Cavity Backed Slot Antenna

Sarang Masani, Ila Parmar, Hitendra Jadeja

Abstract—Among the current driving forces in wireless communications, there is a need for compact, efficient, inexpensive and reproducible antennas. In some instances, particularly long-distance applications, radiators with directive, high-gain characteristics are necessary. This paper proposes a cavity-backed slot antenna to that end. This antenna will enhance the gain, directivity and can also be easily flush mounted to the flying object. The shape and size of the slot can be effectively utilized to get the desired result. The proposed antenna is feed by waveguide which facilitate it to be applicable at high power operation where coaxial cable fails due to skin effect. Present antenna is verified using Numerical Technique called Finite Element Method FEM. The conception of this antenna is realized by the software HFSS “Ansoft-High Frequency Structure Simulator”. By properly selecting shapes, dimensions of the slots and number of slot affects the parameters like return loss, gain along Θ, Ø directions, Cartesian plot and radiation pattern. The Backing of cavity to the slot antenna provide the basics of the gain enhancement and the slot loading effect and the cavity volume plays an important role in achieving the desired return loss at the specific frequency. The simulated antenna shows the 7.0944 db of gain and return loss of -28.60. The proposed antenna works at 6 GHz.

Index Terms—Return loss, CBSA, FEM, HFSS.

I. INTRODUCTION

The Slot antennas are known for their sturdy, planar structure and have long been a prominent part of wireless systems. Their structure is complementary to the printed dipole and a single radiating slot will generate a linearly polarized, but broad, far-field pattern[3].

CBSA is a natural choice for the satellite high gain and high frequency operation.

As CBSA provide less interface when composed in array it is a good choice for high frequency operation where we require large array of antenna to achieve high gain [4]. However, the slot structure used in the CBSA is rectangular slot so analysis can be done easily and the waveguide feed provide us an advantage of operating the antenna over high power operation. The inherent bidirectional nature of the slot’s radiation may be wasted if communication is only required in one direction. If the antenna is mounted on a structure, that backside radiation would be radiating into the structure which could cause significant field cancellation [2]. By properly positioning a metallic reflector or cavity behind the slot, the backside radiation can be recuperated and added constructively to form a uni-directional and directive major beam[8].

II. WAVEGUIDE FEED CBSA

In this paper the feeding to the main antenna cavity is done using rectangular waveguide with standard dimension which is to be used at 6 GHz frequency of operation the dimension. Coaxial cable is not used for the feeding purpose because at high power operation it gets damage due to skin effect and also for the frequency beyond 3ghz the suitable feeding method is using waveguide Another advantage of using the standard waveguide for feeding purpose is that if in case the simulated design is successful we can further make it move on fabrication purpose and the testing instrument available at the standard dimension of the antenna are easily available.(www.microwaves101.com/encyclopediawaveguide edimiones.cfm) gives the standard dimension of waveguide at 6ghz.

III. BASIC ELEMENT OF CBSA STRUCTURE

The CBSA Antenna structure consist of a rectangular waveguide at standard dimension (WR-159).The another component used is a cylindrical cavity which backs a basic slot antenna. The whole structure is feed by the rectangular waveguide. There are 3 slots on the topmost circular disc
The waveguide with standard dimension at 6ghz are used for feeding purpose. The cavity dimensions are 38mm height, radius 30.5mm, and 2mm thickness. The dimension of waveguide is 22.19mm x 42.39mm x 40mm. The slot dimension is 3.5mm x 23mm x 1mm. The circular plate radius is 57.5mm and the thickness of the plate is 1mm.

**IV. ANALYSIS OF CBSA ANTENNA STRUCTURE**

This paper presents the simulation result of the cavity Backed 3 slot antenna. The material used is aluminum.

Fig.3 shows the return loss Curve for the present antenna at approximately 6 GHz. A return loss of 26.45dB is obtained at desired frequency.

Fig.4 shows the overall again of the antenna which is 6.9677db. The different colored lines shows the magnetic and electric field as near the maximum gain there are two deeps which shows the deviation obtained due to the distance between the two slot.
Fig. 5 shows the 2D radiation pattern of CBSA which shows good radiation pattern with minimum of side and back lobes.

Figure 6 shows the 3D gain total which shows the major lobe and minor lobe at 6 GHz which is 6.936db.

Fig. 7 Vswr plot of CBSA antenna is shown which is less than 2 which is acceptable.

Fig. 8 shows the electric field distribution in the circular plate having three slots.
V. RESULT TABLE

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>6.10 GHz</td>
</tr>
<tr>
<td>Gain</td>
<td>6.96dB</td>
</tr>
<tr>
<td>Return Loss</td>
<td>28.46dB</td>
</tr>
</tbody>
</table>

VI. CONCLUSION

In this paper, the slot radiator when backed by cavity provide enhancement in gain and directivity. Using single slot CBSA we obtain high gain and return loss with Good radiation pattern yielding a directive lobe at broadside and Backside radiation levels were shown to be greatly suppressed, a direct benefit to the front side gain. Waveguide on feeding provide it applicable on high frequency operation where coaxial cable suffers from damage. Ansoft-High Frequency Structure Simulator software is used for simulation. The gain and return losses obtained are acceptable. The present antenna works well at the required 6ghz.

ACKNOWLEDGMENT

The authors like to express their thanks to the department of ECE and the management of parul institute of engineering & Technology(under GTU) to support and encouragement during this work.

REFERENCES


8]  Song Shi, Kazuhiro Hirasawa, Zhi Ning Chen “Circularly Polarized Rectangularly Bent Slot Antennas Backed by a Rectangular Cavity” Ieee Transactions On Antennas And Propagation, Vol. 49, No. 11, November 2001

AUTHORS:

Sarang Masani received the B.E degree in Electronics and communication from Atmiya Institute of Tech & Science under Saurashtra University, Rajkot, Gujarat in 2011. Currently he is pursuing M.E in Electronics & communication from Parul Institute of Engg. & Tech. under GTU, Gujarat. His research interest includes Antenna and micro wave communication and their applications. Masani Sarang may be reached at sarang10sarang@gmail.com.

Ila Parmar received the B.E degree in Industrial Electronics from M S University, Vadodara, Gujarat in 2003. And M.E degree in Industrial Electronics from M S University, Vadodara, Gujarat in 2007. Her research interest includes Antenna and micro wave communication and their applications. She has a 6.5 year experience in teaching only

Hitendra Jadeja received the B.E degree in Electronics and communication from Atmiya Institute of Tech & Science under Saurashtra University, Rajkot, and Gujarat in 2011. Currently he is pursuing M.E in Electronics & communication from Parul Institute of Engg. & Tech. under GTU, Gujarat. His research interest includes Antenna and micro wave communication and their applications. Jadeja Hitendra may be reached at hitendra.jadeja.engg@gmail.com.