TUNABLE WAVEGUIDE WR2300 TO N-TYPE COAXIAL ADAPTER

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Abstract

A systematic design of a tunable full height waveguide WR2300 to N-type coaxial adapter is presented. The basic design is composed of an N-type coaxial probe to WR2300 waveguide at 352.2 MHz. A unique tuning mechanism has been introduced to do impedance matching at the desired frequency for varying load conditions. Probe consists of two circular tuners-one at the upper end and other at the lower end. Frequency can be tuned by shifting the upper tuner and matching can be adjusted with the lower tuner. Modeling and analysis have been carried out using High Frequency Structure Simulator (HFSS) software. The waveguide with unique tuning mechanism was fabricated. The measured results are in agreement with simulated results.

INTRODUCTION

Waveguide to coaxial adapters are used to connect waveguide devices to coaxial components with minimum insertion loss and voltage standing wave ratio (VSWR) over the desired frequency band. Since the transmitted power is in kW range, power loss is a major factor in waveguides as it causes mismatch in waveguide system.

This paper presents a new type of a tunable full height waveguide WR2300 to coaxial adapter. It is realized by adding two circular tuners in the coaxial probe in order to obtain better impedance matching over the desired frequency. The effects of circular tuners have been studied by varying the lower and upper tuners. The waveguide to coaxial adapters may be connected to other high power waveguide components, such as directional couplers, waveguide distribution system and varying loads so it is important to match it at the required frequency.

DESIGN APPROACH

A non- radiating circular slot has been made in the broader wall of the waveguide to insert the coaxial probe in order to launch the electric field in the waveguide[1-2]. The coaxial probe height is approximately quarter wave length. The variation in the position of the upper and lower tuners creates continuous variation in input impedance and frequency. The simulated structure of tunable waveguide WR2300 to N-type coaxial adapter with conductive (aluminium) circular tuners is shown in Figure 1. The waveguide WR2300 has a dimension of a=23”=584.2mm and b=11.5”=292.1mm. The other optimized dimensions are shown in Figure 1(a).

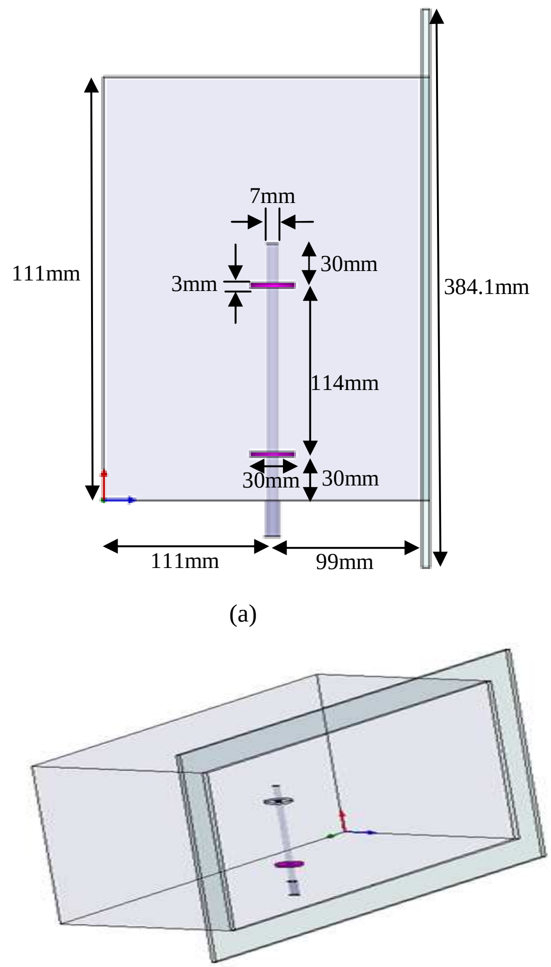


Figure1: Simulated structure of Tunable Waveguide WR2300 to N-type Coaxial Adapter (a) Side view and (b) 3-D view

SIMULATED AND MEASURED RESULTS

The electromagnetic simulation of tunable waveguide WR2300 to N-type coaxial adapter has been carried out using HFSS [3]. Figure 2(a) shows the transmission and reflection characteristics and the input impedance plot for the optimized structure over the frequency range of 200 to

600 MHz. The insertion loss is less than 0.1dB and return loss is 26dB at 352.2 MHz frequency.

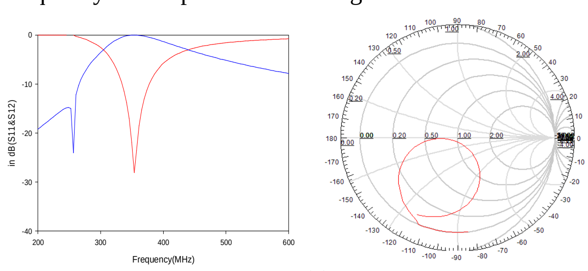
Figure 2(b) and (c) shows the transmission and reflection characteristics and the input impedance plot for the lower and upper tuner variations, respectively.

From Figure 2(b), we can see that when the lower tuner is shifted up by 35mm and down by 28mm, the frequency variation is only 4 MHz. But, the reflection co-efficient has significant effect as it has increased and decreased by 15dB for the same lower tuner variation. As a result, the impedance curve has shifted upward and downward, respectively.

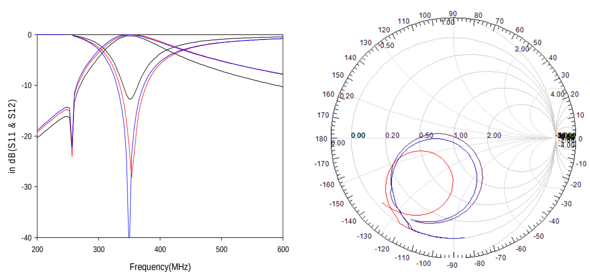
Similarly, it is clear from Figure 2 (c) that the effect on resonance frequency is more due to upper tuner variation than on impedance. The frequency has shifted up and down by 20 MHz when the upper tuner is shifted down by 50mm and shifted up by 28mm, respectively. At the same time, reflection co-efficient has only increased by 6 dB and decreased by 2 dB for the same upper tuner variation. The waveguide WR2300 with N-type coaxial adapter is fabricated as shown in Figure 3(a). The reflection characteristics and the input impedance plot for the fabricated structure are shown in Figure 3(b) and (c), respectively. The measured results are in agreement with the simulated results.

CONCLUSION

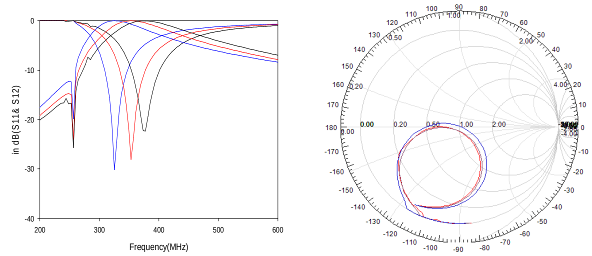
In this paper, a tunable waveguide WR2300 to N-type coaxial adapter is presented. It is observed that the effect of the lower tuner is more on input impedance and the effect of upper tuner is more on resonance frequency. Thus by varying the lower tuner and upper tuner, impedance and frequency can be tuned to a desired value. This proposed waveguide tuning mechanism can be implemented for any other waveguide system for frequency and impedance matching.



(a)



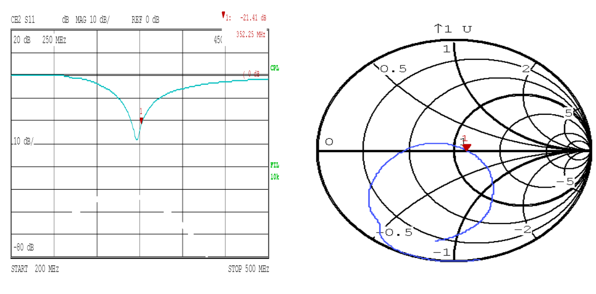
(b)



(c)

Figure 2: Reflection and Transmission co-efficients and input impedance plot of Tunable Waveguide WR2300 to N-type Coaxial Adapter for (a) Optimised structure, (b) Lower tuner variation and (c) Upper tuner variation.

(a)



(b) (c)

Figure 3: (a) Fabricated Waveguide WR2300 to N-type Coaxial Adapter and its (b) Reflection characteristics and (c) Input impedance.

REFERENCES

[1] David M. Pozar, “Microwave Engineering”, John Wiley & sons, Inc.,1997.

[2] George Kennedy and Bernard Davis, “Electronic Communication Systems,” McGraw-Hill, 1977.

[3] HFSS by Ansys (formerly Ansoft).