KEY WORDS

Waveguide slots, Linear array, Planar array, Off-axis grating lobes, Centered longitudinal slot, Post, Strip, T-junctions, Couplers, Wall thickness, Stub waveguide, Moment matrix, Convergence, Pulse basis functions, Triangular basis functions, Broken sinusoidal basis functions, Global sinusoidal basis functions, Point matching, Galerkin's technique, Wall current.

SUMMARY

At microwave frequencies, especially at s and x bands, a popular method for producing radiation is by using slots cut in the walls of a rectangular waveguide. Extensive studies have been made on slots and slot arrays and especially on broad wall longitudinal slot arrays by many research workers. A linear array consisting of broad wall longitudinal slots suffers from the periodic erros associated with the requirement to stagger the slots on both sides of the centerline. One way to avoid this problem is to use broad wall centered longitudinal slots, excited parasitically, as the radiating elements of a truly linear array. This work is a systematic approach to construct a planar array consisting of such parasitically excited radiating elements.

The investigations reported in the thesis can broadly be divided under the following major heads:

(1) Analyses of various types of thin metallic foils and round post inside a rectangular waveguide using the method of moments and variational method have been presented in Chapter I. The configurations analyzed in this chapter are a variable height vertical strip, a pair of longitudinally displaced full height vertical strips, a variable height post, and an inclined strip in the waveguide. These obstacles introduce a transverse component of electric current at the center of the broad wall. This component of current excites a longitudinal slot cut at that location.

(2) Analysis of a full height vertical post with rectangular cross-section is carried out using the method of moments in Chapter II. The equivalent problem of two thick apertures has been solved to obtain the equivalent network of the thick post using aperture field formulation.

(3) A centered longitudinal slot on the broad face of a rectangular waveguide in presence of a single vertical strip and a pair of vertical strips have been analyzed in Chapter III. The effect of finite wall thickness of the waveguide has been properly accounted. The coupled integral equations are solved to obtain the currents on both the strip surfaces and the fields at both the slot apertures. The equivalent network of the combination have been evaluated. Using a pair of collinear strips a resonance effect has been obtained.

(4) Synthesis of a linear array of parasitically excited centered longitudinal slots to realize a specified radiation pattern is described in Chapter IV. Taylor's method of synthesis together with Woodward's technique and transmission matrix approach have been used to determine the normalized shunt conductances of the radiating elements. This technique is not only applicable to waveguide slots but also to any form of radiators with series feeding.

(5) The linear array described in chapter IV are stacked vertically to form a planar array. This type of an array could be fed from a single rectangular waveguide by cascaded sections of T-junctions. The analysis of a broad wall longitudinal slot coupled T-junction is described in this Chapter V. Three-port scattering matrix of such a junction made of dissimilar rectangular waveguides has been evaluated. The conditions satisfied by the scattering coefficients of the three-port junction with unequal port impedances and unequal cross-sections are derived and verified.

(6) The method of analyses of a broad wall longitudinal or transverse slot coupler between two dissimilar rectangular waveguides have been presented in Chapter VI. The four-port scattering matrix and equivalent

loading have been evaluated. The conditions satisfied by the scattering coefficients of the four-port junction with unequal port impedances and unequal cross-sections are derived and verified. This type of long slot couplers are widely used to monitor power in a system.

Throughout the work, there has been an unifying approach towards the design of a planar array where the off-axis grating lobe problem is fully eliminated. The planar array consists of broad wall centered slots as the radiating elements. To achieve the goal, whatever has been felt necessary from time to time has been carried out and they are presented in the thesis in a systematic manner. This uniformity is quite apparant in the work.