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SIW BASED LEAKY WAVE STRUCTURE FOR 5G APPLICATIONS

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Abstract

Enhancement of beam scanning and increasing efficiency by reduce the effect of cross polarization through Doubly Layered-Microstrip Leaky Wave Antenna (DL-MLWA) with novel design is proposed in this project. The antenna will be optimized for low reflection coefficient at 5G frequency and the antenna indeed, a frequency beam scan capability at that frequency. Miniaturization and enhancement of beam scanning of the proposed Leaky Wave antenna is realized by hexagonal shaped Leaky Wave delay line is etched on the Substrate Integrate Waveguide based radiating element. This radiating slots are placed in such a way that the unit cell leaky structure is symmetrical around the centreline of entire SIW radiating structure. Also a longitudinal etched slot in leaky structure is designed and optimized to match the unit cell leaky structure impedance to characteristic impedance of SIW main line.

Index Terms–Beam scanning; Cross Polarization; Doubly Layered-Microstrip Leaky Wave Structure; Substrate Integrated Waveguide (SIW); Radiating Slots

I. INTRODUCTION

An antenna is a metallic device which receives or radiates radio waves. The antenna acts as an intermediate component between transmission line and free space. The transmission line can be in the form of co-axial line or a waveguide. The electromagnetic energies are transported from the transmitting source to the antenna or from the antenna to the receiver. In advanced wireless systems, the antennas are usually required to optimize the radiation energy in particular direction or suppress it.Thus the antenna must serve as the directional device.For wireless communication systems, the antenna is one of the most critical components.A good design of the antenna will improve overall system performance and relax system requirements.Over the last past six decades the antenna technology has been an indispensable partner of the communication revolutions.

II.LEAKY WAVE ANTENNAS

Leaky waves are waves that radiate, or leak power, as they propagate on a guiding structure. A leaky-wave antenna (LWA) is one that takes advantage of a leaky wave on a guiding structure to make a directive beam of radiation. A LWA provides for an easy means to provide a directive beam at a given angle in space without the necessity for a sophisticated feed network or phase shifters. The beam naturally scans with frequency, which can or might not be desirable. for a few applications, having a beam that scans with frequency may well be an economical thanks to obtain beam scanning. Electronically-tuned elements also can be incorporated into a LWA to produce a method for electronic beam scanning at a set frequency. Recent advances have seen LWAs supported low-profile printed-circuit technology and on metamaterials. In other applications, leaky modes are found on printedcircuit transmission lines, where they're undesirable. Leaky waves have also been wont to explain interesting phenomena like the Wood’s anomaly in optics and therefore the directive beaming and enhanced transmission effects in plasmonics.

The unique benefits of LWAs is that they supply high directivity and (frequency or electronic) beam scanning with much smaller form factor, lower cost and better gain than antenna arrays, as they are doing not require a posh feeding network. In uniform LWAs, these benefits are annihilated by the restriction of forward-only scanning. Periodic LWAs are capable of radiating both in forward and backward directions, using leaky space harmonics,. However, their aforementioned LWA benefits are countered by the collapse of the radiation efficiency at broadside. an explicit solution to the current persistent issue came in 2002 with the appearance of metamaterial Composite Right/Left-Handed (CRLH) LWAs, the primary LWAs capable of efficient full-space scanning, which made LWAs potentially superior to arrays.

Leaky-Wave Antenna (LWA) belongs to the more general class of Moving wave antenna, using a moving wave as the main radiating mechanism on a guiding structure.Traveling-wave antenna fall into two general categories, slow-wave antennas and fast-wave antennas, commonly called leaky-wave antennas.

The moving wave on a Leaky-Wave Antenna is a fast wave, with a phase velocity greater than the light speed.This type of wave radiates continuously along its length, and thus the wavenumber kz transmission is complicated, consisting of both a phase and a constant of attenuation.With this form of antenna, strongly directive beams can be accomplished at an arbitrarily defined angle, with a low sidelobe stage.

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It presents and illustrates the answer to the broadside radiation issue furthermore because the unit symmetry rules. Finally, it demonstrates variety of novel concepts, structures, systems and applications, including active LWA beam forming, gain enhancement via power recycling, LWA direction-of-arrival estimation, non-reciprocal LWA diplexers, direction diversity enhanced MIMO systems, smart reflectors, graphene-tunable THz antennas, real-time spectrogram analyzers, and vortex beam launchers for orbital momentum multiplexing.

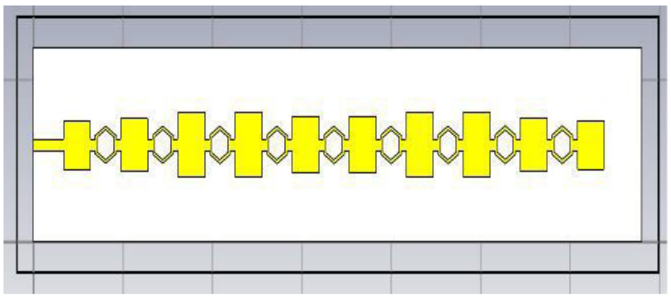

Fig.1. Leaky wave antenna

Disadvantages of leaky wave antennas is that the radiation beam typically scans with the operating frequency. this is often often problematic as, for several applications, it's required to possess a hard and fast waveband when the antenna beam is scanned. With one dimensional leaky wave antennas, this will be done by electronically reconfiguring the leaky-line precondition. Using active devices like varactor diodes or MEMS, the leakymode complex propagation constant is altered, thus producing the required control of the scanning beam.

III.SUBSTRATE INTEGRATED WAVEGUIDE

Microstrip devices are not effective in high frequency applications, and because the wavelength at high frequencies is low, the manufacture of microstrip devices requires very tight tolerances. Waveguide devices are favored at high frequencies; but their manufacturing process is difficult. Therefore a new idea emerged: integrated waveguide substrates. SIW is a transition from microstrip to dielectric-filled (DFW) waveguide. The dielectric filled waveguide is converted to an integrated waveguide (SIW) substratum by using vias for the waveguide's sidewalls.Substrate Integrated Waveguide (SIW) acts as alternative option to metallic waveguides.

The approach of the substrate integrated waveguide (SIW) innovation permitted to acknowledge segments with lower loss and insignificant parasitic cross-coupling, making in this way the SIW radio wire more alluring than ordinary planar integrated antenna. For these favorable circumstances, SIW innovation is viewed as an appropriate possibility for the structure of mm-wave antenna apparatus, in view of straightforward creation, simple coordination and low assembling cost. All things considered, the measurement and complex design speak to even now a breaking point in the utilization of SIW segments. This paper presents a SIW antenna exhibit working at 30 GHz for future 5G applications. One advantage to SIW is that the volume of metal holding the signal is much greater than it would be in microstrip or stripline. Hence the loss of the conductor is less. One possible downside of SIW is that there may be significant losses in leakage. This is because of the close distance between the vias.

A substrate integrated waveguide (SIW) may be a printed (PCB) version of the standard rectangular waveguide. the 2 wide walls are composed by the copper metallization between each row of vias, and also the vias substitute the vertical narrow walls of the standard rectangular waveguide. These rows of metallized vias are near an ideal electric conductor precondition since those vias are very near one another (in terms of wavelengths). To be more accurate, the vias are inductive boundary conditions. the primary propagating mode is extremely near the one that might be found in a very rectangular waveguide with the identical cross section full of the substrate dielectric. As any waveguide of this kind, the system behaves as a high-pass filter, because of the existence of cutoff frequency.

Fig.2. SIW structure

IV.PROPOSED WORK

A double layer substrate is utilized as a component of the proposed microstrip leaky wave antenna. The principal layer of the substrate is a lossy dielectric with h=1mm,e=2.1 Teflon(PTFE) is utilized ,and the subsequent layer is additionally a lossy FR4 with h=0.5mm,e=4.3.The point of utilizing such substrate is to lessen the creation costs without conceding huge force dissipations,since low-misfortune dielectric sheets are generally more affordable than PCB.

Without metal via:

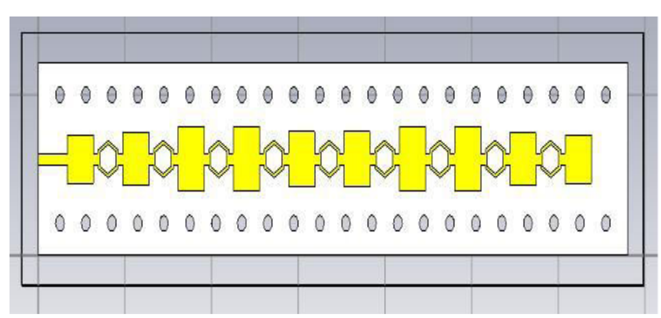

Fig.3. SIW structure without metal vias

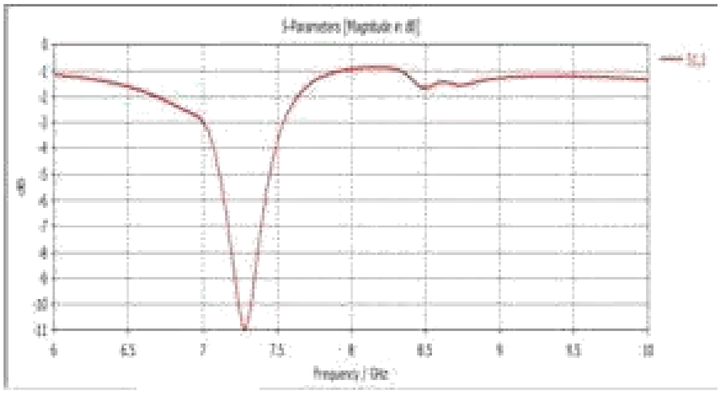

Fig.4. Output graph for SIW structure without metal vias

With metal via:

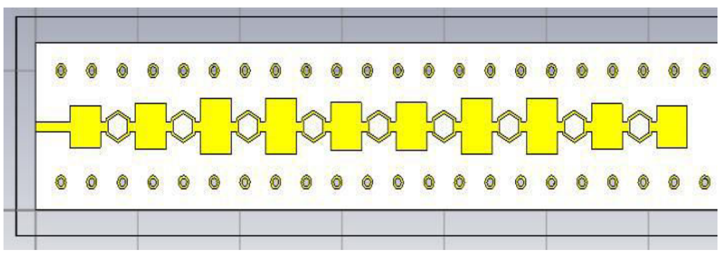

Fig.5. SIW structure with metal vias

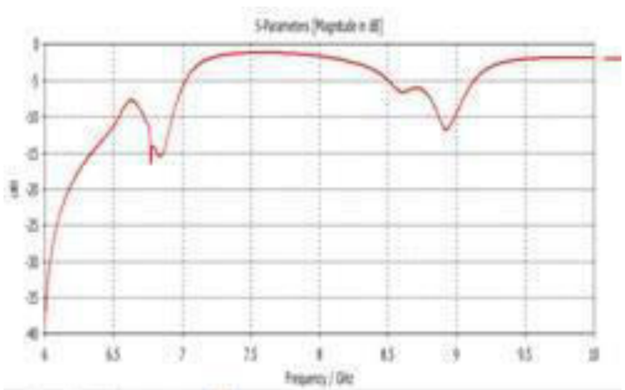

Fig.6. Output graph for SIW structure with metal vias

Further, the extension has been included in the Fig.5.The extension is provided to improve the efficiency and directivity of the radiation pattern.The input frequency has been set as 20 to 30GHz.The simulated S-parametric graph is shown in Fig.6

With metal via and extension:

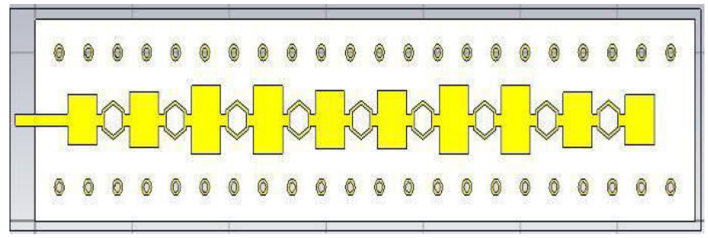

Fig.7. SIW structure with metal vias

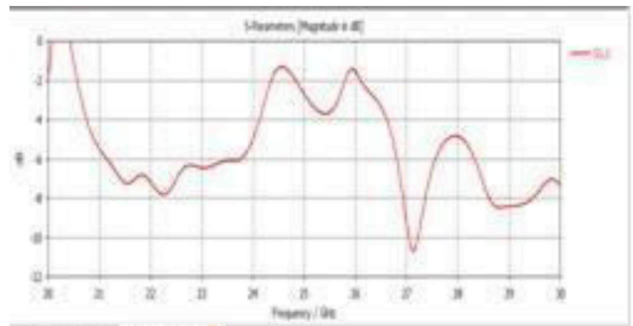

Fig.8.S-parameter graph

V.CONCLUSION

This paper discusses the double layered structure integrated with the substrate integrated waveguide technology and the leaky wave structure together in order to enhance the directivity and the efficiency of the existing model. This paper introduces the new concept which stands out from the other novel technologies of single layer by supporting the dual layer with the dielectrics as Teflon and FR4. The simulation has been carried out for the frequency range of 20-30GHz and the results and the radiation pattern has been analysed for the further study.

VI. REFERENCES

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