Slot Antenna in Ridge Gap Waveguide Technology

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Abstract— **A Slot antenna design based on recently developed gap waveguide technology has been presented in this work. This antenna can be built easily by having the feed network on the bottom metal plate, where the ridge will be distributing the waves for equal excitation of each slot element, and the top metal plate will have the slots. Design and simulation results of the basic T-junction for a corporate-feed network and the single element slot show that- it is possible to have an array antenna with BW of 15 % or more based on ridge gap waveguide technology.**

Keywords- Slot array antenna, corporate-feed, T-junction

I. INTRODUCTION

Planer waveguide slot array antennas and microstrip patch array antennas have been an interesting research topic among the antenna professionals since 1970s. Typical printed antennas can be compact, lightweight and can offer low cost but these types of antennas suffer usually from high dielectric losses at high frequencies. Also, when an array of printed antenna is built for high gain or multiple beam application, the antenna efficiency decreases even more because of increased losses in feeding network. The steps and discontinuities in the feeding network also tend to give spurious radiation [1]. Planar waveguide-type slot array antennas do not suffer from the above disadvantages, and is therefore an attractive candidate for high frequency applications requiring high gain [2-4]. But waveguide slot arrays are associated with complex feed network under the radiating waveguide array and high manufacturing costs of standard rectangular waveguide at high frequency. Apart from the cost of waveguide array itself, the integration of high frequency MMIC with rectangular waveguide is also very challenging at high frequencies [5-6].

Recently evolved gap waveguide technology described and verified in [7-9] can be applied very successfully to address some of these problems. The low loss feed network needed for an array can be built very easily with the help of ridge gap waveguide concept. In addition, radiating slots can be placed conveniently on the top smooth metal plate of ridge gap waveguide. Thus, the ridge gapwaveguide slot antenna can be an attractive as well as cost effective solution for high gain and high efficiency applications.

There has till now not been any publications on gap waveguide antennas, except for the horn antenna in [10] , and the initial works in single-hard wall waveguide slot arrays in [11]. Therefore, the purpose of the present paper is to present the first ridge gap waveguide excited slot antenna. We consider a fully radiating single slot, i.e. a slot from which all the incident power is radiated, corresponding to using a fully branched distribution network, i.e. a corporate-feed network. We also present a single T-junction for use together with this slot in the corporate-feed network. The final conference paper will also show results for a 2x2 array using the slot and T-junction design in this short abstract

II. DESIGN OF T-JUNCTION FOR CORPORATE FEED

The basic component of a usual array antenna corporate-feed network is a T- junction. The T-junction usually consists of a quarter wave transformer section and three 50Ω lines. This is shown in figure 1. The simulation results for the basic T-junction is shown in figure 2. The simulation results show that it will be possible to design a wideband feed network for a complete array antenna based on this T-junction.

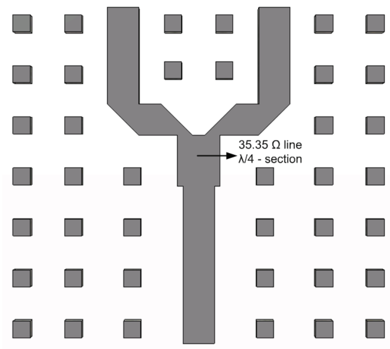

Figure 1. Single T-junction for corporate feed network (Top metal plate not shown)

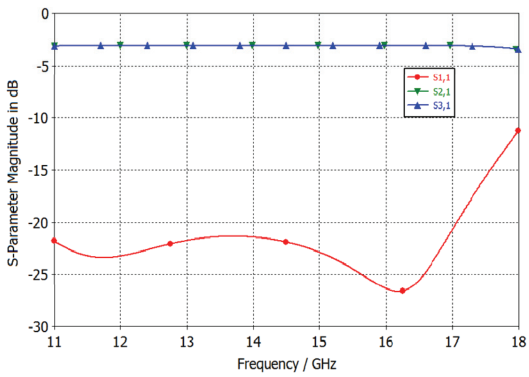

Figure 2. Simulation results for the T-junction

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III. SINGLE SLOT DESIGN

The slot array antenna design usually starts with a single element slot. Similar approach is followed in this work as well. The single slot antenna excited by ridge gapwaveguide is shown in figure 3. The single element is designed to operate in 12-14 GHz frequency range. The length and the width of the slot element is varied to have the return loss around 15 dB over the above mentioned bandwidth. The reflection coefficient for the single element is shown in figure 4.

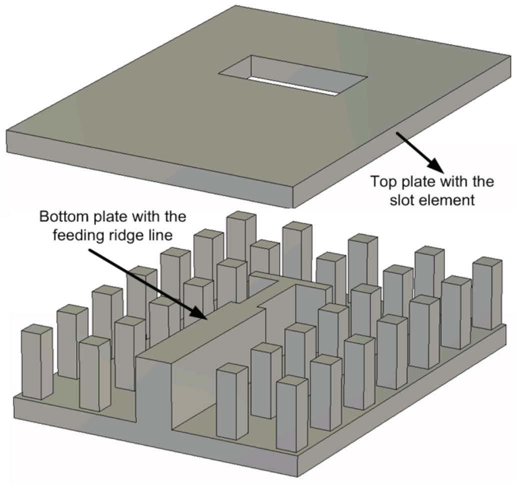

Figure 3. Single element slot in gapwaveguide technology

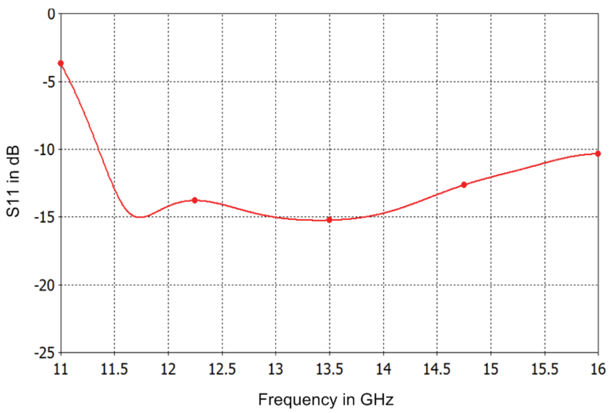

Figure 4 . Single element slot in gapwaveguide technology

IV. CONCLUSION

We have presented a slot antenna design based on ridge gapwaveguide technology. A single T-junction is designed as a basic unit of the entire corporate-feed network. Also a single element slot antenna is designed by having a slot on the top metal plate of the ridge gapwaveguide. Simulated results clarify that - both the T-junction and the slot have reasonably wide bandwidth, and it will be possible to use these basic elements for the entire array design.

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