Quad-Ridged Horn Antenna with L Shaped-Slot Fed by Microstrip Line

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Abstract—In this paper, a simple structure, microstrip-fed, dual-polarized, quad-ridgeded horn antenna is proposed. The VSWR (Voltage Standing Wave Ratio) of proposed antenna is less than 2.2 for the frequency range of 0.8–6 GHz. The measurement results of VSWR, isolation, gain and radiation patterns are presented and discussed.

***Index Terms* — Antennas, Quad-ridged, Microstrip line, Horn antenna, Dual-polarized**

Introduction

In the recent years, microstrip antenna is the most developing area in the antenna field, exploiting their advantage such as inexpensive, easily manufactured, low weight, low volume, and compatibility with integrated circuits. However, inherent disadvantages of microstrip antenna are low gain and narrow bandwidth [1]. At the mere mention of antenna gain and bandwidth, horn antenna with the broad band and high gain properties is a suitable antenna type for microwave and millimeter wave applications, electromagnetic compatibility testing, and standard measurements [2–7]. The ridged horn antenna with tapering flared section has the better bandwidth performance than conventional horn structure [8–10]. However, metalwork is widely used in Ridged horn antenna design, and micromachining is more important for high band frequency. In view of the above, a kind of quad-ridged horn antenna with easy fabrication fed by microstrip line is proposed in this paper. Tapering flared sections printed on the FR4 epoxy resin substrate is substitute for conventional metalwork process. In the OTA test, priority of return loss is higher than antenna gain. To obtain the better VSWR performance of antenna in the operating frequency, 100 ohm resistance is shunted on the excitation. Moreover L-shaped slot is on the each of the tapping flares and radiation pattern is improved in the lower band of antenna.

The antenna has been fabricated in the operating frequency range of 0.8–6 GHz. The experiment results of VSWR, isolation, gain and radiation patterns at various frequencies are provided in this paper.

I. Antenna configuration and design considerations

The whole antenna structure consists of two orthogonal PCB boards. Each of one is a printed horn antenna with two tapping flare sections. The length and width of flare section are 142 mm and 71 mm, respectively. There is a straight slot (without FR4 substrate) exists in the vertical part of horn antenna, and the other part of antenna passes through this slot. The placement of two parts of antenna (shown in Fig.1.) is orthogonal arrangement. The four tapping flare sections of two printed antennas should be isolated with each other. And two via holes exist in each of printed horn antenna. A pair of tapping flare is shorted by 100 ohm resistor. The location of 100 ohm resistor is close to the excitation area. The propose antenna structure and 100 ohm resistor layout are shown in Fig. 2.

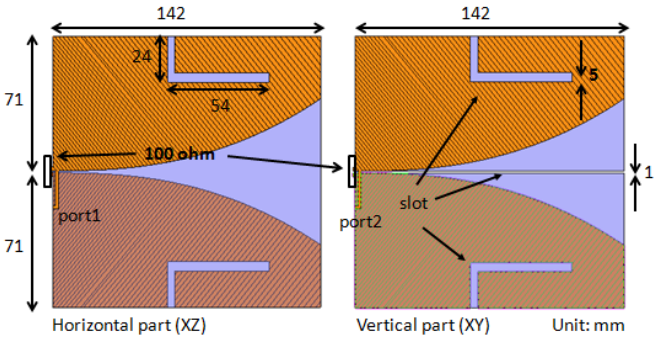

Fig.1 The geometry of four tapping flare sections

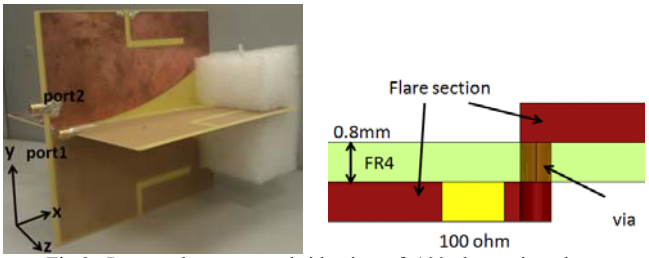

Fig.2. Proposed antenna and side view of 100 ohm resistor layout.

The lower VSWR is obtained by using a 100 ohm resistor. In Fig.3 (a), the VSWR of proposed antenna is lower than 2.2 from 0.8 GHz to 6 GHz. The standard horn with lower VSWR will lead the test system more stable especially in multiple transmission and reception test system. The tapping flare section is not only the radiation part but the ground plane of microstrip line. By using the fed of microstrip, antenna could combine with SMA connector or other circuit board easily. Even though two perpendicular printed horn is close, the isolation between two input port is good. The S21 shown as Fig.3 (b) is less than -30dB in the operating band. There is a 5mm-width L-shaped slot on the each of the tapping flares. By controlling the dimension of the L-shaped slot, better radiation pattern on the lower frequency is achieved. The radiation pattern of 800 MHz without L-shaped slot shown as Fig.4 is omnidirectional. And it's not suitable for standard horn antenna application, .

A printed horn antenna can only provide single

polarization. By switching different input port, dual polarization can be achieved. Figure 5~7 show gain patterns operated at 0.8 , 2.45 and 5.8 GHz of the fabricated antenna with port 1 excited (port 2 connected to a matched load). Base on the results, the directivity of gain pattern at the lower frequency is not good enough because of limited antenna size. And XPL (cross polarization level) is at least 15 dB on the broadside direction in the operating frequency range.

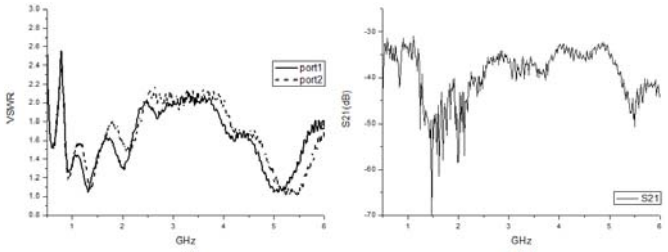

Fig.3 Measurement results of proposed antenna (a) VSWR (b) isolation

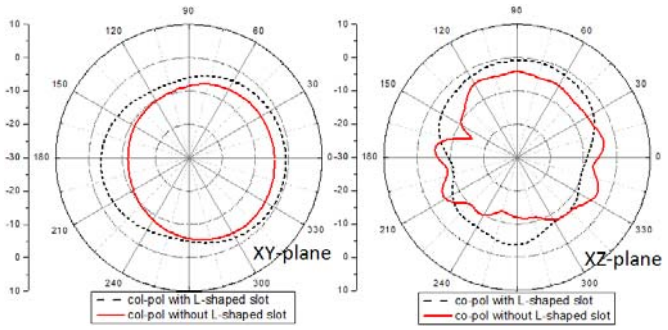

Fig.4 Gain patterns (w/o L-shaped slot) at 0.8GHz

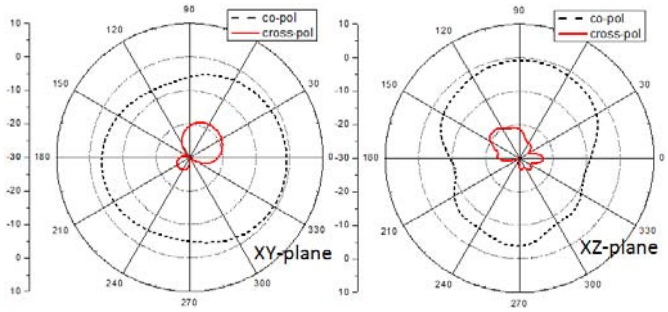

Fig.5 Gain patterns of fabricated antenna at 0.8GHz

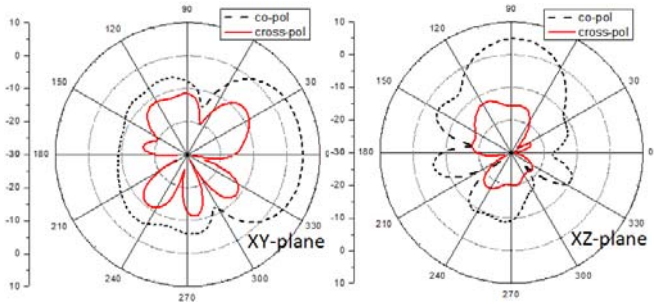

Fig.6 Gain pattern of fabricated antenna at 2.45GHz

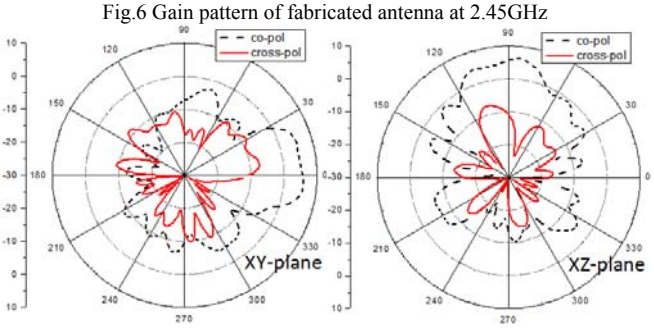

Fig.7 Gain patterns of fabricated antenna at 5.8GHz

II. CONCLUSION

In this paper, a simple and quad-ridged horn antenna has been proposed by using the PCB, which can be easily integrated with printed circuits. The characteristics of good impedance matching, high isolation and dual polarization are achieved. Besides, the 100 ohm resistor and L-shaped slot are used for lower VSWR and better radiation pattern performance, respectively. Based on above characteristics, the proposed antenna can be used as a standard antenna in the test system.

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