A Low Cost Broadband Planar Antenna

R. Dakir, J. Zbitou, A. Mouhsen, A.Tribak, Angel Mediavilla Sanchez, and M. Latrach

***Abstract*—This paper comes with a new low cost compact planar antenna with the improvement of the bandwidth. This structure is based on an FR4 substrate. To develop this structure we have conducted many optimizations by using Momentum integrated into ADS "Advanced Design System" from Agilent Technologies and compared with CST Microwave studio. The comparison between simulation and measurement results permits to validate the final achieved antenna structure with an improvement of the bandwidth. The antenna achieved is a low cost planar, simple in structure and easy to be fabricated, thus promising for applications in wireless communication systems.**

***Index Terms*—Bandwidth improvement, microstrip antennas, wide band antennas.**

I. INTRODUCTION

In recent years, the technologies of wireless communication systems have been rapidly increasing the demands for greater capacities broadband service to support wireless communication, especially for applications of multimedia communications (data, voice, pictures, and video) and wireless radio technologies (Bluetooth, Wifi, GPRS, UMTS, Wimax). They have a great success. As well, the applications require high bandwidth between the mobile communication equipments with reduced size.

Therefore, to meet the increased demand for wireless communication with high bandwidth, the future generations of equipments will need to integrate with antennas systems to provide high performance and to fulfill the needs in terms of gain, bandwidth, etc. Those antennas should function over multi-frequency bands or over wideband. They should be compact and easy to be integrated into the radio systems, which require innovation of new antenna structure with low cost of manufacturing; and they don't have any electromagnetic compatibility problems with the surrounding electronic environment. The antennas adapted for this kind applications are the microstrip printed antennas which allow the development of miniature compact antennas' structure. But this technology generates disadvantages which have low gain, and it supports a low power level.

So, in order to design miniature printed antennas with high bandwidth, many techniques for improving the operating bandwidth have been studied [1]-[7]. This work presents a new low cost compact antenna structure with the improvement of the bandwidth. The type of the chosen port for feeding the antenna is coplanar and easy to be integrated with passive or active elements.

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II. THE CONCEPTION OF A PRINTED BROADBAND

A variety of broadband techniques have been developed by using some factors which affect the bandwidth of a microstrip patch antenna likethe shape of the radiator, the feeding scheme, the substrate and the arrangements of radiating and parasitic elements. In our study, the goal is to improve the bandwidth of the rectangular antenna, by using the slot technique. To do that and validate the antenna structure, we have manipulated Momentum electromagnetic software integrated into ADS "Advanced Design System" from Agilent Technologies. This program is recommended for planar antenna structure with weak thickness of the substrate. The substrate used for this design is FR4 with the following characteristics:

- Relative dielectric permittivity ε_r=4.3.
- Substrate thickness: h=1.6mm.
- Dielectric loss: tan(δ) =10^{-3}.
- Metallic thickness: t=35μm.

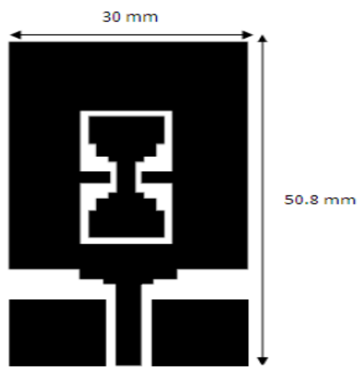


Fig. 2. The structure of the optimized broadband antenna.

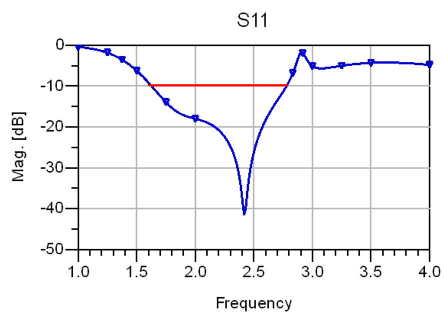


Fig. 3. Simulated return loss versus frequency in GHz.

For optimizing the antenna structure and increasing the bandwidth we have used the optimization technique integrated in ADS which allows us to validate the structure presented in Fig. 2.

As shown in Fig. 3, the matching input impedance is achieved along a frequency band between 1.7 GHz and 2.8 GHz with return loss below-10dB.

Before achieving the antenna and for comparison we have done another simulation by using CST Microwave Studio for 3D electromagnetic simulation.

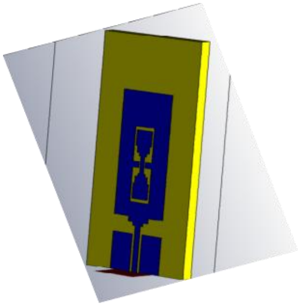


Fig. 4. The antenna structure in 3D.

As illustrated in Fig. 5, we conclude that we have approximately the same result as with ADS.

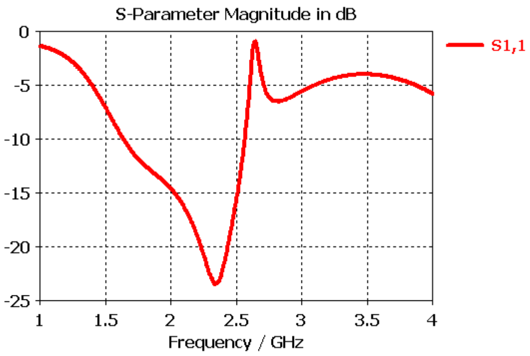


Fig. 5. Simulated return loss versus frequency.

As an example, we have the radiation pattern presented in Fig. 6 at 2 GHz.

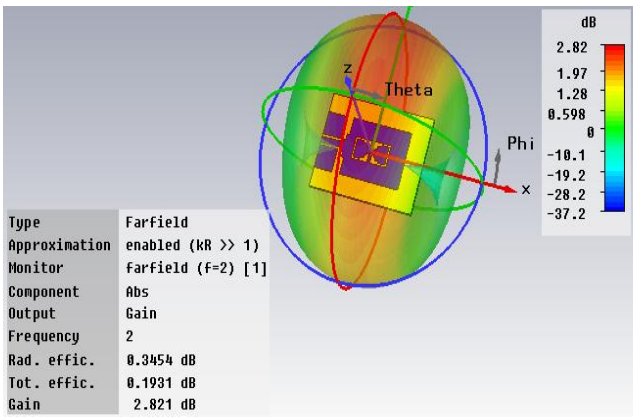


Fig. 6. 3D radiation pattern @ 2 GHz.

III. Achievement and Measurement

A. Achievement and Calibration

After the comparison of simulation results on ADS and CST, we have achieved the structure antenna by using the LPKF machine.

Fig. 7. Photograph of the fabricated structure with LPKF machine.

The kit of calibration used in the setup test is 3.5mm, associated to a VNA R&S@ZVB20 from Rohde & Schwarz. The test has taken into account the return losses in the transitions.

Fig. 8 Calibration Kit 3.5 mm.

B. Test and Comparison

After series of test, we have done a comparison between simulation on ADS, CST and measurement results as shown in the following figures.

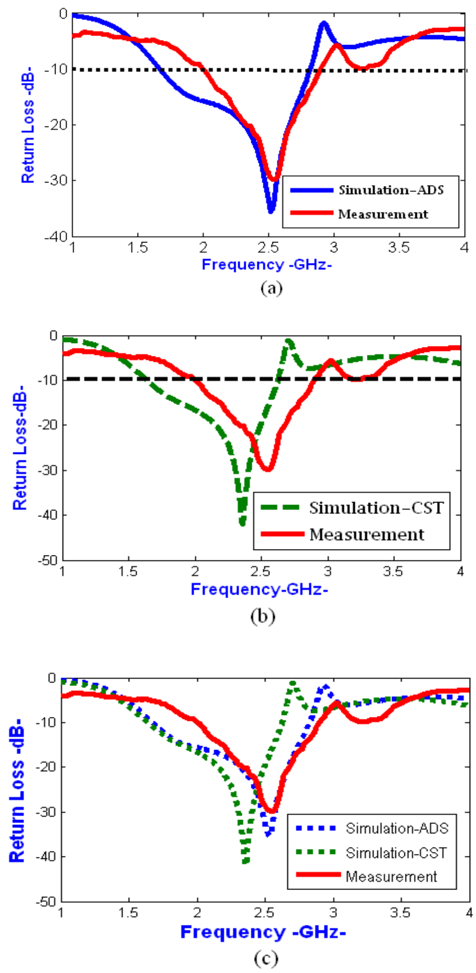
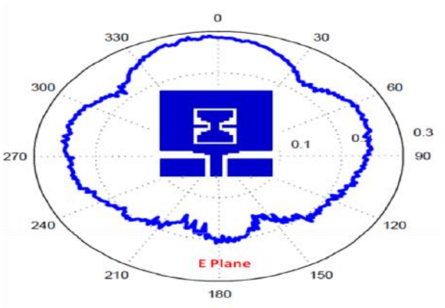
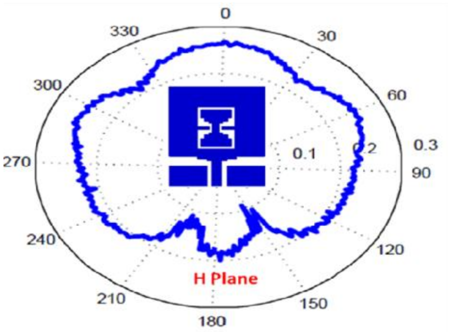


Fig. 9. Comparison of simulated and measured return loss.

We conclude that we have an agreement between simulation and measurements results. We note that the simulation results on ADS are the closest to the measured results. This allows the validation of the antenna structure with large frequency band ranging from 2.1 GHz to 2.8 GHz, with a bandwidth of 700 MHz, compared to the narrow band of a classic rectangular patch antenna. For the measured radiation pattern at 2 GHz, it's presented in Fig.10 for E and H plane.



(a)



(b)

Fig. 10. Radiation pattern at 2 GHz for E and H plane.

IV. Conclusion

This work has presented a study on a new low cost planar broadband antenna structure. The measurement and simulation results are in agreement which validate the antenna structure with a bandwidth of 700MHz. This antenna is feed with CPW line which permits to associate it with printed circuits board. To improve the bandwidth of the antenna we have used a simple technique based on the use of slot technique.

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