Department of Electrical, Electronic and Telecommunication Engineering

Faculty of Engineering

General Sir John Kotelawala Defence University

Communication Technology Laboratory

Module code and name :	**Antennas and Propagation ET 3122**
Name of the lab class :	Radiation Pattern Measurements of a Log-Periodic Antenna
Duration :	2 h
Related Learning Outcome of the Module :	LO2: Analyze the functionality of Wire antennas.
Scope of the lab class :	At the end of this practical work, a student should be able to: • To familiarize the functionality of a Log-Periodic Antenna and Analyze its radiation Pattern.

Objectives

To understand the structure and functionality of a Log Periodic Antenna.

To analyze radiation patterns of a Log periodic antenna.

Components

Motorized Antenna Unit Scientech 2261A

Theory

Log Periodic Antenna:

The main feature of this antenna is frequency independence for both radiation resistance and pattern. The radiation pattern may be unidirectional or bidirectional. This is a horizontally polarized antenna.

It consists of a sequence of side-by-side parallel linear dipoles forming a coplanar array and fed from a two-wire line which is transposed between each adjacent pair of dipoles. The array is fed from a narrow end, and maximum radiation is in this direction.

Although this antenna has slightly smaller directivities than the Yagi–Uda array (7–12 dB), they are achievable and maintained over much wider bandwidths. There are, however, major differences between them.

While the geometrical dimensions of the Yagi–Uda array elements do not follow any set pattern, the lengths (l_n's), spacings (R_n's), diameters (d_n's), and even gap spacings at dipole centers (s_n's) of the log-periodic array increase logarithmically as defined by the inverse of the geometric ratio τ. That is,

$$\frac{1}{\tau} = \frac{l_2}{l_1} = \frac{l_{n+1}}{l_n} = \frac{R_2}{R_1} = \frac{R_{n+1}}{R_n} = \frac{d_2}{d_1} = \frac{d_{n+1}}{d_n} = \frac{s_2}{s_1} = \frac{s_{n+1}}{s_n}$$
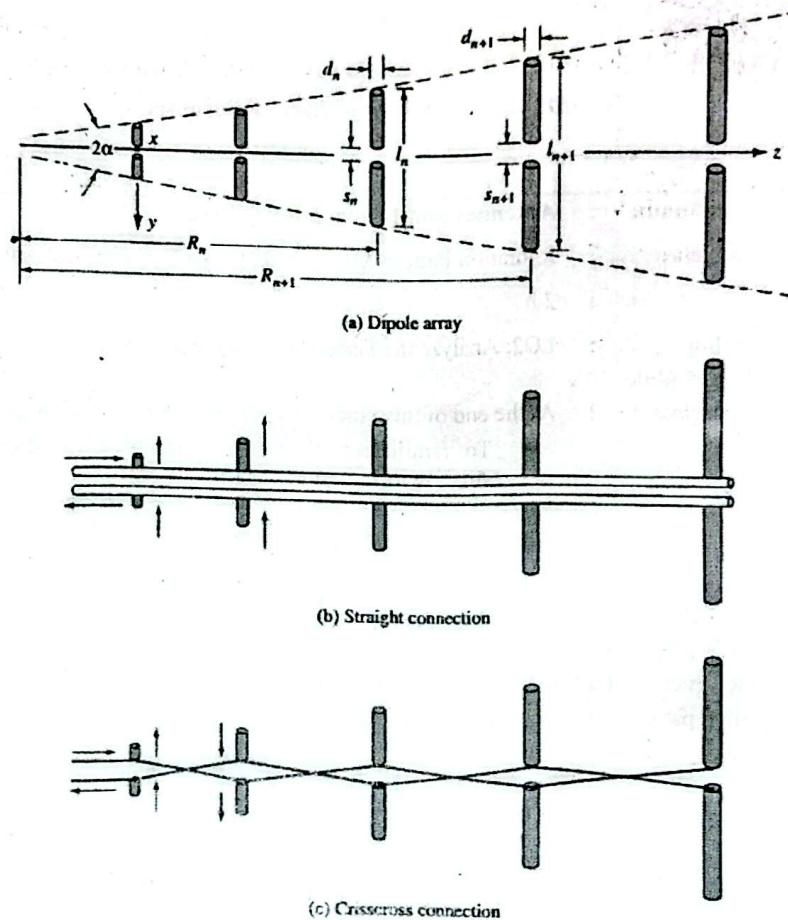
(a) Dipole array

(b) Straight connection

(c) Crisscross connection

Figure 1

Straight lines through the dipole ends meet to form an angle 2α which is a characteristic of frequency independent structures. Because it is usually very difficult to obtain wires or tubing of many different diameters and to maintain tolerances of very small gap spacings, constant dimensions in these can be used. These relatively minor factors will not sufficiently degrade the overall performance. While only one element of the Yagi–Uda array is directly energized by the feed line, while the others operate in a parasitic mode, all the elements of the log-periodic array are connected. There are two basic methods, as shown in Figure 1, which could be used to connect and feed the elements of a log-periodic dipole array. In both cases, the antenna is fed at the small end of the structure.

If a graph is drawn of antenna input impedance v/s frequency, a repetitive variation will be noticed. If plotted against the log of frequency instead of frequency, then variation is periodic consisting of identical cycles. All other properties of antenna undergo similar variation, especially radiation patterns. It is this behavior of antenna, which has given, log periodic name.

Procedure

1. Get the setup ready as per Annex1.

2. Mount the Log Periodic antenna on the top of the transmitting mast.

3. Ensure the following settings.

- The transmitting mast marker is in an 'O' degree position.
- Both transmitting and receiving antennas are facing each other in the horizontal plane. Keep the distance around 100cm between them.
- The transmitter is tuned for maximum forward power to transmit and receive optimum/ maximum radiation for the antenna under test,
- DPM for ES adjust at the transmitting unit is set for 100uA reading and DPM at the RF detector unit is set for 70uA.

4. Now to plot the Polar Graph/Radiation pattern of the transmitting antenna under test, start taking the readings at the interval 10 degrees and tabulate the degree v/s µA readings of the RF detector unit display.

Degree	µA	dBµA
0°		
10°		
..		
360°		

5. Convert the noted micro Amp readings into dBuA with the help of the conversion chart given below. Following formula is used to convert the µA reading in to dB;

$$dB\mu A = 20 \log (\mu A \text{ reading})$$

6. Now plot the polar graph on the polar graph paper as per the converted dBµA readings against degrees of rotation.
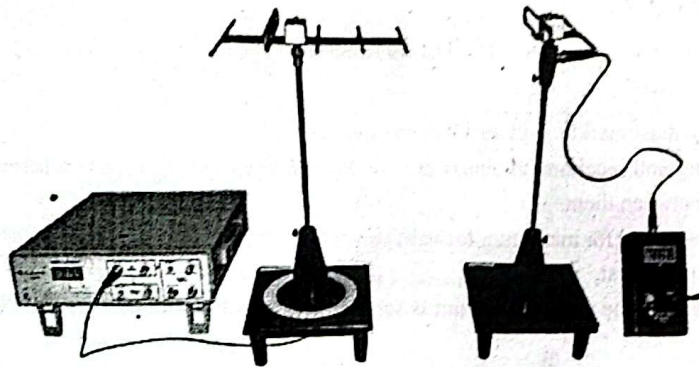
Annexture 1

Fig 2 Set up Arrangements of Antenna Trainer

Procedure:

Main unit:

- Place the main unit on the table and connect the power cord.
- RF Generator: Adjust the Level Potentiometer to Maximum position.
- Modulation Generator: Select the switch to 'INT' position and adjust Level Potentiometer to maximum position.
- Directional Coupler: Select the switch to 'FWD' position and adjust FS ADJ Potentiometer to middle position.

1. Install Transmitting mast, place it beside the main unit and connect it to the main unit's 'RF OUT' using a BNC to BNC cable of 25" long.

2. Install Receiving mast and keep it at some distance (around 1 meter) from the Transmitter mast.

3. Place RF detector Unit beside the Receiving mast and connect it to the Receiving mast using a BNC to BNC cable of 25" long.

4. Connect an Adapter +9V to the RF Detector unit, Switch it on and keep the Level knob at middle position.

5. Keep the base of the Transmitting mast such as the 'O' degree position of Goniometer should be directed towards the RF Detector and also align the marker of the mast with 'O' degree position.

6.Install the Detector Antenna on the Receiving mast. Keep its direction towards the Transmitting mast by rotating it in counter-clockwise direction.

7.Install "log periodicAntenna' on the Transmitting mast. Keep its direction towards the Receiving mast by rotating it in counter clockwise direction.

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8. Switch on the main unit and check the display in PM of the Directional Coupler. It will show some reading according to its level knob at the start.

9. RF detector will also show some readings according to its level knob at starting.

(In case of overloading, reduce it by level Potentiometer of RF detector)

10. Now vary the FS Adjust Potentiometer of Directional Coupler to make the display reading 100 micro Amp and then adjust the Level of RF detector to show the ¾ reading of the main unit's display.

11. Rotate the transmitting Antenna between 0-360 degrees and observe the display at RF Detector. The variation in reading indicates that the transmitter and receiver are working, and radiation pattern is formed.

12. Observe the demodulated signal at the output socket of RF detector on oscilloscope. Vary the level of Modulation generator at transmitting unit and observe the variations in the demodulate signal. If required, reduce the power using RF Level potentiometer to improve the shape of demodulated sine wave.

13. Now the setup is ready for further experiments.