SIMULATION AND EXPERIMENTAL STUDY OF A MULTILAYERED WIRE GRATING POLARIZER

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Abstract

A simple transmission-line model in terms of E-type and H-type modes for analyzing a multilareyed wire grating polarizer is presented. A simulation program that permits of the polarizer parameters design was computed. A prototype has been manufactured and several measurements were done.

1. INTRODUCTION

In last years it has been presented several methods which permit of design polarizer for broadband application. We have developed a simple transmission-line model that permits to study the behaviour of a multilareyed wire grating polarizer. With a simulation program has been designed a prototype that converts the vertical polarization radiated by the antenna into a linear 45 degs slanted as asked from system requeriments. This network has been optimized to work in C-X-Ku bands, and several measurements have been realized.

2. POLARIZER ELECTRICAL DESIGN

As it is known, a single plate formed by conducting wires can be used as a polarizer due to if the incident electrical field is parallel to the wires, it is mainly reflected. Then the grid can be considered as a polarizer whose polarization axis is perpendicular to the wires.

In this model, the incident wave is breaking down in so named E and H type modes [1] that permit study the system as two transmission lines (one for each mode). With this descomposition oblique incidence of the incident plane wave may be treated.

These transmission lines are simulated with transmision matrices. The transmission matrix for the ith stage is formed by T-matrix of a shunt impedance (which simulates the polarizer behaviour) and by air T-matrix (which simulates the phase-shift occurs the wave when travels between two contiguous plates).

In order to get a stepped process of the wave polarization, the plates must be twisted one from each other. Therefore the characteristic modes of a stage are not the same that another stage ones, beeing necessary to define the mode matrices that permit pass from characteristic modes of a plate to a cartesian system defined by the parallel and perpendicular directions to the polarizer axis, and rotation matrices that pass from a certain angle from the first [2].

A product of transmission mode and rotation matrices is done to obtain the transmission matrix of the overal system. From this matrix, the reflection and transmission coefficients can be obtained [3], [4].

Using the proposed model a simulation program was computed allowing the system design and optimization as function of several parameters: distance between plates, diameter of the wires, distance between wires, angles of the incident wave and work frecuency. With this program a polarizer has been designed in C-X-Ku bands.

3. POLARIZER TEST

The polarizer test set consists of a network analyzer (HP 8510B) where the incident and transmission ports are connected to two horn antennas located on each side of the test polarizer. Three pairs of horn antenas were designed to cover the operation band. Transmission and reflection coefficients were measured for copolar and contrapolar components of the electrical polarized field.

The transmission coefficient of polar and contrapolar field electric components as function of frecuency is shown in graph 1 and 2.

As graph 3 shows the transmission coefficient as function of frecuency for two cases: azimutal angle of the incident wave equal to 0 (normal incidence) and azimutal angle equal to 45 degs.

The reflection coefficient has been also measured; the results are presented in graph 4.

Finally, measured data and teorical results are compared in graph 5 and 6, and a successful behaviour can be observed.

4. CONCLUSION

Simple transmision-line model for multilareyed wire grating polarizer has been presented. It has been developed a simulation program that permits of design and optimice a multilareyed polarizer system. The numerical results compared favorably with experimental data.

5. ACKNOWLEDGEMENT

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6. REFERENCES

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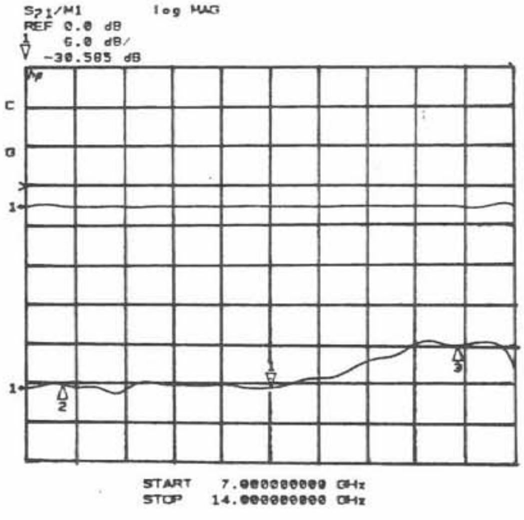
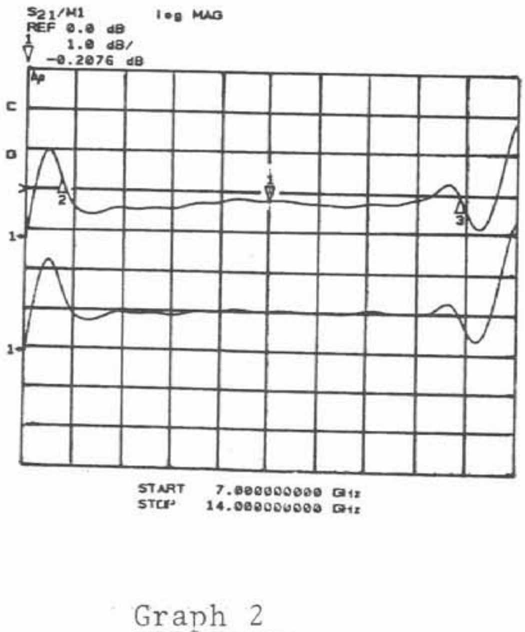
Graph 1

With polarizer

Without polarizer





Graph 2

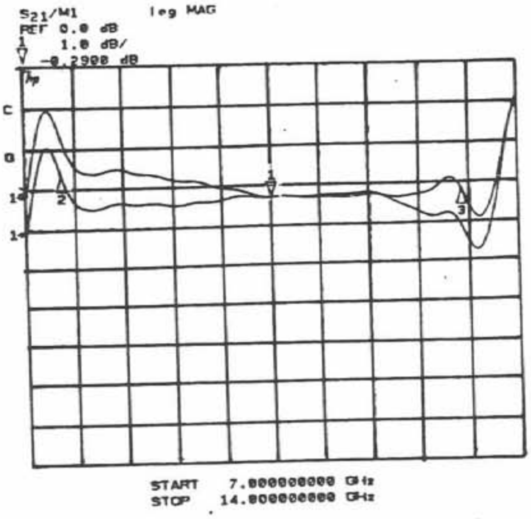
Without polarizer

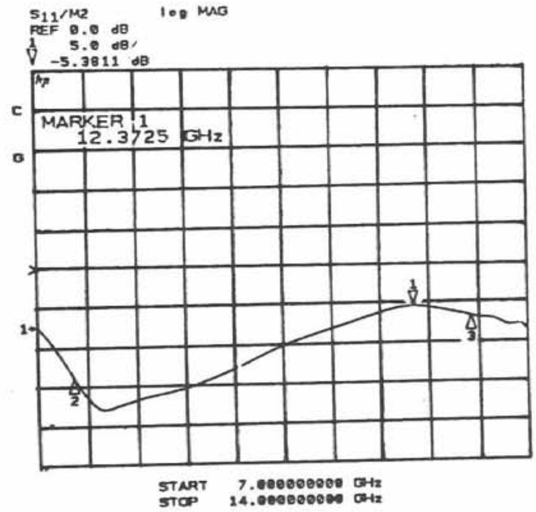
With polarizer

Graph 3

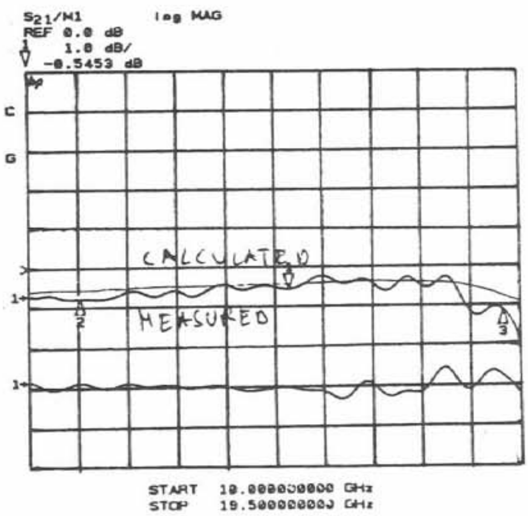
Azimut = 0°

Azimut = 45°

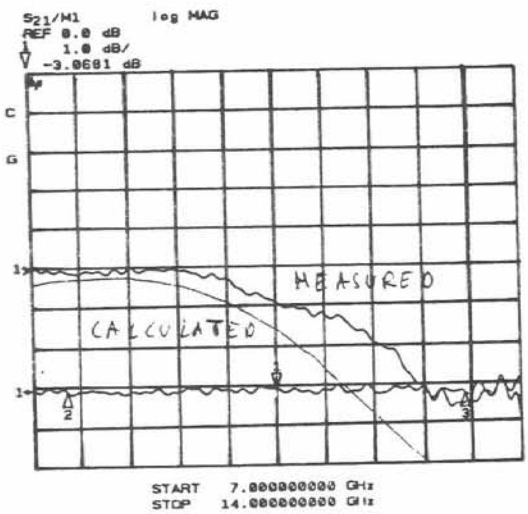




Graph 4



Graph 5



Graph 6