REVIEW ON LPDRA FOR VARIOUS APPLICATIONS

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Abstract: A Log Periodic Dielectric Resonator Antenna (LPDRA) can be used for various applications in different frequency bands. In this paper, DRA is simulated using a CST microwave studio suite TM 2010 tool and determine the value of some parameters such as impedance, frequency and gain of the antenna. So that LPDRA can be used in various applications in different frequencies.

Keywords: DRA, LPDRA, Microstrip and Teflon.

1. INTRODUCTION

A dielectric resonator antenna (DRA) is a radio antenna for the most part utilized at microwave frequencies and higher, that comprises of a square of earthenware material of different shapes, the dielectric resonator, mounted on a metal surface, a ground plane. Radio waves are brought into within the resonator material from the transmitter circuit and bob forward and backward between the resonator dividers, shaping standing waves. The dividers of the resonator are mostly straightforward to radio waves, enabling the radio capacity to emanate into space [1].

Dielectric Resonator Antennas (DRAs) have some particular properties which render them promising, particularly for millimeter wave applications. DRAs can be planned with various shapes, for example, rectangular, round and hollow and hemispherical geometries to suit different structure necessities [2]. Rectangular DRAs can be structured with more noteworthy adaptability since two of the three of its measurements can be changed freely for a fixed resounding frequency and known dielectric consistent of the material [3]. In the event of rectangular DRA, the accessibility of one level of opportunity more than barrel shaped and round DRAs can be utilized to control the bandwidth of the antenna. When contrasted with the microstrip antenna, the DRA has an a lot more extensive impedance bandwidth because of their numerous beneficial highlights. These incorporate their smaller size, light weight, the adaptability in their shape and nourishing instrument, straightforward structure, simple creation and wide impedance bandwidth.

Bandwidth improvement is turning into the real plan contemplations for most down to earth uses of Dielectric resonator antennas. A few bandwidth improvement systems have been accounted for on altered feed geometries and changing the state of the DRA including funnel shaped, tetrahedron, ring, triangular and so forth [4]. The gain, bandwidth and radiation execution of DRA can likewise be adjusted by utilizing array rather than single DRA. If there should arise an occurrence of array, DRA elements of legitimate geometry can be gathered and bolstered reasonably [5-6]. These DRA arrays discover applications in earthbound applications just as radars [7].

Log Periodic DRA (LPDRA) array depends on ongoing improvements of wideband DRAs and the multi-frequency log-periodic strategy. As the log-periodic antenna gives multi-band, high-frequency wide bandwidth with high gain and great radiation attributes, to improve the bandwidth just as the radiation qualities of the array, a log-periodic strategy has been executed on a DRA. The LPDRA is acquainted with accomplish significant multi-frequency wide bandwidth with low director misfortune for Ku-band applications. This antenna configuration has likewise incorporated a minimal effort dielectric material (Teflon) with permittivity of 2.1 for simple creation of array [8]. The structure methodology of the DRA utilizing the log-periodic procedure is talked about, and the detail aftereffects of the proposed antenna are examined in this article. At long last, the LPDRA offers persistent task from 11.4-to 18-GHz bandwidth.

In this paper, the structure of Log Periodic Dielectric Resonator Antenna (LPDRA) is proposed for different applications. CST microwave studio suite TM 2010 programming has been utilized to investigate the exhibitions, for example, return misfortune, radiation examples, VSWR and gain of the structured antenna. The structure methodology of the DRA utilizing log periodic procedure is talked about and the detail consequences of the proposed antenna are displayed in this paper. LPDRA offers nonstop task from 18 to 40 GHz bandwidth. Accordingly it is the brilliant decision for multiband HF task. This proposed LPDRA antenna can assume an essential job in the cutting edge correspondence and radar framework.

2. DESIGN OF LOG PERIODIC DIELECTRIC RESONATOR ANTENNA

The geometry of the LPDRA, including its excitation feed line is appeared in figure 1. The proposed DRA is a 9-element log periodic array intended to work more than 18-40 GHz. The log periodic antenna was designed by D E Isbell having broadband abilities [9]. In this antenna it is ordinary to drive exchanging element with 1800 of stage move from each other [10]. The length, width and separating of the elements of a log periodic antenna increments logarithmically from one end to the next.

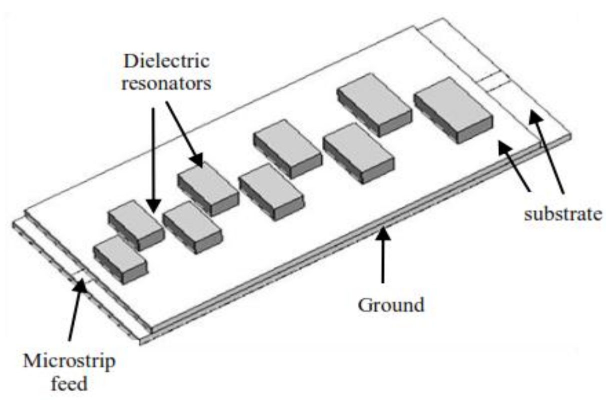

Fig.1 Design of Log Periodic Dielectric Resonator Antenna

The schematic view of the Log Periodic DRA is appeared in figure 2. The length (L), width (W) and dispersing (S) between the DRA elements are given by the expression

$$\tau = \frac{L_{m+1}}{L_m} = \frac{W_{m+1}}{W_m} = \frac{S_{m+1}}{S_m}$$

Where τ is a scale factor

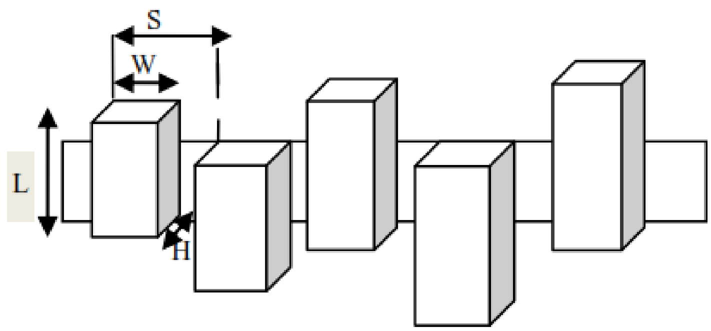

Fig.2 Schematic view of LPDRA Array

On the off chance that the element of the array is duplicated by τ it scales into itself with element m getting to be element m+1, element m+1 getting to be element m+2 and so forth [11]. This self-scaling property suggests that the array will have the equivalent emanating properties at all frequencies that are connected by a factor of τ. The estimation of L, W and S will be scaled into log periodic element [12]. In this plan we utilized dielectric resonators having dielectric steady (εr1) =12 with stature (H) = 3.2 mm. This LPDRA array is bolstered by FR4 substrate with dielectric consistent (εr2) of 4.4 and stature (h) of 1.6 mm. The element of the principal dielectric resonator element were length L= 6.8 mm, width W= 4 mm and dividing S=5.6 mm, the component of other dielectric resonators were scaled by τ. The scaling factor τ is 1.05. The removal of the radiators from the focal point of feed line was basic for the entire array and equivalent to 1.25 mm. The length of array is 72 mm and width is 30 mm. Since the thunderous frequency and the radiation obstruction depend principally on the dielectric resonators measurement and marginally affected by the substrate thickness, so the stature of both the substrate layer and feed line were kept steady.

The fundamental plan of DRA array is like that of an ordinary log periodic array. As microstrip line bolstering offers the benefit of simple and savvy creation of DRA, so the proposed DRA array is energized by microstrip line encouraging. This antenna configuration is utilized where a wide scope of frequencies, moderate gain and directionality are required.

3. PERFORMANCE ANALYSIS OF LPDRA

A LPDRA for 11.4-18 GHz bandwidth has been planned and investigated. The consequences of the seven-element array are talked about as far as bandwidth reaction, input impedance, gain, and radiation design attributes. The recreation investigations of the S-parameter versus frequency attributes for the proposed LPDRA have been completed and are introduced in figure 3.

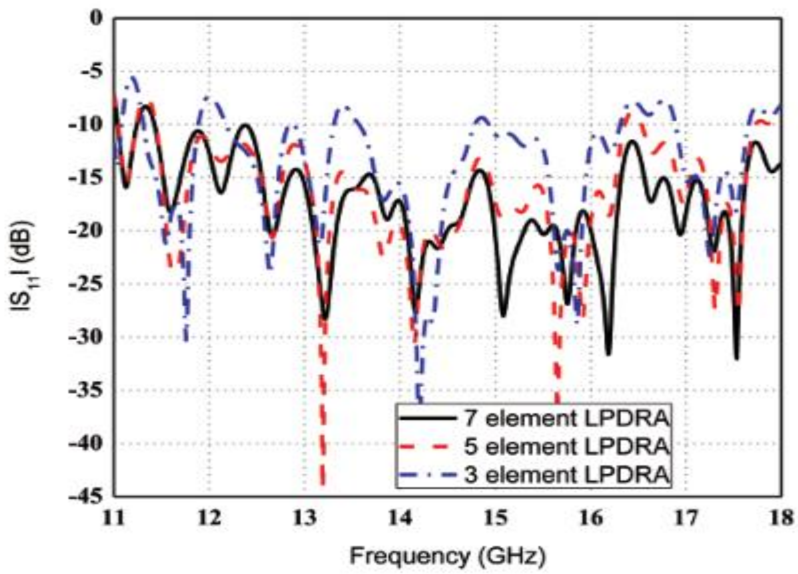

Fig.3 LPDRA for various DR elements

3.1 Parametric Analysis

The gain, bandwidth, and radiation exhibitions of the DRA can be modified by utilizing a log-periodic array rather than a fundamental molded DRA. An array of seven resonators (seven-element LPDRA) results in a wide impedance bandwidth in contrast with five and three-element DRAs. Figure 3 demonstrates the S - parameter versus frequency qualities of the LPDRA for various quantities of elements (three, five, and seven). It tends to be acknowledged from this plot among all arrays; just the array with seven elements gives a wide bandwidth from 11.4 to 18 GHz.

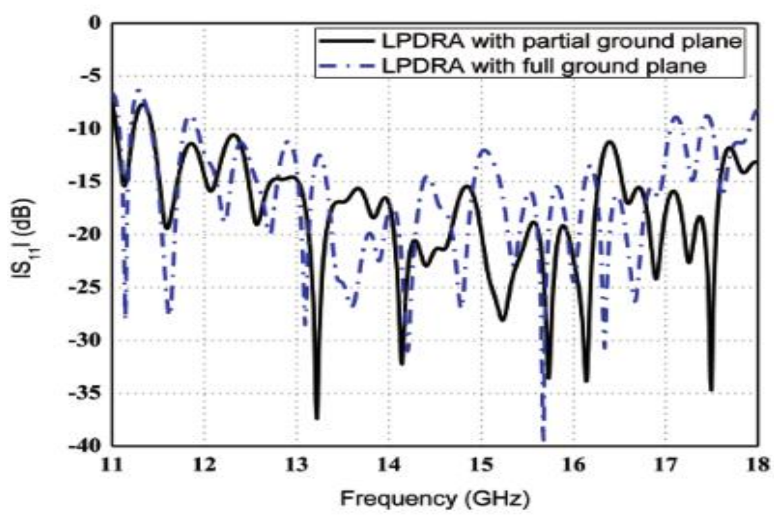

Fig.4 LPDRA with full ground plane and partial ground plane

Essentially in the following structure step, a halfway ground plane was presented rather than a full ground plane to improve the came about bandwidth. A parametric report is portrayed in figure 4 for a LPDRA with a full ground plane and with a fractional ground plane to accomplish the ideal bandwidth. For the LPDRA with a full ground plane, impedance bandwidth goes up to 17 GHz, while for the incomplete ground plane, the ideal bandwidth up to 18 GHz with S11 (dB) underneath 10 dB is seen. The S - parameter estimation of the created LPDRA is performed utilizing a 8720B Agilent arrange analyzer. Figure 4 demonstrates the re-enacted and estimated S - parameter (dB) as the capacity of frequency.

3.2 Frequency Response and Characteristics of Input Impedance

It is seen in figure 3 that the DRA bandwidth is straightforwardly influenced by the quantity of elements utilized. Contrasted with the bandwidths of the 3, 5 and 7-element arrays, the seven-element LPDRA gives the ideal bandwidth. The bandwidth reaction and gain of the LPDRA with a scaling factor 1.05 has additionally been contrasted and the LPDRA with various scaling factors. A LPDRA with DRs having diverse dielectric constants is additionally reproduced to check the optimality of the proposed array. The bandwidth reaction of a DRA with various materials is nearly the equivalent; however the favored material for the proposed array is Teflon. The Teflon-based dielectric materials are most appropriate for DRA structure as they are not inclined to chipping contrasted with other dielectric materials.

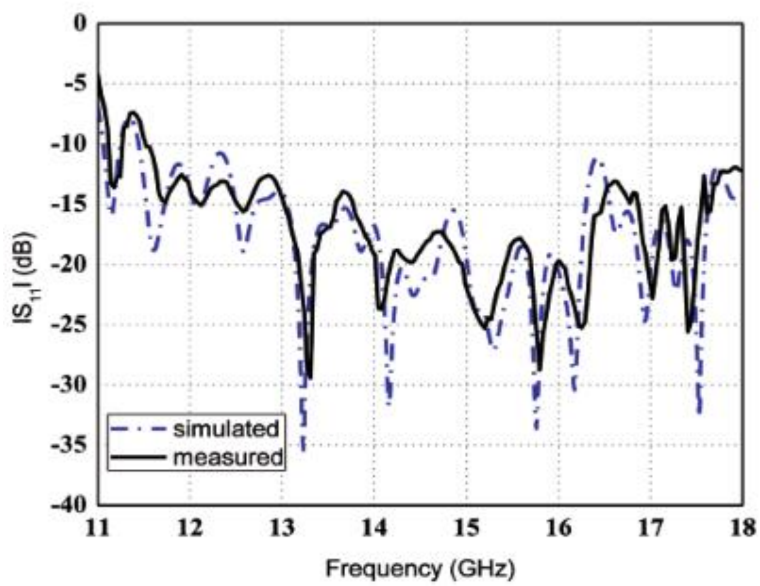

Fig.5 LPDRA Simulated and Measured Plots

At long last, the reenacted and estimated S-parameter of the seven-element LPDRA with a scaling factor 1.05 has been plotted against frequency and is appeared in figure 5. The subsequent bandwidth is observed to be 46%. The reproduced and estimated consequences of the proposed LPDRA demonstrate a decent guess. The genuine and fanciful pieces of information impedance versus frequency bends of the proposed antenna have been exhibited in figure 6. The information obstruction at resounding frequencies of the LPDRA is observed to be about 50ω, while the nonexistent piece of the information impedance is zero, giving great impedance match to a 50-☐microstrip line feed.

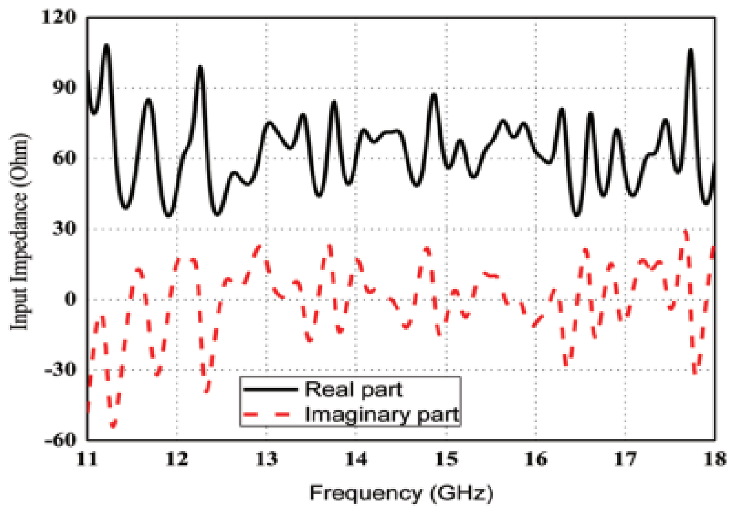

Fig.6 LPDRA Input Impedance Curve

3.2 LPDRA Gain

DRAs are far better than microstrip antennas, as they have insignificant metallic misfortune and high proficiency at millimetre-wave frequencies. Because of low loss of the dielectric materials, DRAs offer a high radiation productivity just as high gain in logical inconsistency with microstrip antenna. The proposed LPDRA is analyzed against a log-periodic microstrip array without DRs, in which the DRs are supplanted with microstrip patches. In a LPDRA, DRs are the transmitting elements, while in a log-periodic microstrip array, the patches are emanating. In the two cases, the array is emanating admirably, yet the execution (regarding gain) of the LPDRA is better analyzed than the log-periodic microstrip array.

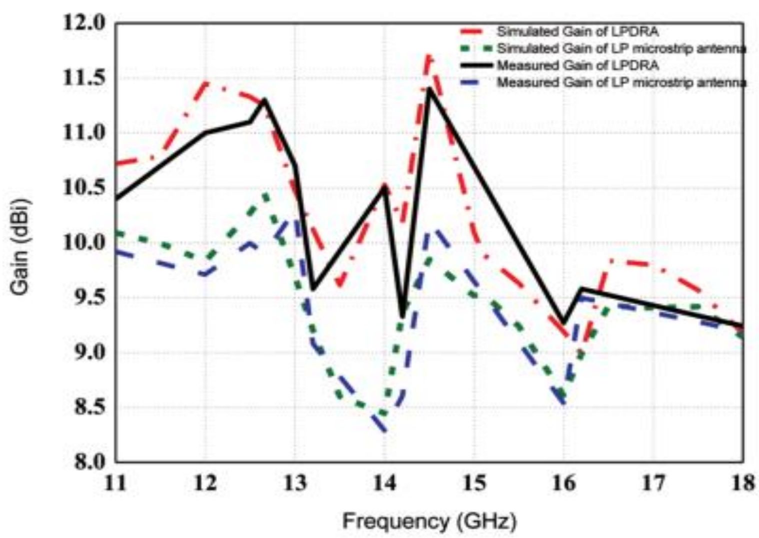

Fig.7 Gain of LPA and LPDRA (Measured & Simulated)

Figure 7 to the recreated and estimated gain versus frequency plots for the log-periodic array with DRs and without DRs. From the plot, it is confirmed that inside the ideal band, the gain of the DRA is superior to the gain of the microstrip antenna. On account of a log-periodic microstrip array, a wide band can be accomplished with low gain and less radiation productivity, as the director misfortune is more noteworthy contrasted with the LPDRA. The gain qualities of the LPDRA fluctuate about log periodically between the scopes of 9.4 to 11.4 dBi with 96% of radiation proficiency.

4. CONCLUSION

In this paper, a Log Periodic Dielectric Resonator Antenna (LPDRA) is designed by using 9-element log periodic array. In that array antenna, using a CST microwave studio suite TM 2010 tool, gain, bandwidth and impedance of the LPDRA array are analyzed. This LPDRA array can be used in various applications by applying different frequencies.

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