ISSN 2395-695X (Print)
ISSN 2395-695X (Online)
International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)

Vol. 2, Special Issue 10, March 2016

ANALYSIS AND DESIGN OF LPDA FOR MONITORING SOLAR BURST

Mr.K.Narasimhan, M.S.(AUS), AP/ECE, SNS College Of Engineering
M.Bhuvaneshwari, M.Sanjana, T.Stella Mary
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
UG Scholar, SNS College of Engineering
Email id: narasimhan.snsce@gmail.com, mbuvana94@gmail.com, sanju.smithi94@gmail.com, mary.stellathangaraj@gmail.com

ABSTRACT:

The Logarithmic Periodic Dipole Antenna (LPDA) is constructed for monitoring solar activities like solar flare, Coronal Mass Ejection (CME) phenomenon etc., in radio wavelengths which causes interference in the radio systems. The log-periodic dipole antenna (LPDA) remains the simplest antenna with reliable bandwidth and gain estimates. The existing system consists of 19 elements with a boom length of 3.1m and a gain of 9-10 dB. It works at a range of 220 MHz to 250MHz as this range mainly consists of solar burst. The proposed system has 10 elements with a boom length of 1.858 m with a gain of 8.1 dB for 210MHz and 9.06 dB for 246 MHz and the frequency range is from 200 MHz to 250 MHz within which the system has two operating frequencies of 210 MHz and 246 MHz An optimal VSWR has also been achieved, it is close to 2 which at both operating frequencies given as 2.29 at 210 MHz and 2.08 at 246 MHz. A similar gain has been achieved for this antenna of smaller size.

Keywords: 1) Solar burst.

2) Gain.

3) VSWR.

4) Boom length.

1. INTRODUCTION:

The Sun is one of the strongest radio sources and observation in the radio region can provide information on structures throughout the solar atmosphere. Characteristic studies of solar radio bursts are a great importance for determining the solar flare and Coronal Mass Ejections (CMEs) phenomenon in radio wavelengths. Indirectly, solar burst potentially produces many negative impacts to the Earth. The powerful UV and X-rays radiation will shorten the orbital life of satellites.

As a result, our communication systems will also be affected. Due to this issue, it is very important to monitor the Sun activities especially during solar cycle. In general, this work is purposely for monitoring a space weather event or solar activity observations specifically the radio flux observation of solar flares and solar bursts are caused coherently by electron beam, shocks, possibly trapped electrons, and high-frequency waves in the plasma. The role of constructing a good antenna is very important for us to solve several issues that relates to solar flares such as (i) to identify active flare sources, (ii) to find out their nature and emission mechanisms, and (iii) to relate their properties with parameters of plasmas and accelerated particles in flaring regions. Turning to solar observation, the surprising development of observational tools has greatly contributed to our understanding of magnetic and gaseous fine structure of solar bursts. Antenna arrays have been excellent solutions for operating bandwidth expansion.

Logarithmic periodic dipole antenna (LPDA) is a well-known scientific instrumentation for power spectrum radio data monitoring used wideband antennas at its front end. It plays a key role in the successful detection of solar radiation as it proves to be highly sensitive. The specialty of the LPDA is that the properties are repeated periodically as a logarithm function of frequency.

The LPDA consists of number of dipoles of different lengths and spaces. It is fed using a balanced transmission line connected at the apex of the array which is transposed between adjacent pairs of terminals of dipoles. The feed is usually a coaxial feed with copper wire and the substrate is developed

ISSN 2395-695X (Print)
ISSN 2395-695X (Online)
International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)

Vol. 2, Special Issue 10, March 2016

using aluminum rods that act as the reflectors. This type of antenna is considered as basic receiving element used in the present system which has an almost continuous coverage of a wide range of frequencies and one of the broadband antennas that suitable for many applications.

2. EXISTING SYSTEM:

In today's world, there are a lot of problems that occur due to climate change, one of them being the extent of solar influence on radio communication and so it has become a necessity to monitor such solar activities. There are centers already present to monitor the solar atmosphere and its effects on the Earth, there are five such centers in India (2 in Ooty, 1 in Pune, 1 in Gauribidanur and 1 in Ahmadabad). These centers all use the 19 element LPDA as the receiver which is 3.1m in length which makes it especially hard to mount and the danger of collapse due to wind and rain storms is also high . The LPDA used in the solar monitoring centers is given in the figure 2.1.

Figure: 2.1 LPDA with support stand used in monitoring centers.

The element length, it's radius and location on the main beam is given below in the form of a table in the figure 2.2. In the table, L is length of the element, D is the diameter of the element and P is the position of the element on the main boom.

Element no.	L (m)	D(m)	P(m)
1	3.965	0.634	3.172
2	3.172	0.507	2.537
3	2.537	0.406	2.030
4	2.030	0.324	1.624
5	1.624	0.259	1.299
6	1.299	0.207	1.039
7	1.039	0.166	0.831
8	0.831	0.133	0.665
9	0.665	0.106	0.532
10	0.532	0.085	0.425
11	0.425	0.068	0.340
12	0.340	0.054	0.272
13	0.272	0.043	0.217
14	0.217	0.034	0.174
15	0.174	0.027	0.139
16	0.139	0.022	0.111
17	0.111	0.017	0.089
18	0.089	0.014	0.071
19	0.071	0.011	0.057

Figure: 2.2 Table with dimensions of LPDA

3. PROPOSED SYSTEM:

The primary objective of the system proposed is to acquire similar gain for a reduced number of elements. This reduction in the size of the antenna overcomes mounting errors and also the effect of wind on the support structure is reduced. The overall stress on the entire structure is reduced to a great extent. The table below in figure 3.1 shows the proposed antenna parameters.

Element No	L(mm)	P(mm)	D(mm)
1	375	0	8
2	351	265	7
3	329	513	7
4	308	745	6
5	288	962	6
6	270	1166	5
7	253	1356	5
8	237	1535	5
9	222	1702	4
10	207	1858	4

ISSN 2395-695X (Print)
ISSN 2395-695X (Online)
International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)

Vol. 2, Special Issue 10, March 2016

Figure: 3.1 Table with the dimensions of LPDA proposed.

4. METHODOLOGY

The implementation of LPDA is done using Ansoft HFSS Version 13. This software has been chosen for simulation due to two main reasons : i) It is an open source software and ii) It is easy to use. By following the design procedure we get the finalized LPDA as shown in figure 4.1 below.

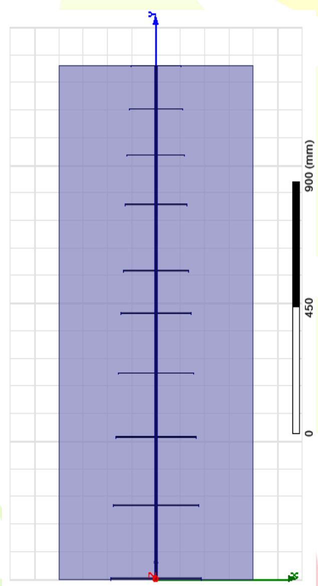

Figure.4.1 Final LPDA design in HFSS

5. RESULTS

The operation Using HFSS software for the design of LPDA gives us three types of results: i)Gain, ii) VSWR and iii) Radiation pattern. These parameters are essential in determining the performance of the antenna. The basic values are that the VSWR must be 2 or smaller and the gain has to match the original gain of the existing system which is 9-10 dB.

The gain plot shows two operating frequencies of 210 MHz and 246 MHz, the antenna shows enhanced performance in these two frequencies. The gain at 210 MHz is -8.01 dB and at 246 MHz it is shown to be -9.066 dB and so naturally 246 MHz remain to be the best operating frequency. Now the gain plot for the designed antenna is obtained as shown in figure 5.1 below.

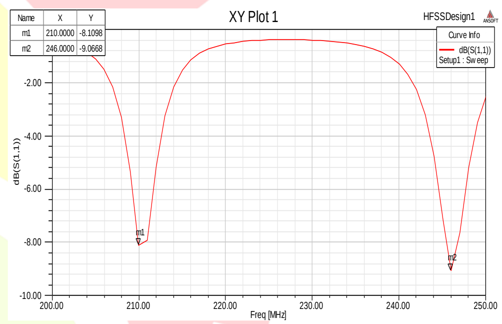

Figure.5.1 Gain plot for LPDA designed

The VSWR for the operating frequencies is observed from the VSWR plot shown in the figure 5.2 below. The VSWR at 210 MHz is 2.29 and for 246 MHz is 2.08 which again proves that 246 MHz remains to be the best of the two operating frequencies.

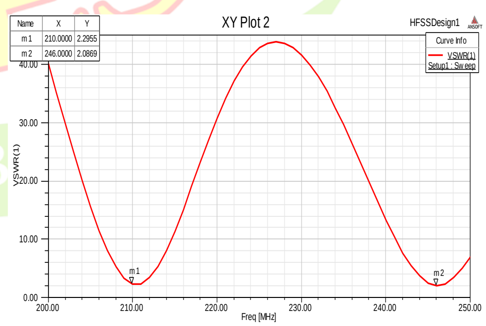

Figure.5.2. VSWR plot for LPDA designed

The radiation pattern shows the distribution of electric and magnetic fields in free space. The figure 5.3 below represents two dimensional smith chart representation of radiation pattern.

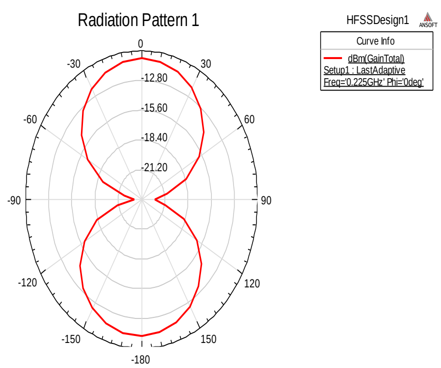

Figure.5.3. Smith chart representation of radiation pattern

The three dimensional radiation pattern gives the electric and magnetic field distribution in free space with a visual aid. The figure 5.4 below represents the 3D representation.

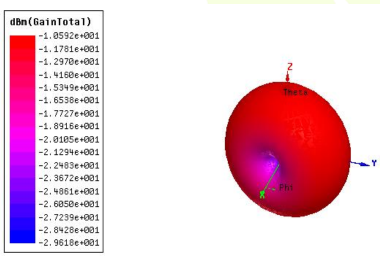

Figure.5.4. Three dimensional representation of radiation pattern

These various outputs give the aspired result and the designed antenna gives us a similar gain to the existing system and so the performance has been optimized. Thus this system can now be integrated with a Callisto spectrometer to monitor solar activity.

REFERENCES

1. Z.S.Hamidi, N.M.Anim, N.N.S.Hakimi, N.Hamzan, A.Mokthar, N.Syukri, S.Rohizat, I.Sukma, Z.A.Ibrahim, Z.Z.Abidin, N.N.M.Shariff, C.Monstein, "Application of Log Periodic Dipole Antenna in Monitoring Solar Burst at Low Frequency Region", IJFPS Vol.2, No.4, December 2012.
2. Lusekelo Kibona, "Gain and Directivity Analysis of Log Periodic Dipole Antenna", IJSER Vol.1, Issue 3, November 2013.
3. Giovanni.A.Casula, Paolo Maxia, Giuseppe Mozzarella, Giorgio Montisci, "Design of a Printed Log Periodic Dipole Antenna", Progress in Electromagnetics Research Vol.38, 2013.
4. Amanpreet Kaur, Gurusimranjit Singh, "A Review Paper on Fractal Antenna Engineering", IJAREEIE, Vol.3, Issue 6, June 2014.
5. Jaleel Azeez Hamadameen, "Analysis, Design and Simulation of a Log Periodic Dipole Antenna for Mobile Communication", WSEAS Transactions on Communication.
6. Z.S.Hamidi, N.M.Shariff, "Evaluation of Signal to Noise Ratio of Log Periodic Dipole Antenna", IEEE, 2013.
7. Mohammad.J.Almalkawi, Lee.W.Cross, Khair.A.Alshamailek, "A Transmission Line Circuit-Oriented Approach for Miniaturization of LPDA", IEEE 2014.