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An Analysis of Antenna Temperature and Radar Cross Section of Log Periodic Dipole Antenna

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ABSTRACT

The LPDA antenna because it is very suitable and economic amount the types of antennas. It consists of an array of dipoles in which their lengths and spacing are arranged in a log periodic manner, but not all elements in the system are active on a single frequency of operation. The temperature or Antenna Noise Temperature depends on its gain pattern and the thermal environment that it is placed in. We need to design an antenna that can detect the data and monitor the solar burst type III in radio region. It must be sensitive to a broad frequency range and angular distribution of the incident radio pulse and capable to handle the noise issue that is necessary to gain the pure signal. With large instantaneous bandwidths and high spectral resolutions, these instruments will provide increased imaging sensitivity and enable detailed measurements of the dynamic solar burst. For standardized the time, GPS clock is used to control the sampling time of the spectrometer and a tracking controller control the antenna direction. In conclusion, LPDA is the most practical antennas provide general broadband transmission and reception in a wide range of frequency.

***Keywords*:** Sun; Log Periodic Dipole Antenna; type III; radio region; antenna temperature radar cross section

1. INTRODUCTION

The antenna used to transmit and receive electromagnetic wave. The parameter that describes how much noise an antenna produces in a given environment is called antenna temperature. This temperature is not the physical temperature of the antenna .The temperature depends on its gain pattern and the thermal environment that it is placed in. Antenna temperature is also sometimes referred to as Antenna Noise Temperature [1,2]. The log periodic dipole antenna (LPDA) is use to monitor solar bursts of the sun. LPDA antenna also known scientific instrumentation for power spectrum radio data monitoring and it used wideband antennas at its front end [3,4].

It considers as one of the most antennas that widely used for normalized site attenuation (NSA) and radiated emission (RE) testing this antenna detect the solar burst in radio region [5]. In principle, antennas can be used to transmit or receive electromagnetic waves [6]. The properties in both cases are the same due to the principle of reciprocity. We choose the LPDA antenna because it is very suitable and economic amount the types of antennas. This antenna has simplicity design .we design the antenna that have a aspects such as gain and bandwidth that antenna can offer is the one of the factor this antenna is chosen [7].

This antenna also is the part of ISWI (International Space Weather Initiative) project in order to monitoring the solar activity 24h/7d coverage of solar observations in state of support develop countries participate internationally with a latest technologies of instrument [8-10]. In this study we need to design an antenna that can detect the data and monitor the solar burst type III in radio region [11,12]. We use the spectrometer work with this antenna to distinguish the solar burst [13,14].

The log-periodic dipole array LPDA consist of an array of dipoles in which there lengths and spacing are arranged in a log periodic manner, but not all elements in the system are active on a single frequency of operation [15,16]. Depending upon its design parameters, the LPDA can be operated over a range of frequencies having a ratio of 2:1 or higher, and over this range its electrical characteristic gain, feed point impedance, front to back ratio, etc. the length of the boom of the antenna enhance the performance and the advantage of this antenna is gives the higher input impedance than monopole antenna [17,18]. This Loq-Periodic Dipole antenna need all the dimensions of the array elements to be scaled in a log periodic manner, to achieve a corresponding scaling in frequencies [19]. The loq-pariodic dipole antenna are design base on the given specifications and for assumed values of Scale Factor (τ) and spacing factor (σ) [20].

The significance of this study is to understand how do the LPDA can be used to monitor solar activities of the sun using the LPDA antenna. We will construct our own LPDA antenna using aluminum rod. The modification of this antenna will gives a wide range of frequency from 40 MHz - 1000 MHz instead of 45MHz-870MHz (previous antenna). This study will focuses on preparation and performance of the (LPDA) antenna as well as the characteristic of CALLISTO spectrometer as receiver in observation of solar flares and Coronal Mass Ejections (CMEs) [21,22]. The data in this study might be used by authorities to monitor and analyze the signals from the sun [23].

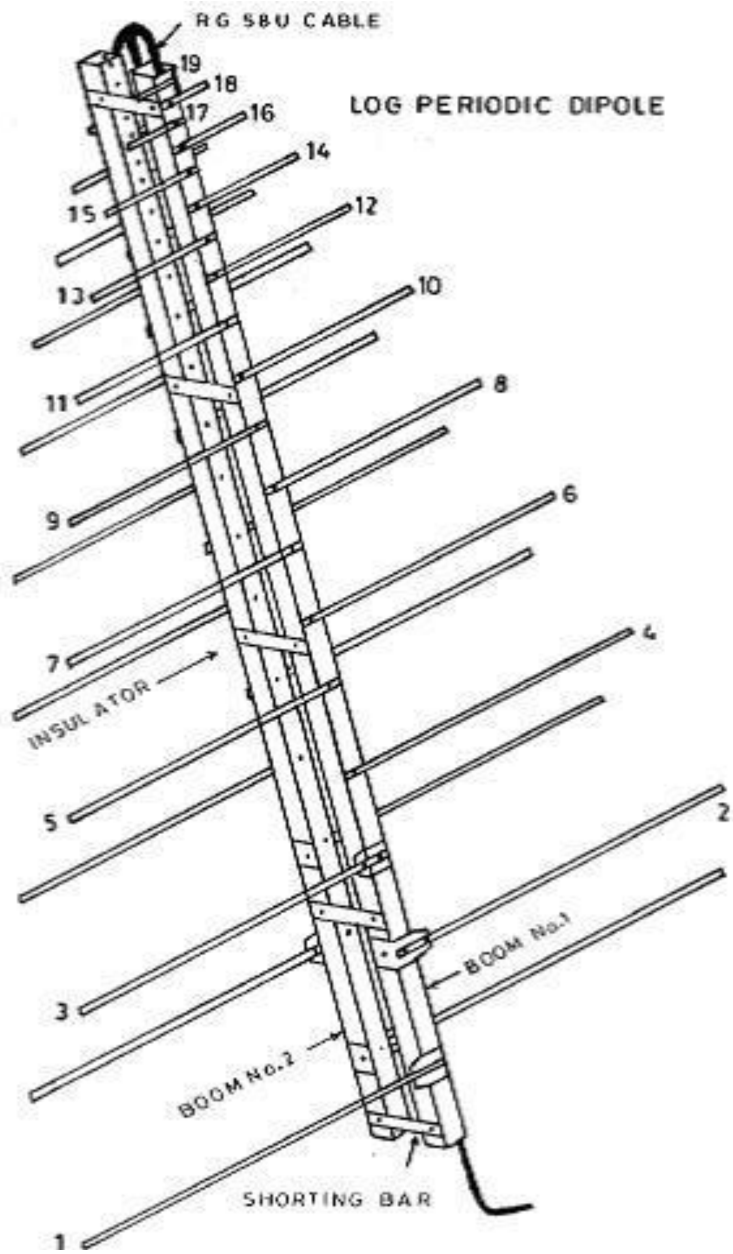

Figure 1. The schematic diagram of LPDA.

2. ANALYSIS OF ANTENNA TEMPERATURE

In this section, we will be expose to antenna temperature (LPDA) and analyze the characteristic of this antenna before we construct it. Other than that this section also will describe the solar burst type III and how (LPDA) detect the signal from sun [24]. The parameter that describes how much noise an antenna produce in a given environment called antenna temperature. This temperature difference to physical temperature. Moreover, an antenna does not have an intrinsic "antenna temperature" associated with it; rather the temperature depends on its gain pattern and the thermal environment that it is placed in. Antenna temperature is also sometimes referred to as Antenna Noise Temperature. By analyzing the environment we can get the full definition of antenna temperature. The temperature distribution is the temperature in every direction away from the antenna in spherical coordinates, for example in the night the sky is roughly 4 kelvin and the value of the temperature pattern in the direction of the Earth's ground is the physical temperature of the Earth's ground. As a consequence antenna temperature is depending on directional and pointed into the space or staring. The first inventor who developed this antenna is Isabell in 1961 and Carrel analyzed the LPDA mathematically and computed its radiation pattern, input impedance, etc., using a digital computer [25]. We design our antenna and focusing on the range 45 MHz till 1000 MHz. The parameter that needs to know when we dealing with antenna such as gain, polarization, radiation pattern, directivity and bandwidth [26].This parameter help use to produce the good antenna in transmit or receive information. The array of this antenna consists of elements which are connected by crossing the double line (boom) with each other. It caused pattern characteristics to be repeated periodically with the logarithm of the driving frequency. Second reasons why we choose this LPDA antenna is because of the gain factor. For example Yagi, not suitable to monitoring the sun because just cover the UHF. FM antenna receives small value of gain The high gain in the wide range is needed. Using the low spectral and spatial resolution instruments to detect the solar burst can provide us only the light curve and a crude spectrum of the whole flare which may consist of many distinct sources with different characteristics.

3. RESULTS AND ANALYSIS

The parameters needed in designing the (LPDA) antenna are gain, polarization, radiation pattern, directivity and bandwidth. In this this study, the main criteria that make LPDA become more relevant is due to it sensitivity that possible to detect signal of the Sun .this antenna is the most sensitive amount the antenna. We design the LPDA antenna that focusing on 45 MHz and 1000 MHz. This can help to detect the low frequency from the solar burst. It must be sensitive to a broad frequency range and angular distribution of the incident radio pulse and capable to handle the noise issue that is necessary to gain the pure signal. The antenna have elements will be that represent specific frequency and will be constructed two booms. The length of the antenna must be calculate precisely to make it portable and suitable with the criteria, specification and practical enough to observe the solar activities. Aluminum rods is suitable due to its properties as non-corrosive and light weight. The plastic material is used as an insulator of the antenna.

This log periodic dipole antenna directly control via low loss coaxial cable type RG8 to the CALLISTO spectrometer if we want to find the signal form the sun. The high-frequency electromagnetic signal will be converted into a form convenient by this spectrometer for detecting and measuring the incoming radio emission. With large instantaneous bandwidths and high spectral resolutions, these instruments will provide increased imaging sensitivity and enable detailed measurements of the dynamic solar burst. The CALLISTO software and RAPP JAVA Viewer will be used as the part of data acquisition, CALLISTO spectrometer and computer connected to the internet. For standardized the time, GPS clock is used to control the sampling time of the spectrometer and a tracking controller control the antenna direction. Table 1. Shows the number of elements and specification of the LPDA.

Table 1. The number of elements and specification of the LPDA.

Number of element	Length (mm)	Distance (mm)
1	1875	0
2	1467	1043
3	1148	1859
4	898	2498
5	702	2997
6	549	3388
7	430	3694
8	336	3933
9	263	4120
10	206	4266
11	161	4381
12	126	4471
13	99	4541
14	77	4595
15	60	4638
16	47	4672
17	37	4698

Figure 2. Setup of the antenna at Faculty of Applied Sciences, Universiti Teknologi MARA.

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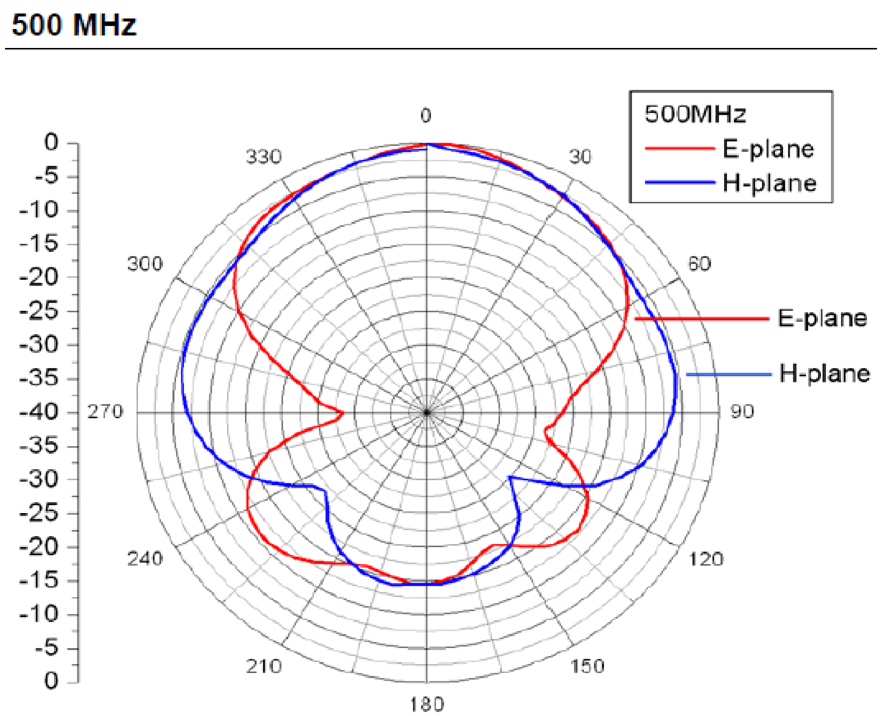

Figure 3. The variation of E field pattern, H-field pattern, vertical azimuth pattern and horizontal azimuth pattern at 500 MHz

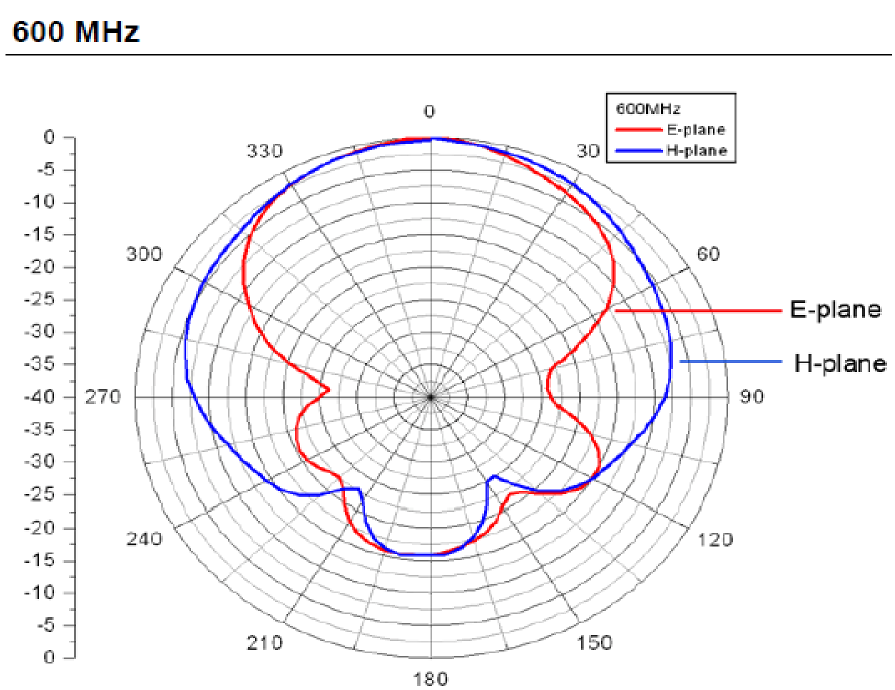

Figure 4. The variation of E field pattern, H-field pattern, vertical azimuth pattern and horizontal azimuth pattern at 600 MHz

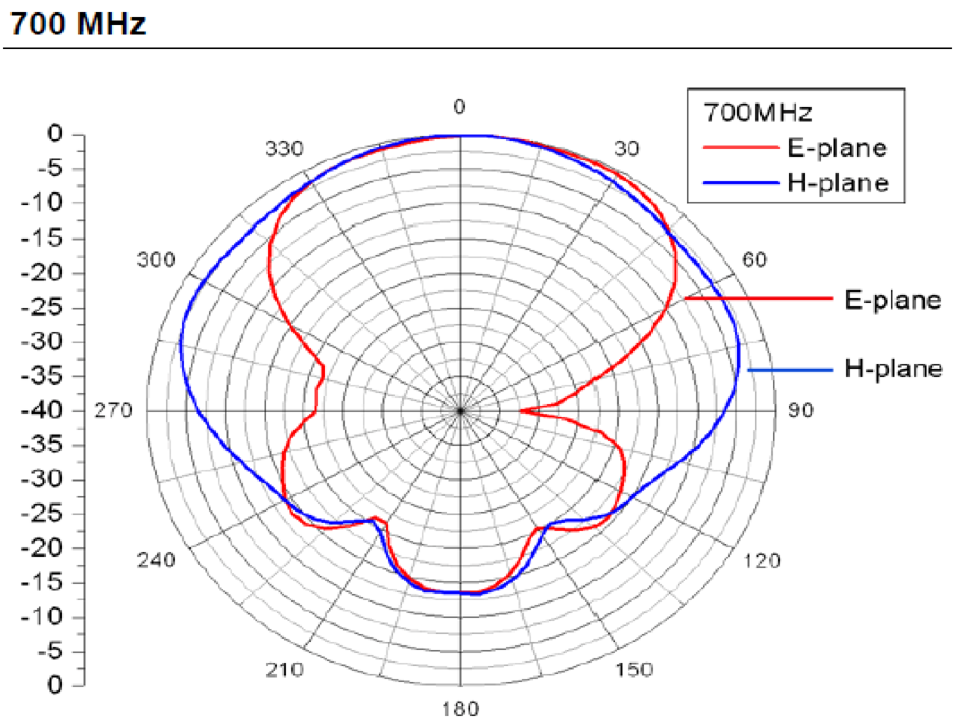

Figure 5. The variation of E field pattern, H-field pattern, vertical azimuth pattern and horizontal azimuth pattern at 700 MHz

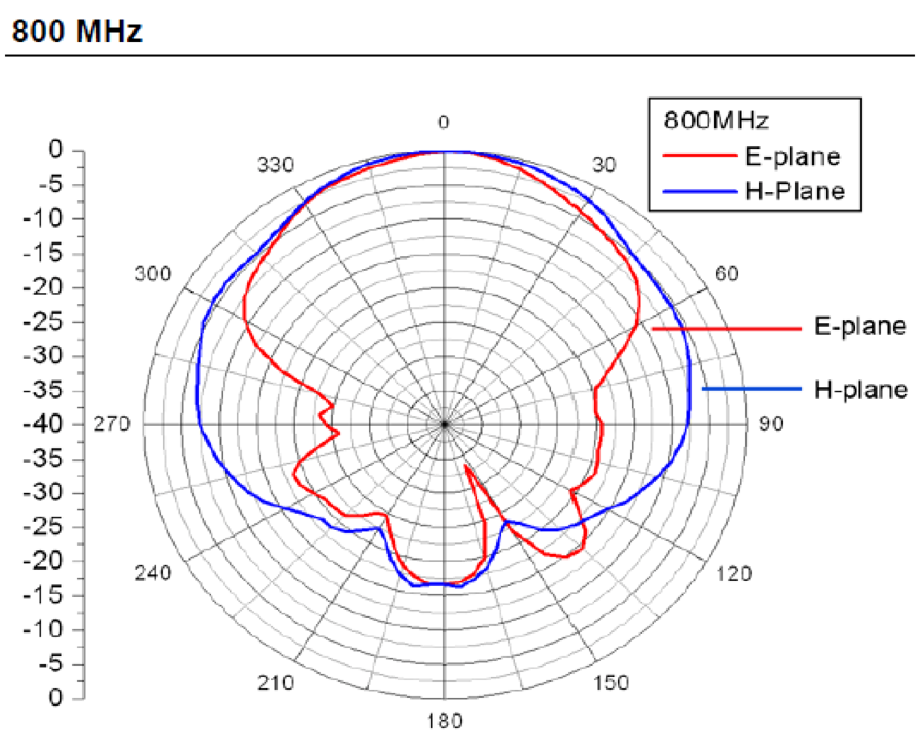

Figure 6. The variation of E field pattern, H-field pattern, vertical azimuth pattern and horizontal azimuth pattern at 800 MHz

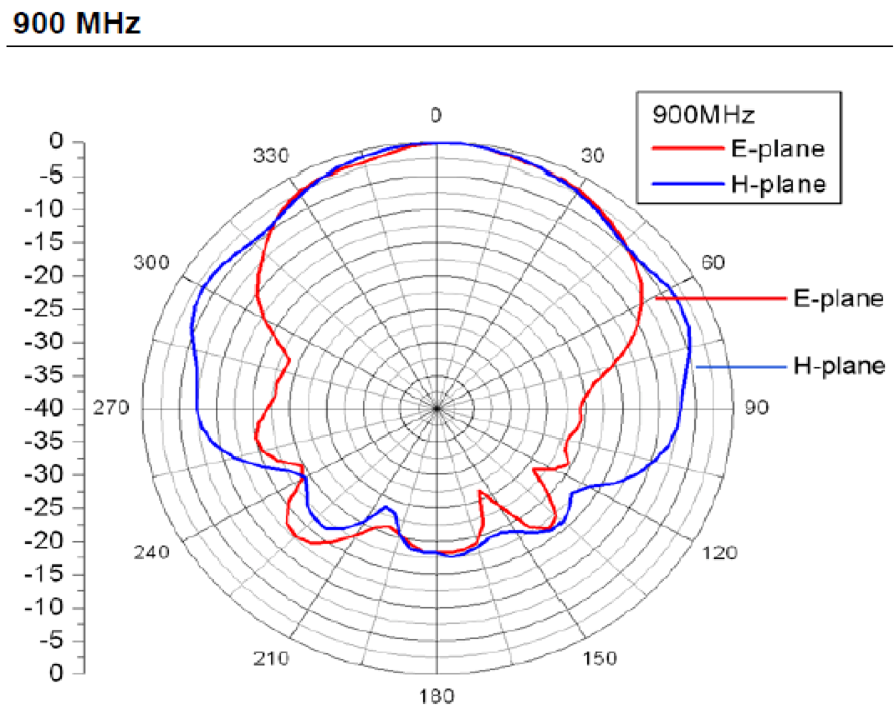

Figure 7. The variation of E field pattern, H-field pattern, vertical azimuth pattern and horizontal azimuth pattern at 900 MHz

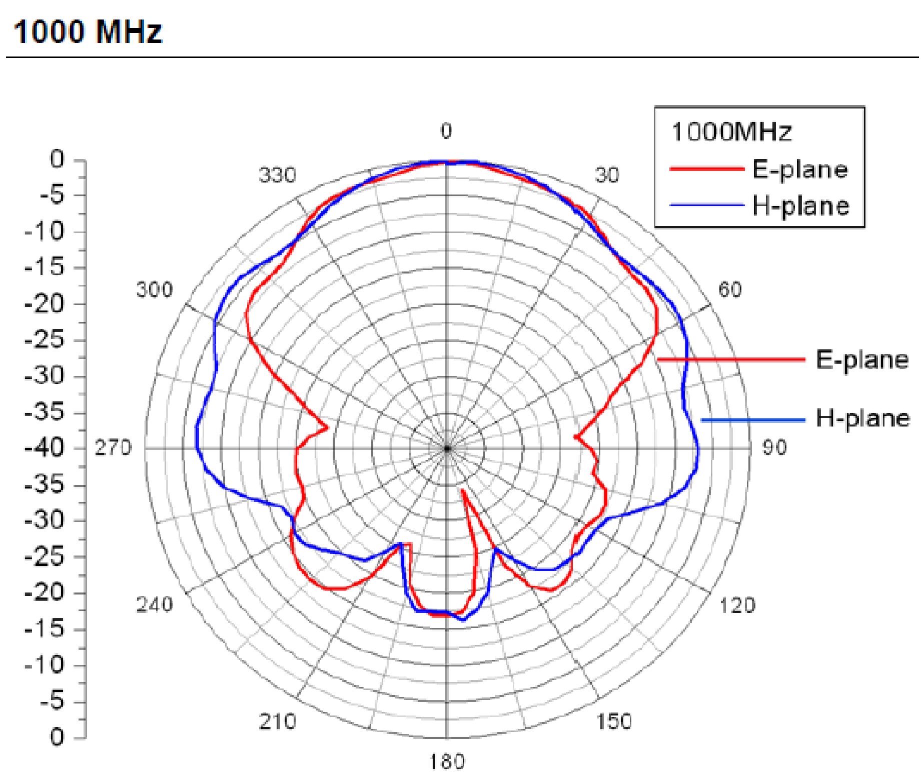

Figure 8. The variation of E field pattern, H-field pattern, vertical azimuth pattern and horizontal azimuth pattern at 1000 MHz

It should be noted that the structure is implemented in Transmission Line Matrix Model (TLM) method and is analyzed for the radiation patterns in Azimuth and Elevation planes. It is based on the analogy between the electromagnetic field and a mesh of transmission lines. As longer elements, to the right of the active region, are in the beam and have not alternating phase, they produce interference effects to the pattern result. Figure 3 shows respectively the variation of E field pattern, H-field pattern, vertical azimuth pattern and horizontal azimuth pattern at 500 MHz

Figure 3-8 give the illustration of our simulated LPDA antennas at 500 MHz and 1000 MHz respectively. For a linearly-polarized antenna, this is the plane containing the electric field vector and the direction of maximum radiation. The electric field or "E" plane determines the polarization or orientation of the radio wave. For a vertically polarized antenna, the E-plane usually coincides with the vertical/elevation plane. Meanwhile, in the case of the same linearly polarized antenna, this is the plane containing the magnetic field vector (sometimes called the H aperture) and the direction of maximum radiation. The magnetizing field or "H" plane lies at a right angle to the "E" plane. For a vertically polarized antenna, the H-plane usually coincides with the horizontal/azimuth plane. For a horizontally polarized antenna, the H-plane usually coincides with the vertical/elevation plane.

The LPDA were simulated using EZNEC software and it was considered under free space. The simulated radiation pattern (electric and magnetic), VSWR, input impedance, gain and front to back ratio are illustrated in the Figures 3-8. We used the MATLAB simulations to analyze the performance properties of the LPDA antenna. All main inputs for the program are Tau, sigma, the characteristic impedance of the feeder element, the length of the dipoles and the spacing between the dipoles have been decided earlier. The outputs of the program are the currents at the bases of the dipoles and E and H-plane patterns of the antenna which are obtained by the currents of the dipoles.

4. CONCLUDING REMARKS

In conclusion, LPDA is the most practical antennas provide general broadband transmission and reception in wide range of frequency. Although it consists of a system of driving element, but not all elements in the system are active on a single frequency of operation. Due to different lengths and different relative spacing, it allows changes in frequency to be made without greatly affecting the electrical operation. We have analyzed the antenna temperature and radar cross section of log periodic antenna. The concept of Log-Periodic Dipole Array antenna has been studied and we have seen that for wideband application log periodic antennas are used.

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(SWPC) for the sunspot, radio flux and solar flare data for comparison purpose. The research has made use of the National Space Centre Facility and a part of an initiative of the International Space Weather Initiative (ISWI) program.

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