Lens Antenna

The lens antennas are widely used at microwave frequencies. They are not ordinary lens, but made up of dielectric material or metal plates. The main purpose of lens antenna at microwave frequency is as a Collimator., i.e., it is meant for converging the diverged wavefront.

The lens antennas are broadly classified into two:
i) Dielectric lens and ii) Metal plate lens.
Again these are classified into two. a) Delay lens and
b) Fast lens.

Delay lens:- The velocity of the wave outside the lens is more and inside the lens is less. Hence it is called delay lens.

Fast lens:- These lenses increased velocity of the wave within the lens.

i) Dielectric Lens:- The dielectric lens are madeup of dielectric material. The dielectric material whose dielectric constant greater than unity are used.

Ex:- polystyrene or lucite and polyethelene [$\varepsilon_r = 2.56$ - polystyrene, $= 2.25$ - polyethelene]

As the dielectric constant is more the refractive index of the lens is greater than one. Hence, when ever the EM wave passes through this lens, the wave bends and its velocity changes

i) if $\frac{f}{D} > \frac{1}{4}$ or $f > \frac{D}{4}$, the reflector illumination approaches a uniform value. This increases aperture efficiency but at the cost of spillover.

ii) with $\frac{f}{D} = \frac{1}{4}$ or $f = \frac{D}{4}$ increases spillover to the extent that aperture efficiency decreases.

iii) with $\frac{f}{D} < \frac{1}{4}$, $f < \frac{D}{4}$ places the focal point inside the reflector. Here no spill over occurs but illumination of the reflector tapers from a maximum at the centre to zero within the reflector.

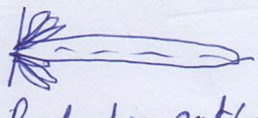
Salient Features

i) parabolic reflector also called dish is most popularly used at microwave frequencies.

ii) It produces uniform plane parallel wavefront that is it works as a collimator.

iii) It produces a uniform shape main lobe and as resembles a fat cigar in shape.

iv) It is a unidirectional antenna.



Radiation pattern.

v) paraboloids are not used at lower frequencies because of their large size.

vi) A parabolic reflector consists of a primary antenna which is active and a secondary antenna (parabola) which is passive.

vii) There will be aperture blockage due to primary antenna.

viii) $BWFN = 140\left(\frac{\lambda}{D_a}\right)$ $HPBW = 70\left(\frac{\lambda}{D_a}\right)$

Directivity $(D) = \frac{4\pi A}{\lambda^2}$

by

$$G_1G_2 = \left(\frac{W_1}{P_1}\right)\left(\frac{4\pi R}{\lambda}\right)^2$$

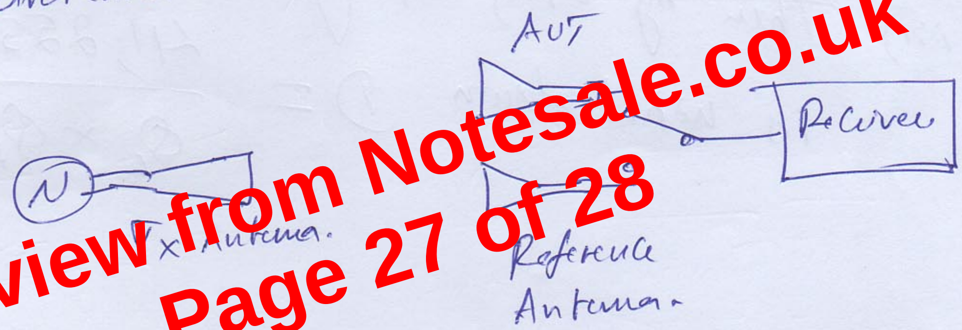
$$G_1G_3 = \left(\frac{W_2}{P_2}\right)\left(\frac{4\pi R}{\lambda}\right)^2$$

$$G_2G_3 = \left(\frac{W_3}{P_3}\right)\left(\frac{4\pi R}{\lambda}\right)^2$$

Knowing $\frac{W_1}{P_1}$, $\frac{W_2}{P_2}$, $\frac{W_3}{P_3}$, λ and R, G_1, G_2, and G_3 are obtained.

Comparision method

In this method AUT and another standard reference antenna will be used as recievers



i) First the transmitting antenna will radiate the known power. Then the AUT is used as reciever and the recieved power is noted down.

ii) Later for the same value of radiated power a standard reference antenna is used as reciever and the power is noted.

iii) By using FRISS transmission equation the AUT gain is measured

Directivity Measurement

If the antenna is lossless, then directivity and gain are same. But if the losses are considered then we have to consider various methods to find the directivity. The simplest but accurate method is

i) By using the pattern measurement method the radiation pattern for the AUT is found.

ii) Then the half power beam width (HPBW) for E-plane and H-plane are noted down.

iii) Then by using the general formula the directivity is noted down $D = \frac{41253}{\theta_E \times \theta_H}$