DESIGN OF SLOT COUPLED PROFILED ORTHOMODE TRANSDUCER (OMT)

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Abstract— This paper presents the design of waveguide orthomode transducer (OMT) at C-Band (3.85-4.8GHz) using slot coupled Taper /Branching configuration. Profiling is used in taper section to achieve the specified performance. Finite Element Method is used for analysis and optimization of the structure. Designed OMT will be the part of feed system of the Earth Station Antenna used for Satellite Communication. Return Loss is better than 17dB and polarization isolation is better than 35dB were achieved without any tuning element over the specified band.

Index Term - OMT (Ortho-Mode Transducer)

I. INTRODUCTION

Orthomode Transducer (OMT) is polarization diplexer. OMT serve either to combine OR to separate two orthogonally polarized microwave signals at same frequency or different frequency.[13].

Types of OMT available are : (a) Narrow band configurations: symmetrical taper/branching and asymmetrical taper/branching. (b)Broad band configurations: Distinct Dual junction, Equal junction configuration. This paper summarized the different profile options available to the OMT designer hyperbolic profiled OMT designed and developed.[13].

II.CONFIGUARATION AND DESIGN OF SLOT COUPLED PROFILED OMT

Two simultaneous orthogonal polarizations are supported in the Common Port(Port-1) of Taper/Branching configuration as shown in Fig.-1.Vertical polarization is provided to Through Port (Port-2) by appropriately tapering the Common-port's waveguide dimension to the through port waveguide dimensions. Different profiling techniques are used to match the impedance of the common port to through port like sinusoidal , linear , exponential ,hyperbolic etc. In this paper I have used Hyperbolic profile.

Horizontal polarization signal is coupled to Coupled port(Port-3). Slot is used to match impedance of common port to coupled. Tapering section of waveguide port acts as a cut-off waveguide to the horizontal polarization signal and reflect the signal in horizontal polarization back. The reflected horizontal signal is coupled to the coupled-port through the coupling slot.

Here , as shown in figure the design of hyperbolic profile OMT it has electrically four port and physically three port visible. It works in transmit band and receive band of 3.85GHz - 4.10GHz and 7.15GHz – 7.25GHz respectively. Design of OMT was carried out in two steps. In step-1 , dimensions of the circular and rectangular waveguide were finalized to be about 10% higher cut off frequency of operation. Next the profiling transition (tapering) was designed to match the circular waveguide port (common port) impedance to the through port impedance. Tapering was achieved by the Hyperbolic profiling. This has provided advantage of mode convergence and shortening the device. In step-2 , the equation of the hyperbolic profiling is as follow:

Hyperbolic

$$a(z) = ai + \frac{z^2(ao^2 - ai^2)}{L^2} \quad ,$$

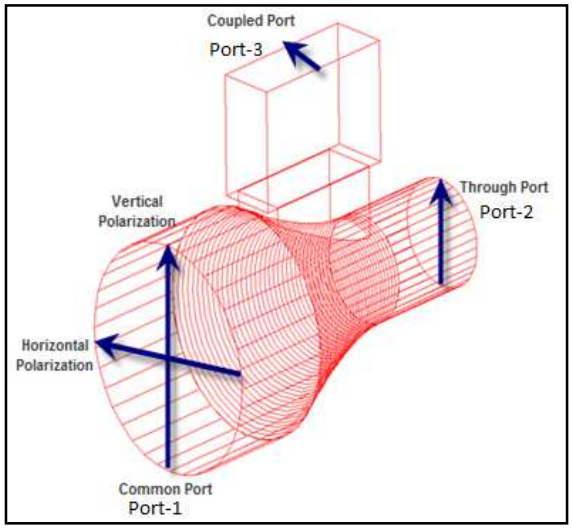

Figure 1

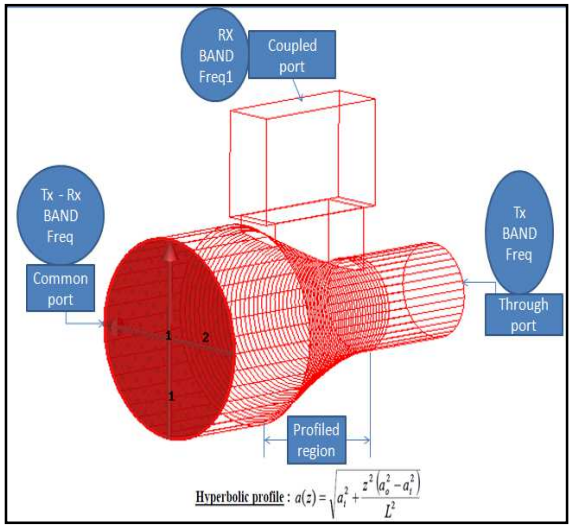

Figure 2

Figure 1 & 2 Hyperbolic OMT view

which provide cutoff to the horizontal polarization signal was finalized. Slot impedance and dimensions are were finalized to provide the maximum power handling capability while maintaining desired polarization isolation and return loss. Hyperbolic profile transition was used at coupled and through ports to match the non-standard waveguide ports to the standard WR-159 waveguide interface. Initial analysis and optimization of the designed OMT was carried out using mode matching technique generated optimized dimensions were analyzed using FEM based code. A difference in two results was observed. Mode matching technique based on software was not able to converge the results , since steps in the tapering region were close enough to couple the higher order modes to the next steps. Final analysis and optimization of the complete OMT was carried out using FEM technique based software. Final analysis and optimization of the complete OMT was carried out using FEM technique based on software. Sensitivity analysis of OMT was carried out to ensure immunity to the fabrication tolerances.

III.ANALYSED AND MEASURED RESULTS

Here , in figure 3,4,5 result of analysis done using HFSS of hyperbolic OMT is given & table 1 contains the upper & lower frequency result.

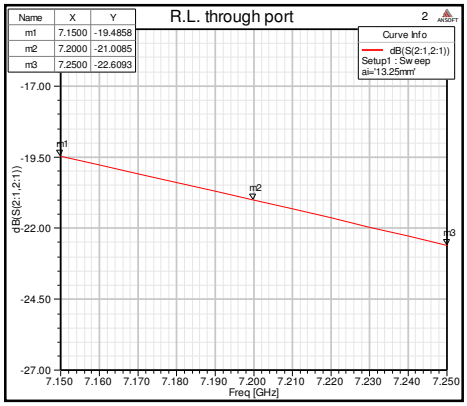

Figure 3 Simulated result plot R.L. of through Port of Hyperbolic profile OMT

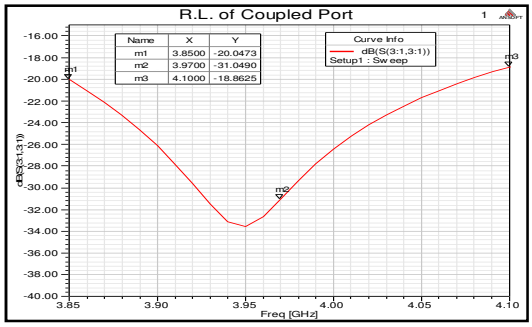

Figure 4 R.L. Simulated result plot of couple Port of Hyperbolic profile

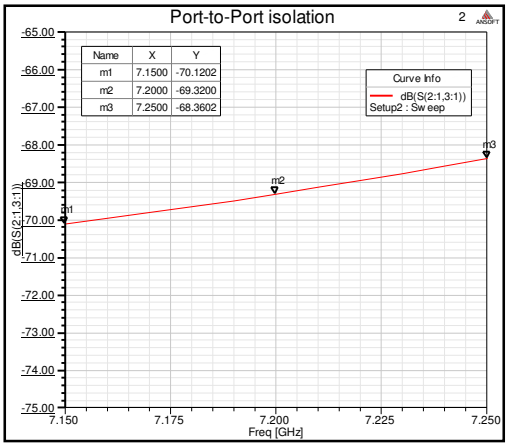

Figure 5 Simulated result plot Port to Port Isolation of Hyperbolic profile

S-Parameter	Lower Frequency	Higher Frequency
S(2:1,2:1) R.L. of through port	**-19.47**	**-22.60**
S(3:1,3:1) R.L. of couple port	**-20.04**	**-18.86**
S(2:1, 3:1) I.L. of port to port isolation	**-70.12**	**-68.36**

Table 1 SIMULATED RESULT PLOT of S-parameter of hyperbolic OMT

IV.CONCLUSION

In this paper design of profiled C-Band OMT with hyperbolic profile configuration is presented. Fast and accurate CAD was carried out using Finite Element Method. Data are analyzed using HFSS software. Desired all results are achieved.R.L. is better than 17dB & isolation is better than 40dB.

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