INTERNATIONAL JOURNAL OF ELECTRONICS; MECHANICAL and MECHATRONICS ENGINEERING Vol.3 Num 3 pp.(607-609)

SIW HIGH GAIN SLOT ANTENNA FOR WLAN/WIMAX APPLICATION

Neda **A**kbari[1], Javad Nourinia[1] and Ch. Ghobadi[1]
Department of Electrical Engineering, West Azarbaijan Science and Research Branch, Islamic Azad University, Urmia, Iran.
Corresponding mail: (neda_akbari1987@yahoo.com)

ABSTRACT

In this paper with using substrate integrated waveguide technology and slot antenna, an antenna array with 8 (2×4) elements has been designed. The antenna substrate is ROGERs 4003 with two different thickness. In lower substrate with 0.5 mm thickness fed network of antenna is putted and upper substrate with 1.5 mm thickness slot in order to radation is embedded. The proposed antenna is designed in C band for WLAN/WiMAX application. Pattern of antenna is directive with peak gain about 18dBi. In feed netowork is used from new method of feeding with using of aperture couple and cavity resonator method.

KEY word: antenna, array antenn, substrate integrated Waveguide, High Gain antenna

INTRODUCTION

In the last years, the concept of the substrate integrated waveguide (SIW) has been proposed [1,2], in which an “artificial” waveguide is synthesized and constructed with linear arrays of metalized via holes or posts embedded in the same substrate. The connection between the waveguide and the planar circuits is provided via transitions formed with a simple matching geometry between both structures [3, 4], thus providing a compact and low-cost platform. This new SIW concept allowed for the design of microwave and millimeter-wave circuits such as antennas and antenna arrays. In fact, in 2004, Farrall and Young[5] have presented an SIW slot antenna operating at 10 GHz, where they have fabricated a one- and two-slot antennas. S_{11} about −28 dB has been achieved in both cases, and a gain 3 dB higher for the two-slot antenna has been obtained. The same year, Yan et al. [6] have designed and fabricated an SIW antenna with an array of slots. S_{11} of −18 dB has been obtained around 10.2 GHz. A measured gain of 15.7 dB was achieved. Then in 2005, a couple of SIW slot antennas have been presented in [7–10] by Young et al. In the first work [7], an SIW slot antenna using thick photo-imageable film technology on a reduced thickness substrate has been realized. The antenna operated at W-band where the resonance frequency was 96.4 GHz with a return loss around −20 dB. In [8], the authors have presented a slot antenna using a folded SIW, reducing the width of the original guide by half. Simulations have shown a −18 dB return loss and a 400 MHz bandwidth with a 6.5 dB gain. The same authors have presented two other slot antennas using three main components: a nonradiating SMA-waveguide transition, a power divider from the standard waveguide to the folded waveguide, and an array of slots on the folded one. In [9], the measurement data indicated a −24.4 dB reflection coefficient, a bandwidth of 255 MHz, around a resonance frequency of 9.53 GHz, and an 8 dB gain for the two-slot design and a 6.5 dB for the one-slot design. While in [10], a reflection coefficient of −19.7 dB, a 525 MHz bandwidth, around 8.96 GHz, have been achieved. Yan et al. [11] have developed a monopulse antenna using 4 × 8 longitudinal slots and operating at 10 GHz. In 2006, Weng et al. [12], have studied a slot antenna in the Ku-Band and have obtained a reflection coefficient less than −10 dB on a 500 MHz frequency bandwidth. Hong et al., have presented their activity at State Key Lab, concerning various antennas as slot-array, leaky-wave, omnidirectional, monopulse, and dielectric resonator antennas, filtennas and rectennas [13].in this paper with using substrate integrate waveguide and novel method at design of feed network, high gain of antenna with suitable bandwidth is presnted

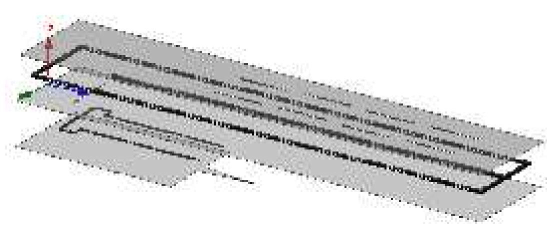

Fig.1 structure of proposed antenna

Antenna structure and result:

The antenna structure is shown in fig.1. The proposed antenna has been consist of two Rogers 4003 layers with tanδ=0.003 and ε_r=3.55. The thickness of bottom substrate and thickness of upper layer are 0.5 mm and 1.5 mm, respectively. The bottom layer consist of: 1) a microstrip line with .1 mm length and .2 mm width to provide 50 ohm input impedance. 2) A transmission line is placed between SIW and microstrip line. To provide impedance matching between SIW and microstrip line W_{tapper}=25mm and L_{tapper}=6mm are choice, As shown in fig.2. And 3) At last, in the end of SIW line is putted a slot that is provided transition between tow layer. The Top layer is included a SIW resonator, a -3dB equal power divider and SIW slot antenna (with 4 elements). The antenna slot length and width are 30mm and 0.5mm, respectively. The offset of slot array is 0.5mm and SIW width is 16mm.

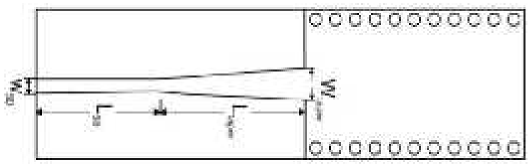

Fig. 2. Transition between microstrip and SIW line

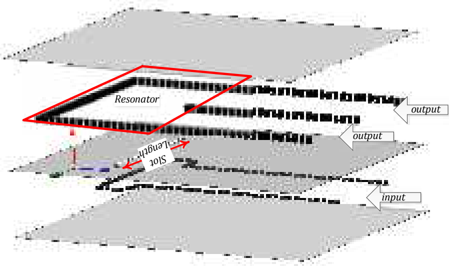

Fig.3. feed network of antenna structure

In fig.3 the feed network structure is presented. Antenna has been optimized and simulated. For example, The optimization of transition slot between two layers is shown in fig 4. As shown in fig. 4, at L_{slot}=26 mm have better result.

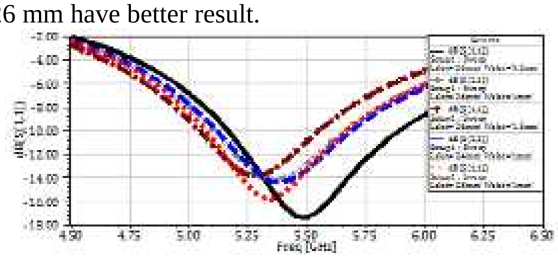

Fig.4 variation of transition slot length and width

The return loss of antenna is illustrated in fig. 5. As shown in figure the bandwidth of proposed antenna is 320MHz (from 5.25GHz to 5.57GHz). The simulated pattern of antenna is shown in fig.6. The pattern of antenna is directivity with peak gain of 18dB and side lobe level is about 18dB lower than main lobe.

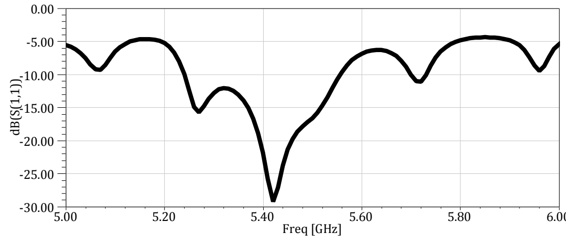

Fig. 5 return loss of proposed antenna

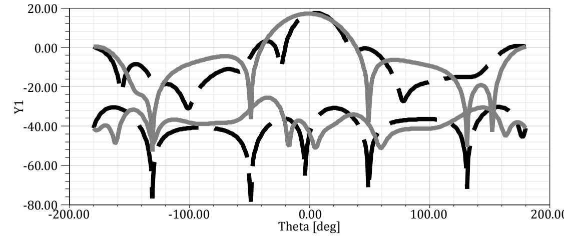

Fig. 6 pattern of proposed antenna

Conclusion

In this paper, we studied an SIW antenna array at 5.5 GHz, using the phase shifter and the slot antenna designed in previous work. To do so, we designed, and measured a two-element SIW antenna array. We proved, regarding the obtained results, that the developed SIW phase shifter and slot antenna can be combined to develop an SIW antenna array with good performances.

References

1. C. A. Balanis, Antenna Theory: Analysis and Design, Wiley and Sons, New York, NY, USA, 2nd edition, 1997.
2. D. Deslandes and K. Wu, "Single-substrate integration technique of planar circuits and waveguide filters," IEEE Transactions on Microwave Theory and Techniques, vol. 51, no. 2 I, pp. 593–596, 2003.
3. D. Deslandes and K. Wu, "Integrated microstrip and rectangular waveguide in planar form," IEEE Microwave and Wireless Components Letters, vol. 11, no. 2, pp. 68–70, 2001.
4. D. Deslandes and K. Wu, "Integrated transition of coplanar to rectangular waveguides," IEEE International Microwave Symposium Digest, vol. 2, pp. 619–622, 2001.
5. A. J. Farrall and P. R. Young, "Integrated waveguide slot antennas," Electronics Letters, vol. 40, no. 16, pp. 974–975, 2004.
6. L. Yan, W. Hong, G. Hua, J. Chen, K. Wu, and T. J. Cui, "Simulation and experiment on SIW slot array antennas," IEEE Microwave

and Wireless Components Letters, vol. 14, no. 9, pp. 446–448, 2004.

7. D. Stephens, P. R. Young, and I. D. Robertson, “W-band substrate integrated waveguide slot antenna,”Electronics Letters, vol. 41, no. 4, pp. 165–167, 2005.
8. B. Sanz-Izquierdo, P. R. Young, N. Grigoropoulos, J. C. Batchelor, and R. J. Langley, “Substrate-integrated folded waveguide slot antenna,” in Proceedings of the IEEE International Workshop on Antenna Technology, vol. 2005, pp. 307–309, March 2005.
9. B. Sanz-Izquierdo, P. R. Young, N. Grigoropoulos, J. C. Batchelor, and R. J. Langley, “Slot array antenna using folded waveguides,” in Proceedings of the Loughborough Antennas & Propagation Conference, UNSPECIFIED, Ed., Loughborough University, April 2005.
10. B. Sanz Izquierdo, P. R. Young, N. Grigoropoulos, J. C. Batchelor, and R. J. Langley, “Slot antenna on C type compact substrate integrated waveguide,” in Proceedings of the 35th European Microwave Conference, vol. 1, pp. 469–472, Paris, Farnce, October 2005.
11. L. Yan, W. Hong, and K. Wu, “Simulation and experiment on substrate integrated monopulse antenna,” in Proceedings of the IEEE Antennas and Propagation Society, International Symposium, vol. 1 A, pp. 528–531, July 2005.
12. Z.-B. Weng, R. Guo, and Y.-C. Jiao, “Design and experiment on substrate integrated waveguide resonant slot array antenna at ku-band,” in Proceedings of the 7th International Symposium on Antennas, Propagation and EM Theory (ISAPE '06), pp. 1–3, October 2006.
13. W. Hong, B. Liu, G. Q. Luo et al., “Integrated microwave and millimeter wave antennas based on SIW and HMSIW technology,” in Proceedings of the International Workshop on Antenna Technology: Small and Smart Antennas Metamaterials and Applications (IWAT '07), pp. 69–72, March 2007.