Substrate Integrated Waveguide Technology for Wireless Systems using HFSS

Anil Kumar Patnaik
Department of ECE
Raghu Institute of Technology
Visakhapatnam India

S P S Dinesh
Department of ECE
Raghu Institute of Technology
Visakhapatnam India

G Lakshmi Durga
Department of ECE
Raghu Institute of Technology
Visakhapatnam India

S Dinesh Yadav
Department of ECE
Raghu Institute of Technology
Visakhapatnam India

K Abhilash
Department of ECE
Raghu Institute of Technology
Visakhapatnam India

Abstract:- **This paper gives an approach of powerful integrated transmission lines compatible with planar technologies such as Substrate Integrated Waveguide(SIW), where SIW can be constructed as open wave-guiding structures and associated in the area of millimeter-wave antenna when the uniformity of these guides are disrupted. It can also integrate planar structure like micro strip line and non-planar structure like waveguide together, combining their advantages in return. This technology has wide selection of advanced manufacturing methods that especially focuses on low-cost and high quality factor efficiency. This paper suggests high SIW structure capacity in the communication system and addresses particular advantages in detail.**

Keywords-Substrate Integrated Waveguide, millimeter-wave antenna, quality factor efficiency.

I. INTRODUCTION

Substrate integrated waveguide may be a technique which integrates the planar arrangement like non-planar and micro strip arrangement like waveguide is in stable. Through some metalized holes there are two metal plates are located altogether of the substrate layer(fig.1) and those metalized holes are not used to attach with. This type of structure is straightforward to supply using PCB technology[5]. SIW arrangement retains most of the advantages associated with traditional metal waveguides, namely high Q-factor(low loss) and high capacity handling with self-consistent electromagnetic shielding[1][8]

SIW framework can support only typical waveguide TM modes. the foremost important advantage of SIW technology is its ability to permit the complete integration of all components on an equivalent substratum, including active and passive elements[2]. The SIW technology incorporates the advantage of traditional micro strip circuits like simple production, compact size, low weight and metallic wave guides like low losses, full shielding, high power handling[1]. The appliance of SIW technology tends to be very suitable for the deployment of wireless components and therefore the integration of full wireless sensor networking systems[7]. Various SIW antennas starting from slotted waveguides to leaky-wave antennas and cavity backed slot and patch antennas[1][6].

2.METHODOLOGY:

SUBSTRATE INTEGRATED WAVEGUIDE: An underlying substance or a layer on which metallic strip antenna is fabricated and it plays major role in micro strip antenna operating.SIW may be a new sort of the cable with convenience of self-consistent field shielding, low cost and lightweight weight. The SIW is shown in fig.1[1] with metal vias, dielectric substrate and ground planes. An oblong guide is generated within a substrate by adding to metal over a ground plane and enclosure the structure with rows of plated vias on either side.[4]

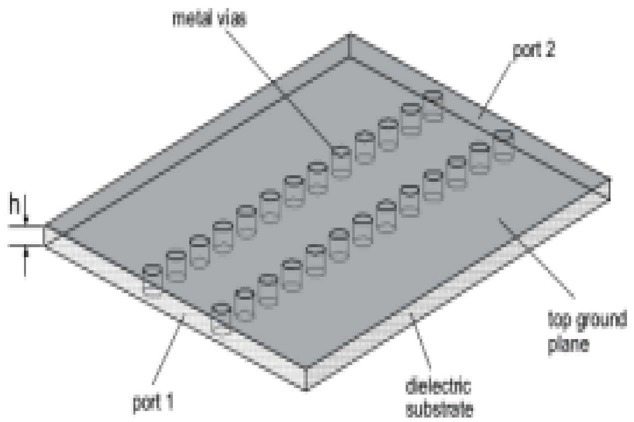

Fig.1 Representation of SIW

In an EM wave, this design looks like a dielectric-filled rectangular wave guide, with reduced height compared to normal ratio 2:1 i.e, width, height also reduces the impedance and increases the length. This entire simulation can be designed in a system-on-substrate[2][3].

A. Single slotted SIW:

With the next primary measurements of varied dimensions of parameters for substrate, ground, vias and wave ports components, the design is simulated using Ansoft HFSS simulator under similar conditions which are comparable operating frequencies. The results are accomplished with analytically determined parameters. one slot SIW could even be a measured antenna and it is a quite slot antenna. Normally, the width of SIW is shorter than that of the normal waveguide much obliged to the presence of the dielectric substrate and this feed network is extremely complicated and it attains high gain. This slot antenna clearly demonstrates better performance in terms of return losses. The single slot SIW antenna is shown in fig.2[1].

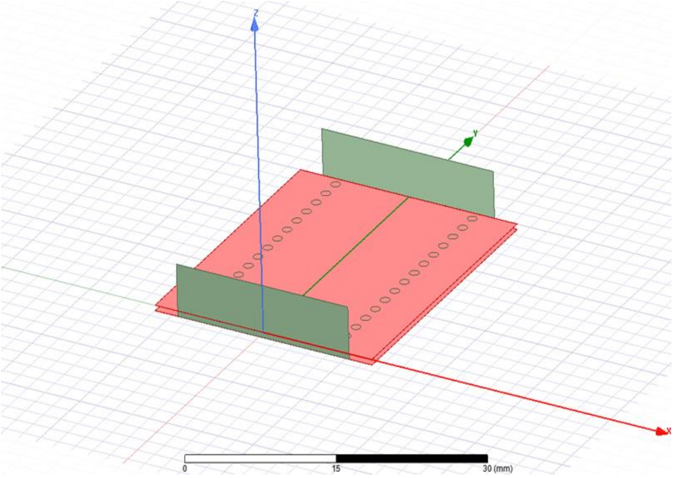

Fig.2 Single Slot SIW

TABLE 1 SIW PROPERTIES (OBSERVATIONS):

Center frequency	12GHz
Return losses	Freq=11.4,14.2,17.3
Directivity	Max =6.1dB Min =-32.3dB
Radiation pattern	Range =-30,-32,-34,-36 Phase =-176deg

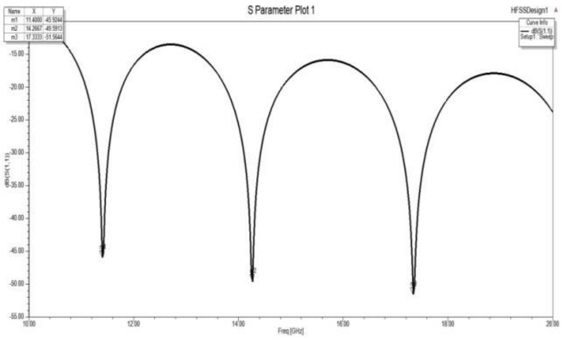

Fig 3: Return Loss Plot of Single Slot SIW

The above result represents asa S-Parameter Plot. Here,we get frequencies11.4,14.2,17.3 by assuming initial frequency as 12GHz[4].

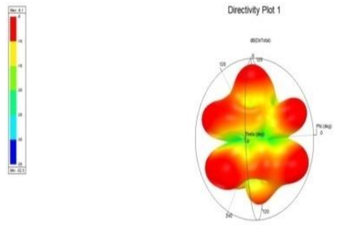

Fig 4: Directivity plot for SIW

The above result represents as Directivity Plot where it ranges from Maximum to Minimum i.e.,6.1dB to -32.3dB respectively[4].

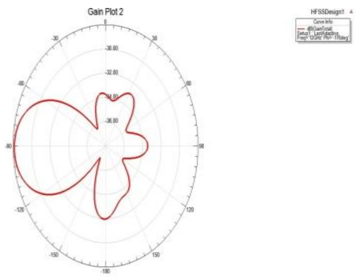

Fig 5: Simulated radiation frequency at 12GHz

The above result represents as a Radiation Pattern.Here,the initial frequency is 12GHz and the gain range is -30,-32,-34,-36 at Phase angle -176deg[4].

B. Double Slot SIW:

Our main motto in this project is that by increasing the number of slots and there by the effects on return losses which has been studied. By triggering end-to-end reciprocal pairing between adjacent spaces, the slot lengths were to make sure good radiation. The difference between the slot arrays of two elements that we considered is λ/2. We used an equivalent substrate to design the antenna array which performs at same frequencies;ROGERS RT/Duroid 5880. The metal vias are the extension to the double slot SIW also it attains. Our motto is to increase the number of slots thereby the effects on return losses, the high gain and directivity with an equivalent frequency of 12GHz. The planning is simulated and total simulation design is to urge radiation and return losses by using HFSS 3D electromagnetic simulation software. For 2 adjacent slots, the ideal dimension of radius is 0.5mm. The SIW double slot antenna is shown in fig.6.

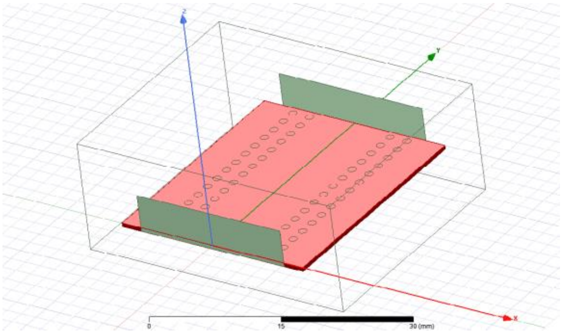

Fig.6Double-Slotted SIW

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TABLE 2: DOUBLE SLOT SIW PROPERTIES (OBSERVATIONS):

Center frequency	12GHz
Return losses	Freq=10.06,11.4,13.4,15.9,18.73
Directivity	Max =2.36dB Min =-37.50dB
Radiation pattern	Range =-35,-30,-35,-40 Phase =90 deg

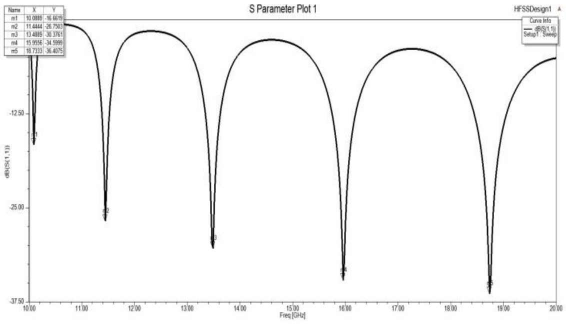

Fig 7: *Return Loss Plot of Double Slot SIW*

The above result represents asa S-Parameter Plot.Here,we get frequencies10.06,11.4,13.4,15.9,18.73by assuming initial frequency as 12GHz[4].

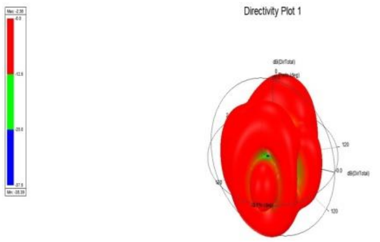

Fig 8: Directivity plot for double slotted SIW

The above result represents as Directivity Plot where it ranges from Maximum to Minimum i.e.,2.36dB to -37.50dBrespectively.

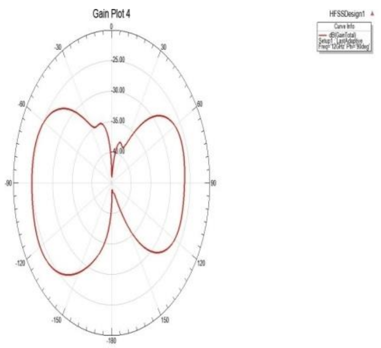

Fig 9: Simulated radiation frequency at 12 GHz

The above result represents as a Radiation Pattern.Here,the initial frequency is 12GHz and the gain range is -35,-30,-35,-40at Phase angle 90 deg[4].

CONCLUSION:

SIW technology emerges after a decade as mature technology for a variety of microwave and millimeter wave applications. Future perspectives include the development of lowcost and environmentally friendly wireless systems on new materials such as paper, plastics and textiles. Recent advances in antennas and array structures have been reviewed and described based on the Substrate Integrated Waveguide (SIW) technology presented in published papers. Issues related to design, and the different scientific explanations proposed for SIW application in modern antennas and arrays is presented. It is observed from the literature available and the complete conventional rectangular waveguide fed antenna and array structure can be developed with SIW technology.

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