover the entire UWB spectrum. It shows minimum return loss -24.36db at 3.035 Ghz. when DMS is introduced in antenna then frequency notching characteristics are obtained. Here we get a stop band with centre frequency at 5.393 Ghz having return loss more then -10db. The frequency range of this notch band is from 5.220Ghz to 5.466Ghz.So by introducing DMS a stop band of 0.246 mhz bandwidth can be obtained.

b) VSWR plot

The VSWR plot of the proposed antenna is shown in

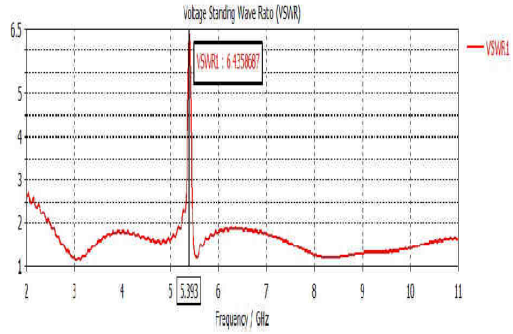


figure 3-

Fig. 3 VSWR plot of proposed Antenna

It is clear from the above figure that VSWR is below two from 2.5Ghz to 11Ghz.At stop band cutoff frequency which is 5.393mhz the VSWR is maximum having value

6.435.In the stop band region all frequency points having VSWR greater then two.

c) Gain plot

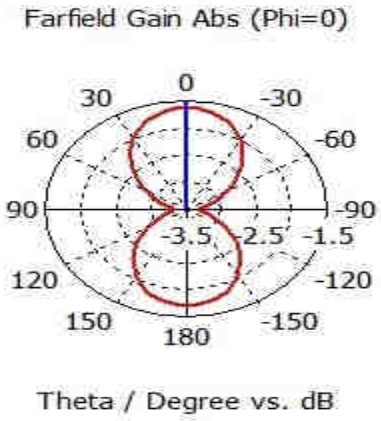


Fig. 4 Gain plot at 2 Ghz

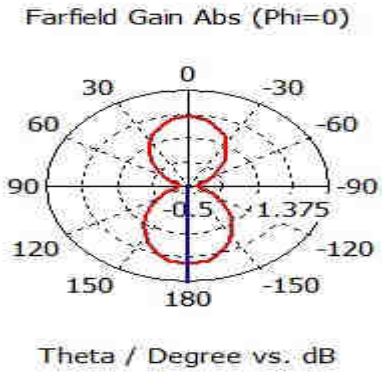


Fig. 5 Gain plot at 3.1 Ghz

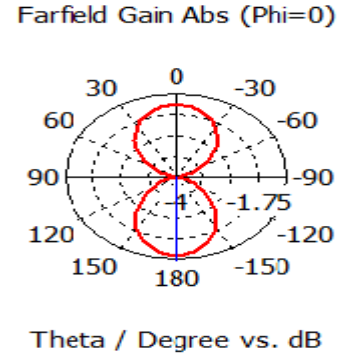


Fig. 6 Gain plot at 5.34 Ghz

It is clear from the above figures that main lob gain is maximum at 3.1 Ghz having value 1.51db. while Gain decrease in the notch band and having its minimum value -1.17db at 5.34 Ghz.So Gain of the proposed antenna decreases in notch band.

IV. CONCLUSION

As Wireless communication technology is rapidly grown hence there is a need of high performing system. Antenna is a very crucial part of a wireless communication system.The main objective of this complete work is to design a small size and low weight UWB microstrip patch antenna with frequency notch characteristics and having perfect impedance matching to a 50ohm transmission line with minimum return loss and high gain . A circular shaped UWB microstrip patch antenna with Notched Band Characteristics is designed and simulated on CST STUDIO Suite 2014. Very good Simulation results are achieved. The proposed antenna shows good UWB performance in the range of 3-11 GHz and achieves band notching from 5.221-5.466 GHz to avoid interference within this frequency range. In this work we designed and simulate a microstrip UWB antenna employing Defected Microsttrip Structure. The frequency notched characteristics are obtained by this Defected Microstrip Structure. Further work can be done by using more then one Defected Microstrip Structure connected in cascade to obtain a broad bandwidth of stop band. The shape of the defected Microstrip Structure characterizes the cutoff frequency. So by designing a suitable shape of Defected Microstrip Structure and cascading of these structure a new UWB antenna can be designed for coexisting with other narrowband system. Further work can be done to obtain more then one stop band characteristics.

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