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LOG PERIODIC DIPOLE ANTENNA FOR UWB APPLICATIONS

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ABSTRACT:

To Design a Printed Log Periodic Dipole Antenna (PLPDA) that is able to operate over Ultra Wide Band frequency range (3.1 GHz to 11.6 GHz). The advantage of the antenna is compact and easy to integrate with planar circuits which are suitable for applications that need wide bandwidth and high gain and directivity antenna. The dimension of antenna has initially been calculated and modelled using a CST simulation tool to optimize the effect of dielectric properties of substrate on the width and length of dipole element conductors. Antenna size can be reduced while maintaining its overall performance characteristics. FR-4 substrate is used as its more reliable in India than RT-Duroid and also produces same efficiency. To validate the designed antenna, it is fabricated and its gain, directivity, return loss and VSWR are measured**.**

Keywords**:**

printed log periodic dipole array antenna (PLPDA), UWB (ultra wide band), CST microwave studio, FR-4.

1. INTRODUCTION:

Ultra wideband (UWB) wireless communication allows low power level and high data rate transmissions have embarked great research interests

for wireless communications applications in the 3.1 GHz–11.6 GHz frequency band. Printed log-periodic dipole antenna (PLPDA) is an example of UWB antenna which radiates in end-fire direction within ultra wide frequency band. With the multiple resonance property, its bandwidth can be increased by enhancing the number of the dipole element. The log-periodic array consists of several dipole elements which each are of different lengths and different

In transmission line region, elements do not radiate because the size of elements is less

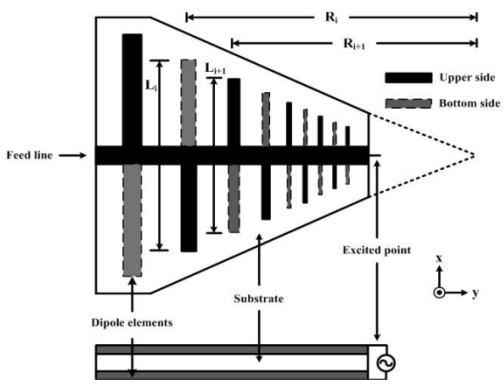
2. LITERATURE SURVEY:

relative spacing. A distributive type of feeder system is used to excite the individual elements. The element lengths and relative spacing, beginning from the feed point for the array, are seen to increase smoothly in dimension, being greater for each element than for the previous element in the array. It is this feature upon which the design of the LPDA is based, and which permits changes in frequency to be made without greatly affecting the electrical operation. A good LPDA may be designed for any band, HF to UHF at nominal cost, high forward gain, good front-to-back ratio, low VSWR. In log periodic array there are three regions

Transmission line REGION ($< \lambda/2$)
Active REGION ($= \lambda/2$)
Stop REGION ($> \lambda/2$)

The following sections present each of the research work that is brought out enumerating the issues and challenges encountered. The antenna feeding structure consists of two coaxial cables, in order to

realize an infinite balun which provides the required broadband input matching[1].The two layers of the LPDA are printed on two separate thin dielectric substrates which are substantially separated from each other[2].Designed for operation in free space as well as in printed configurations. Design considers low dielectric constant materials and thin printed embodiments. They focused to introduce the design and development concepts of a broadband UHF LPDA that allows Conformal Load Bearing Antenna Structure (CLAS) integration. Double mender dipole was used as the building block which reduces the array width is able to operate over wide frequency range (800-2500 MHz)[3]. The advantage of this antenna is compact and easy to integrate with planar circuits which are suitable for applications that need wide bandwidth and high gain antenna.



STRUCTURE OF LPDA

Antenna were designed as cylindrical wire dipoles using carrel concept. Koch-shaped dipoles is a wideband antenna design and evolve the traditional Euclidean log-periodic dipole array into the log-periodic Koch-dipole array (LPKDA)[4]. Antenna size is reduced while maintaining its overall performance characteristics. Advantages and disadvantages of the proposed LPKDA are validated through a fabricated proof-of-concept prototype that exhibited approximately 12% size reduction with minimal degradation in the impedance [5]. The design of a stripline- type LPD array, in which Carrel's method is modified to include an effective relative dielectric permittivity in computations elating to dipole lengths and spacings. The stripline geometry also incorporates a center-strip feed line for excitation of the array from a coaxial input terminal at the largest dipole end, together with a broadband balun at the smallest dipole feedpoint. The concept of reconfigurable antenna which is widely used as an additional feature of reconfigurable ability for future wireless communication systems especially for cognitive radio applications, radar system and multi-frequency communications[6]. Frequency reconfigurable LPMDA [5] has been designed to perform a wideband frequency operations by connecting fifteen dipole antennas using coaxial feed line technique.

3. PROPOSED SYSTEM:

The above fig1.a and fig 1.b depicts the overall structure of our LPDA. It consists of 10 dipole elements and the wideband transition between micro strip. Its designed based on the technique of HMSIW(half mode substrate integrated waveguide). The substrate used is FR-4. The advantages of using FR-4 is its reliable ,cheap and also produces an approximately accurate results. The dimensions of various dipole elements are tabulated as shown below.

The shortest dipole element determines the highest frequency range and the largest dipole element determines the shortest frequency range. Depending on the frequency range various parameters are list out as shown in the parameters table list.

Parameters list

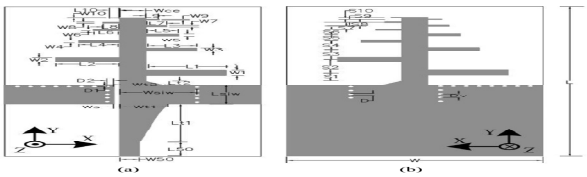
PARAMETER	VALUE	PARAMETER	VALUE	PARAMETER	VALUE

FIG 1.a Front view FIG 1.b Back view

DV	1	S2	6.3*0.7	W4	0.8*0.7
L	91.7*0.7	S3	9.7*0.7	W5	0.5
L1	13.3	S4	3.85*0.7	W6	0.3
L10	0.15	S5	2.35*0.7	W7	0.2
L2	7.93	S6	1.5*0.7	W8	0.2
L3	4.83	S8	0.6*0.7	Wce	5.6*0.7
L4	2.95	S9	0.4*0.7	Wt2	8.7*0.7
L5	1.79	S10	0.3	W	57*0.7
L50	7*0.7	Lsiw	13.4*0.7	W1	2.7*0.7
L6	1.09	Lt2	18*0.7		

4. DESIGN FORMULAS:

1. Specify the substrate p thickness



2. Calculate

3. Calculate equation fo

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} +$$

4 ΔL is the normalized extension of the length and given as

$$\frac{\Delta L}{h} = 0.412 \frac{\left(\varepsilon_{reff} + 0.3\right)\left(\frac{W_p}{h} + 0.264\right)}{\left(\varepsilon_{reff} - 0.258\right)\left(\frac{W_p}{h} + 0.8\right)} \quad (4)$$

5. Calculate the value of L_p and Z_0 as

$$L_p = \frac{v_o}{2 f_r \sqrt{\varepsilon_{reff}}} - 2\Delta L \quad (5)$$

5. SIMULATION OUTPUTS:

B. S PARAMETER (Return Loss)

The S-parameters is obtained with the various range of frequencies and is plotted. The return loss should be as small as possible so as to transmit maximum power (a large negative number).upon stimulation return loss of greater than -10 db is achieved.(fig 4)

Fig 4: return loss

6. CONCLUSION:

Thus in this paper a printed log periodic dipole array antenna was designed to operate within the frequency range of 3.1GHz-11.6GHz. Its various parameters were calculated. The analysis and simulations are done to measure the S parameter, directivity, gain ,return loss and VSWR. Then a prototype is fabricated and tested by the Network Analyzer.

A. VSWR

In fig 1, it could be noted that the VSWR<=2in the frequency range 3GHz-11 GHZ. From this we could conclude that frequency range over which VSWR<=2 can be defined as the bandwidth. It's necessary that voltage standing wave ratio be smaller than 2 , since its nothing but the amount of wave reflected wave, hence smaller the VSWR higher the efficiency.

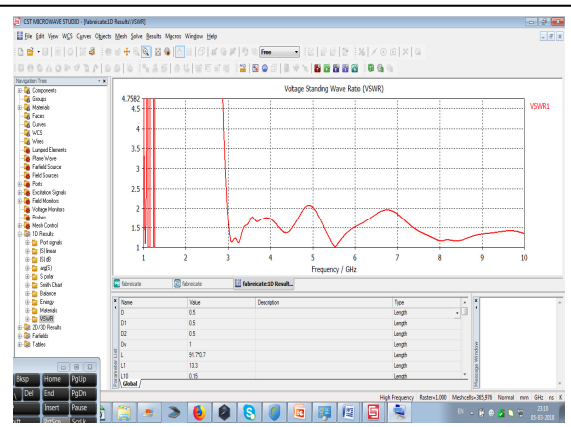


Fig 1: VSWR vs. Frequency plot

SIMULATION OUTPUT – RADIATION PATTERN

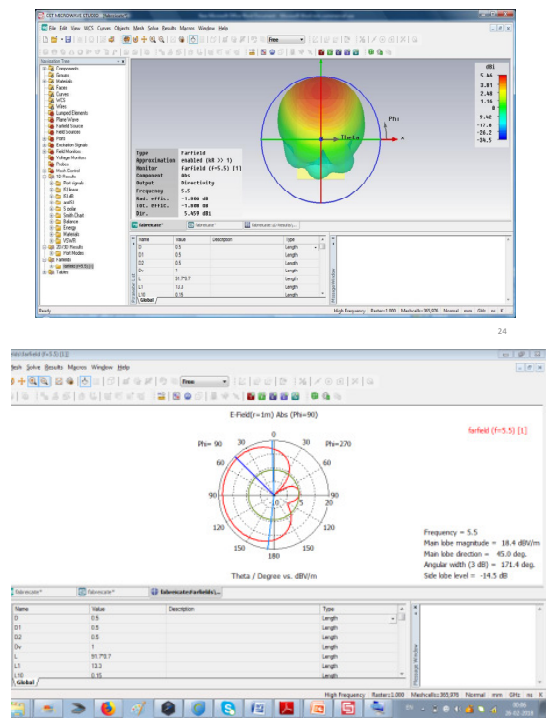


Fig 2: Directivity

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