STACKED HYBRID MONOPOLE DIELECTRIC RESONATOR ANTENNA FOR ULTRA WIDEBAND APPLICATIONS

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ABSTRACT

A hybrid antenna is presented, consisting two stacked cylindrical dielectric resonators that having a step in its outer diameter. This combined with a quarter wave monopole antenna that simultaneo usly act as a radiator and a loading element. Through this configuration impedance bandwidth up to 142% with monopole type radiation ,covering frequency range 2.2 to 3.2 GHz and VSWR < 2 and minimum Gain achieved is 3.4 dB. This hybrid configuration producing an ultra wideband response.

Keywords: *Dielectric Resonator Antenna(DRA), monopole, Ultra wideband antenna(UWB).*

1. INTRODUCTION

Recently demand in wireless application indicate need to combine different services on a single handset. So it is efficient to use single antenna that cover various frequency bands. DRA fulfil this requirement effectively. DRA is an antenna that makes use of a radiating mode of a dielectric resonator. It consist of dielectric materials in its radiating patch also called as dielectric resonators (DRs) on one side of the substrate and has a ground plane (metal) on the other side. In the extreme demand of wireless communication technology it is the efficient radiators to achieve successful and affordable communication. DRA offers attractive features as antenna elements. These features include their mechanical simplicity, small size, high radiation efficiency due to no inherent conductor loss, relatively large bandwidth, versatility in the shape and simple coupling schemes to nearly all commonly used transmission line.

The hybrid monopole/dielectric resonator antenna (DRA) has become attractive to antenna designers due to its broadband characteristics along with the advantages of the DRA [1], [4]. Hybrid antenna consisting cylindrical dielectric resonator antenna with quarter-wave monopole producing 102% impedance bandwidth[1]. A very interesting work on the guidelines for the design of this antenna was presented [2]. H shape dielectric resonator antenna offers 62% impedance bandwidth [3]. Four-element multilayer cylindrical DRA array offers 47% impedance bandwidth. This antenna is suitable for WIMAX application [4]. A wideband rectangular DRA using a proper tapered strip excitation from one side of the DR offers good radiation characteristics and bandwidth of 96% [5]. Rectangular DRA present 55.8% relative impedance bandwidth [6]. In this paper proposed antenna is stacked two cylindrical DRA with monopole that is capable of producing 142% impedance bandwidth.

2. ANTENNA CONFIGURATION

Antenna configuration of DRA mainly consists of three basic components; they are Substrate, ground(Perfect Electric Conductor material etched on substrate and dielectric resonating material mounted above the ground, referred as “Dielectric Resonator ”. Generally in the microwave band, DR is an electronic component that

exhibits 'resonance' for a wide range of frequencies. If the DR placed in an open environment, Power will be lost in the radiated fields only. This fact makes dielectric resonators useful as antenna elements instead of elements in microwave circuits as energy storage devices.

Figure 1 shows the two cylindrical stacked DRAs each having step in its outer diameter and excited by coax-fed cylindrical monopole over a ground plane. The coaxial feed, the monopole and the vertically stacked DRAs share the same axial reference. The antenna is physically enhanced through a wide simulation analysis to achieve ultra-wideband (UWB) performance.

The total bandwidth response of the coaxial feed, quarter monopole and the DRA arrangement become greater bandwidth response than the sum of the bandwidth of the separate antennas. A minimum return loss of -10 dB maintained over the operating bandwidth is chosen two frequencies. Proposed antenna is capable of achieving an ultra-wideband response by selecting appropriate dimensions of coaxial feed, monopole and the stacked cylindrical DRA. This antenna geometry covers more than one microwave band. Proposed antenna generates the frequency range which enhances the bandwidth.

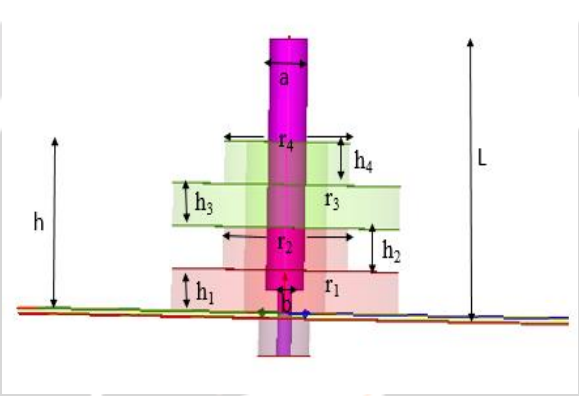


Fig. 1 Cross section of the Stacked cylindrical monopole-DRA

Dimensions of hybrid stacked monopole DRA:

Table 1: Dimension of the Stacked cylindrical monopole DRA

h mm	L mm	r mm	a mm	b mm	ε_r
14 $h_1 = h_2 = 3.5$ $h_3 = h_4 = 3.5$	22.4	$r_1=r_3=10$ $r_2=r_4=5.5$	1.7	0.65	10

Dimension of DRA is calculated by using basic equations of DRA [6]. Initially design is constructed by using calculated value, after that parametric study has been carried out for different height of DRA and radius of DRA.

3.SIMULATION RESULTS

Figure 2 shows return loss that is carried out for different height of DRA and figure 3 shows return loss characteristic for different radius of DRA. Figure 4 shows the proposed antenna is a ultra wideband antenna that covering range 2.2 to 3.2 GHz with return loss < -10 dB. Figure 5 shows the obtained minimum gain of antenna that is 3.4 dB. Radiation pattern is obtained at frequencies 4.4 GHz, 6 GHz, 12GHz (figure 6) that indicate antenna exhibit a monopole type radiation pattern. Radiation pattern at higher frequency is distorted as coupling effect between monopole and DRA is higher.

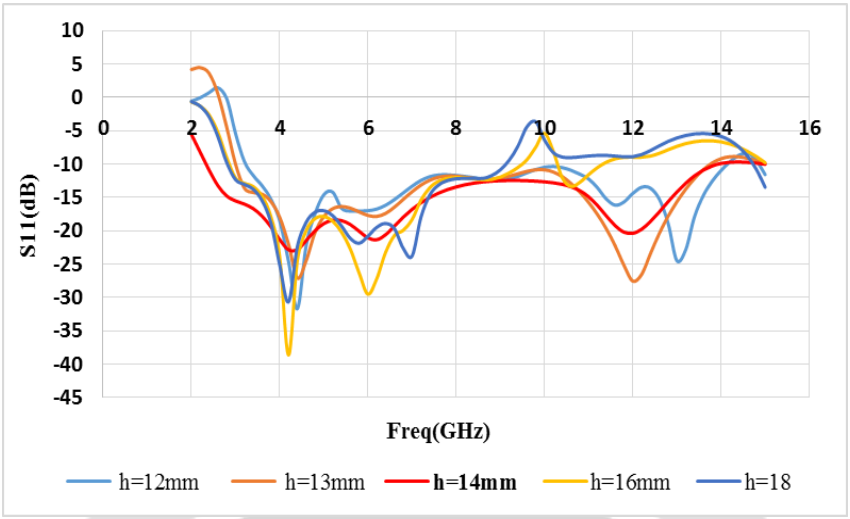


Figure2 : Return loss characteristics for different height of DRA

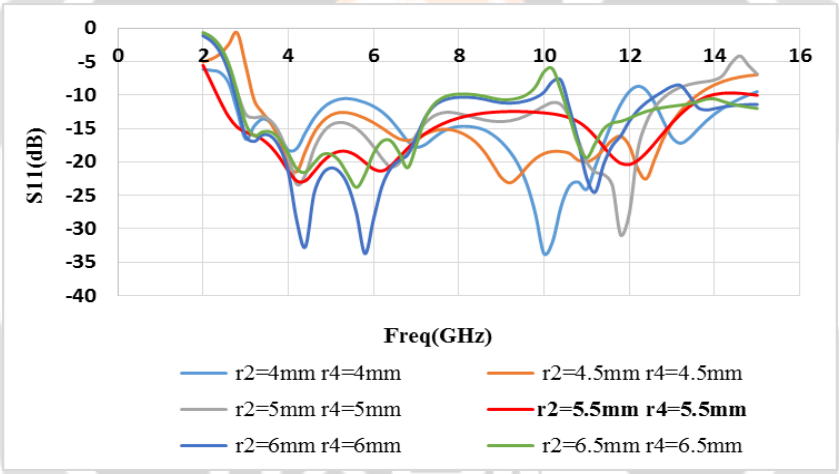


Figure 3: Return loss characteristics for different radius of DRA

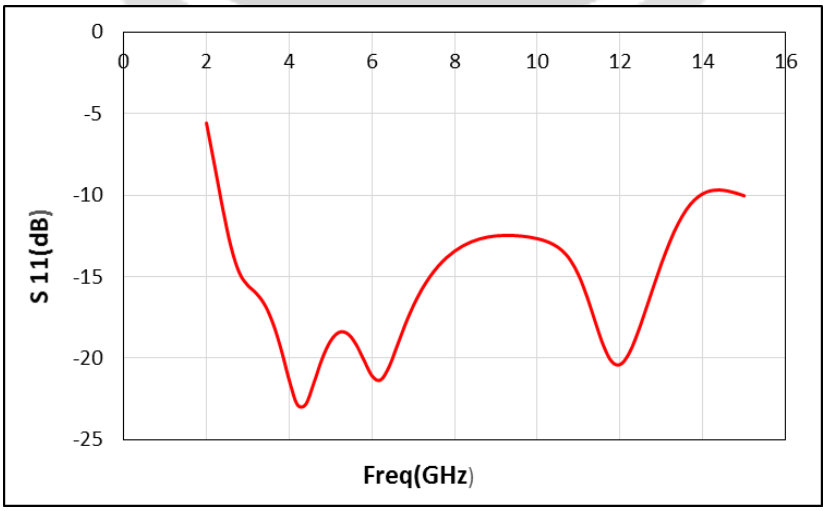


Figure 4: Return loss of stacked cylindrical monopole

DRA

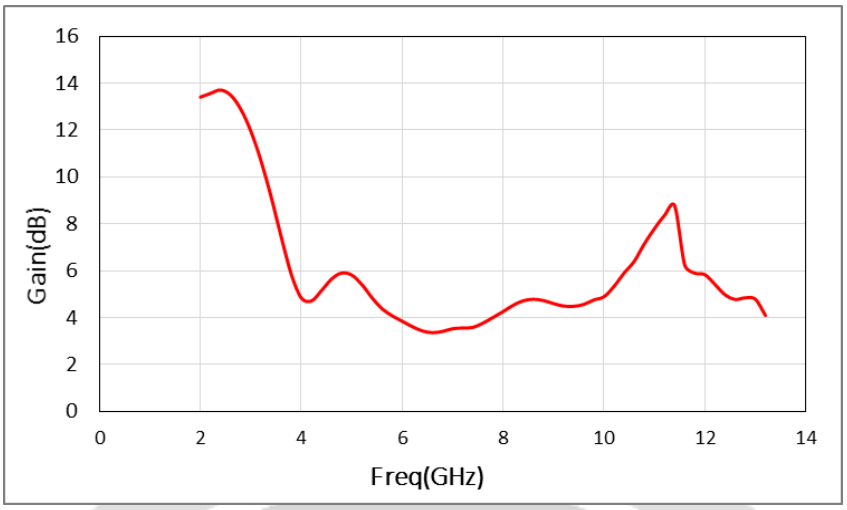
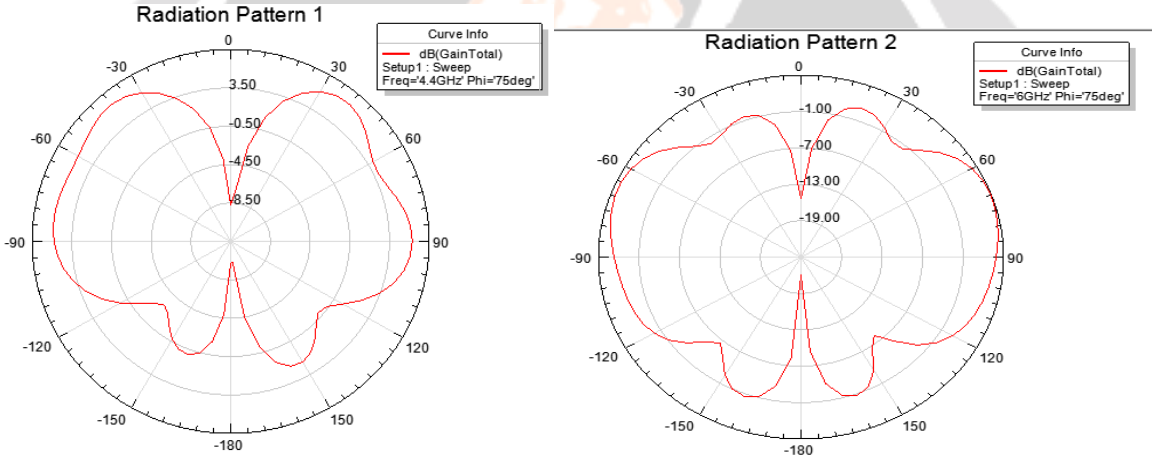
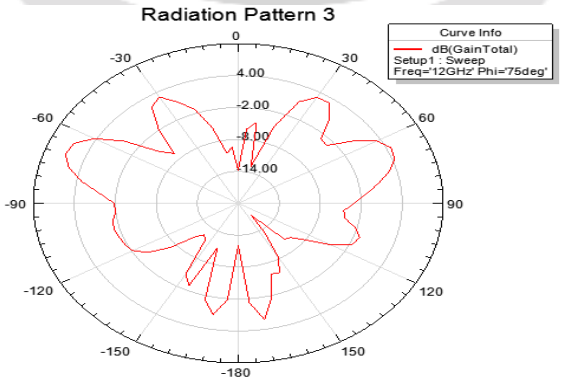


Figure 5: Gain of antenna



Radiation pattern of antenna at **4.4 GHz** Radiation pattern of antenna at **6.6 GHz**



Radiation pattern of antenna at **12 GHz**

Figure 6: Radiation patterns of antenna at different frequencies

4. CONCLUSION

Hybrid antenna present in this paper offers bandwidth upto 142% with average 3.4 dB gain and exhibit monopole type radiation pattern. This antenna produce an ultra wideband response that is used for many applications like WIMAX and satellite communication. By further change in dimension of antenna we can even obtain wider bandwidth.

5. ACKNOWLEDGEMENT

The author would like to thanks Dr. A.C. Suthar & Asst. prof. Nimesh M. Prabhakar from L. J. Institute of Engineering and technology for technical discussion & processing support without whom this paper would never be completed.

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