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Characteristics of the log periodic dipole array

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ABSTRACT

The performance of the Log Periodic dipole array antenna has been characterized, in the form of parametric curves available in most antenna design handbooks and other relevant literature. These characteristic curves are often limiting in scope, as for instance they do not contain parametric curves giving the relationship between the boom-length 'L' and the number of dipole element 'N' for any given bandwidth, even when it is known that these two parameters are the main cost determinants of a LPDA Antenna. The concept of convergence is introduced to aid cost optimization of the LPDA Antenna in terms of number of dipole element 'N'. Although 'N' is used as the minimization criterion, the criteria for establishing convergence encompass all the main electrical characteristics of the LPDA Antenna, such as VSWR, gain and radiation patterns. Lastly, the effects of boom-impedance 'Z_o' and length to diameter ration 'L_n/D_n', on the performance characteristics of the LPDA Antenna was investigated with the view to determining if neglecting the effects of these two parameters were responsible for the disparity in the directive gain values obtained by R. L Carrel compared to those obtained by later researchers. The investigation indicates that if an LPDA Antenna is converged, then the effects of Z_o and L_n/D_n ratio though significant can not alone account for the fairly large disparity in the gain values.

In other to perform these investigations, a modern scientific tool in the form of numerical modeling by method of moments based, Super Numerical electromagnetic code version2 was utilized. The numerical modeling tool was first validated by agreement between measured values and the values as predicted by the modeling tool. Next, simulation of the performance of LPDA antennas under variations of their number of elements was done. Thereafter, the means and standard deviations of the gain were extracted from the simulated numerical models. Trends in the pattern of variation of the means and standard deviations of the gain are used as the basis for deciding the value of number of element at which the antenna can yield acceptable performance (convergence criteria). These are presented as convergence curves, which gives for any given boom-length and

operating bandwidth, the minimum number of elements required for the antenna to yield acceptable performance.

Finally, the effect of length to diameter ratio and boom-impedance on the gain of optimized LPDA antennas are presented as parametric curves.