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Wide Band CPW Fed Slotted Microstrip Antenna

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Abstract

In this paper, a design of compact coplanar waveguide fed UWB slot antenna is presented. The proposed antenna has simple structure consisting rectangular slot with uneven coplanar ground structures. The proposed antenna structure is investigated by using MoM based electromagnetic solver IE3D. The simulation and measured results show that the antenna offers performance for wideband system from 4.5 GHz to11.8 GHz with return loss better than -10dB over the frequency spectrum with VSWR less than 2.5. The antenna configuration would be quiet useful for indoor applications. The antenna is fabricated and simulated. Measured results show a good agreement with simulated results.

Keywords: *coplanar waveguide, slot antenna, wideband*

1. Introduction

The Microstrip antenna became very useful in recent years in wireless communication systems. The Microstrip wideband antennas have attracted much attention due to their advantages such as simple structure, low profile, high data rate, easy integration with monolithic microwave integrated circuits (MMICs), ease of fabrication and this eliminates the alignment problem as in aperture coupled and proximity feed. Thus, the UWB antenna receives much attention in short-range, high-data wireless communication applications. For wireless applications various antenna configurations including planer monopole antennas, various shapes of slot antennas and tapered slot with tuning patch, have been reported for a compact wideband antenna [1-7]. In this paper, a coplanar waveguide (CPW)-fed with uneven ground planes compact wideband Microstrip antenna is proposed and designed.

2. Antenna Structure

The bandwidth of a Microstrip antenna is not very broad because it has only one resonance. Thus, to design a wideband antenna, two or more resonant parts with each one operating at its own resonance is required, and the overlapping of these multiple resonances may lead broadband performance. Therefore, this design is chosen to generate two or more resonant bands for achieving ultra wide bandwidth. In this design, the two uneven ground planes are etched on the same plane as shown in Figure 1. The above design skills are introduced to obtained ultra wideband accompanied with good impedance matching over the entire operating band. A rectangular patch, which has the dimensions of length (L1=70 mm and width (W1=50 mm).The gap and width of central strip W5 are 0.5mm and 3.0mm respectively, as uneven ground planes are embedded from the patch’s left and right sides on the same plane to provide the CPW feed. The size of ground planes are L4=25.5mm, W4=23mm and L3=19mm, W3=23. He gap between large, small ground planes and conducting plane are 2.5mm and 1.6mm respectively. A slotted section is made in the conducting plane of the size L2=29mm and W2=5mm. The width W6 is 3.5 mm. as shown in Figure 1. A photograph of the fabricated antenna is shown in Figure 2. This wideband antenna was fabricated and printed on a 1.6-mm-thick FR-4 substrate with permittivity (ε_r) = 4.4 and a loss tangent of 0.02. The electromagnetic solver, IE3D, is used to numerically investigate and optimize the proposed antenna configuration.

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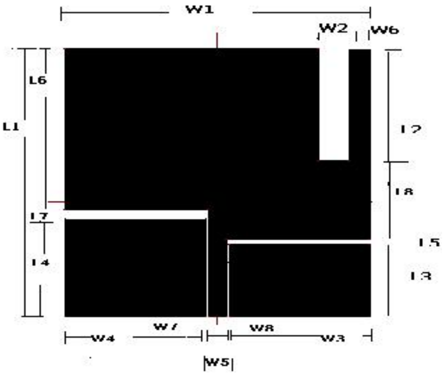

Figure 1. Structure of proposed antenna

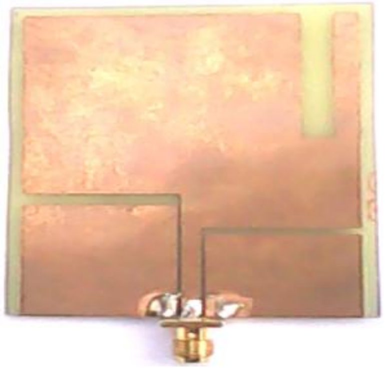

Figure 2. Fabricated antenna

Table 1. Dimension of the proposed antenna

L1	L2	L3	L4	L5
70mm	29mm	18.7mm	25.5mm	1.6mm
L6	L7	L8		
42mm	2.5mm	20.7mm		
W1	W2	W3	W4	W5
50mm	mm	23.1mm	23mm	3.0mm
W6	W7	W8		
3.0mm	0.5mm	0.4mm		

3. Experimental Result and Discussions

For the proposed antenna design, IE3D simulation software is used. The best performance of the antenna is obtained after a large no. of iterations.

Figure 3 shows the simulated and measured return loss (S_{11} parameter) of the proposed antenna with the optimized parameters. Obviously, the simulation results show ultra wide bandwidth from 4.5 to 11.8 GHz. The antenna has good impedance matching with this range. A small difference in simulated and measured return loss results due to additional SMA connector is used in the measurements. An vector network analyser VNA 140 was used to measure the electrical performance of the proposed antenna. The return loss is measured -14.8dB and -18 dB at resonant frequencies at 5GHz and 11GHz respectively. The Return loss (S_{11} parameter) is measured less than -10dB for the entire frequency range 4.5 GHz to 11.8 GHz.

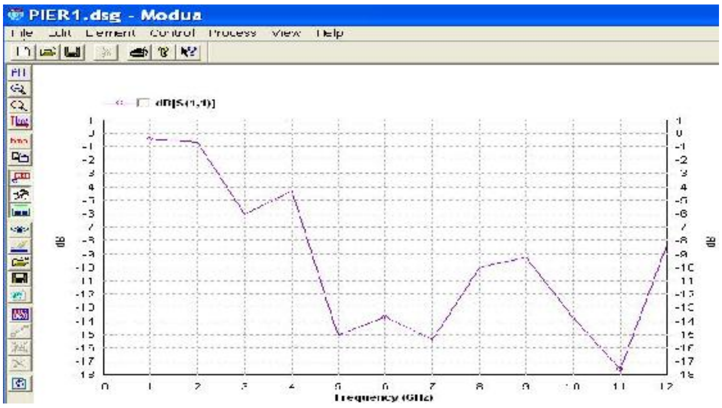

Figure 3(a). Simulated return loss (S_{11} parameter) of the proposed antenna

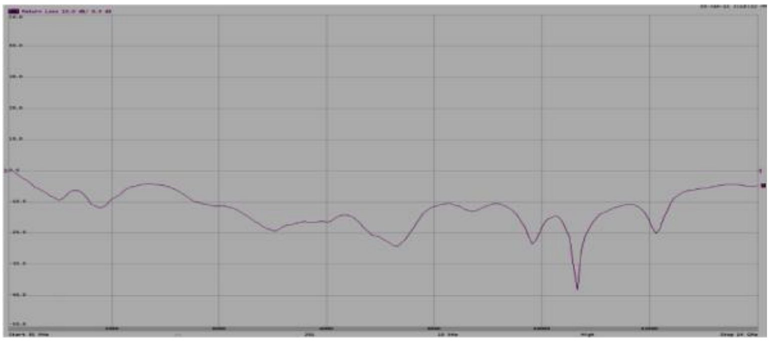

Figure 3(b). Measured return loss (S_{11} parameter) of the proposed antenna

VSWR as varies from 1.2 to 2.5 between the frequency range 4.5 GHz to 11.8 GHz. It can be seen that the very low VSWR is observed at resonant frequencies. Figure 4 shows the simulated VSWR. Measured VSWR shows the agreement with the simulated result Figure 5 shows the result of the measured VSWR of the proposed antenna.

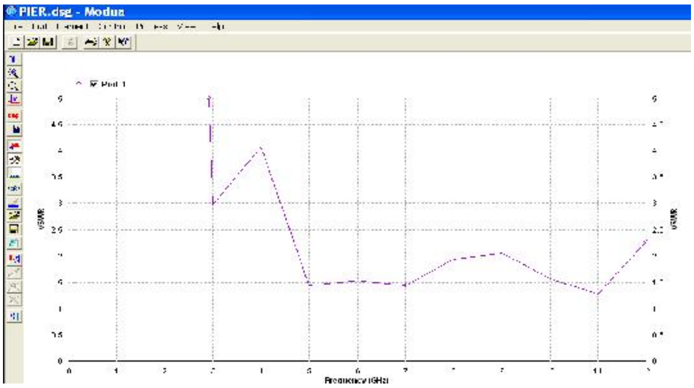

Figure 4. Simulated VSWR of the proposed antenna

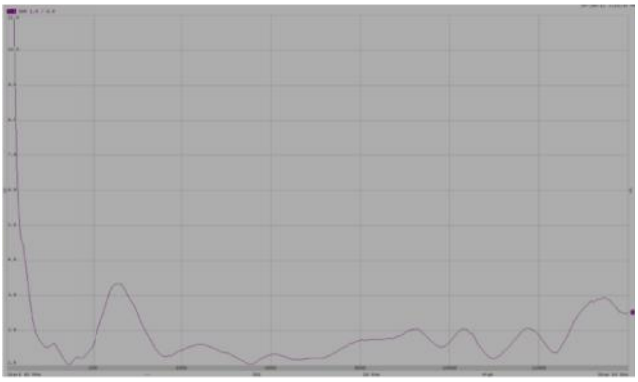

Figure 5. Measured VSWR of the proposed antenna

Figure 6 shows the measured and simulated gain for the proposed antenna fed by CPW. The measured peak gain with frequency among all phi and theta is selected for the proposed antenna. The simulated and measured antenna gain of the proposed antenna varies from 0.5 dBi to 6 dBi for the entire frequency range.

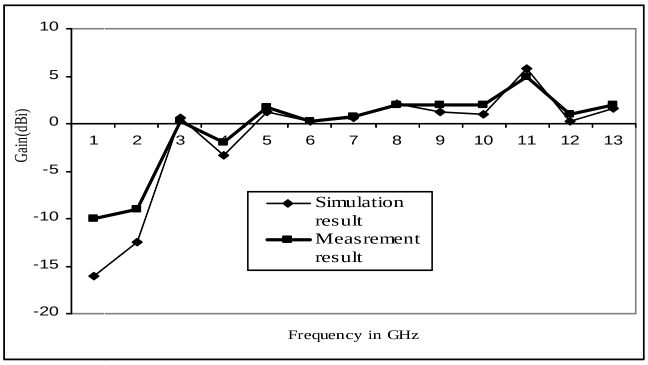

Figure 6. Measured and simulated result of the proposed antenna gain

Measurement setup for measuring the antenna parameter as shown in Figure 7. The measuring position for antenna patterns measurements in anechoic chamber Figure 8.

Figure 7. Measurement set up

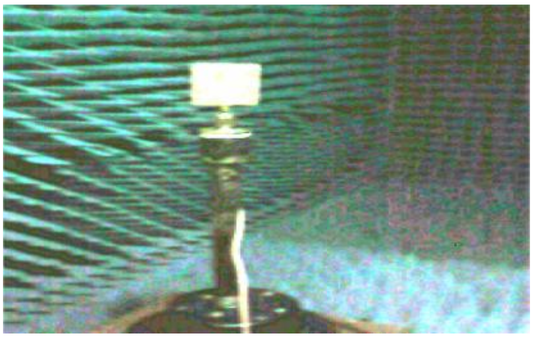

Figure 8. Antenna position for radiation pattern in anechoic chamber

The simulated 2-D far-field radiation patterns are shown in Figure 9 and Figure 10. E-planes at sampling frequencies of 5, 7, and 11GHz respectively. It is found that the antenna has nearly omni directional radiation patterns at all frequencies in the E-plane and the H-plane in Figure 11 and Figure 12. This pattern is suitable for application in most wireless communication system. The antenna exhibits good agreement with measured results

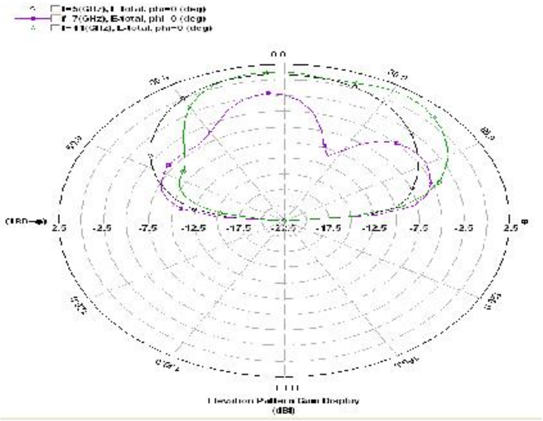

Figure 9. Radiation pattern simulation result E-plane at 5, 7 and 11 GHz

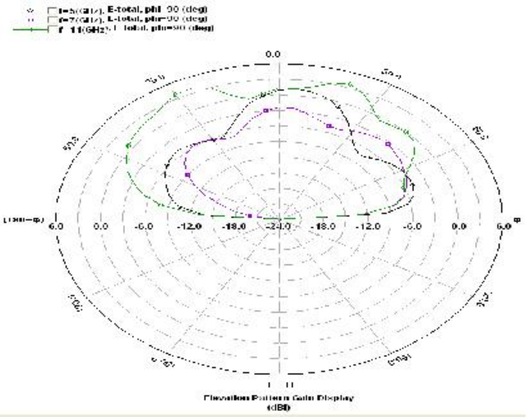

Figure 10. Radiation pattern simulation result E-plane at 5, 7 and 11 GHz

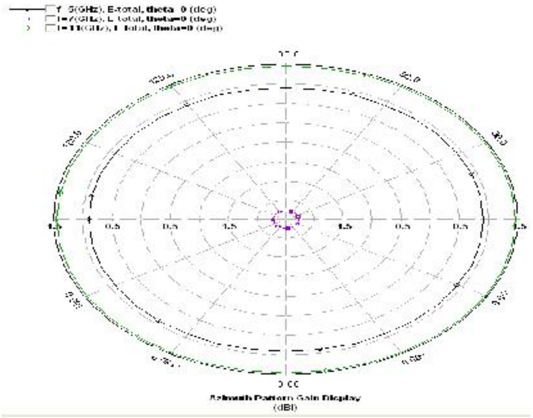

Figure 11. Radiation pattern simulation result H-plane at 5, 7 and 11 GHz

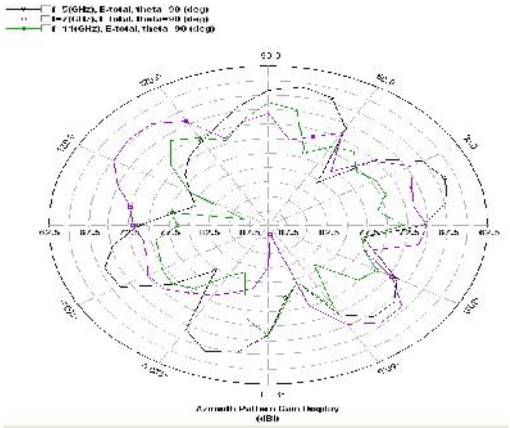

Figure 12. Radiation pattern simulation result H-plane at 5, 7 and 11 GHz

The measured 2-D far-field normalized radiation patterns for the proposed antenna are shown in Figure 13 and Figure 14. The H- and E-planes at sampling frequencies of 5, 7, and 11GHz respectively. It is found that the proposed antenna has nearly agreement with the simulation results.

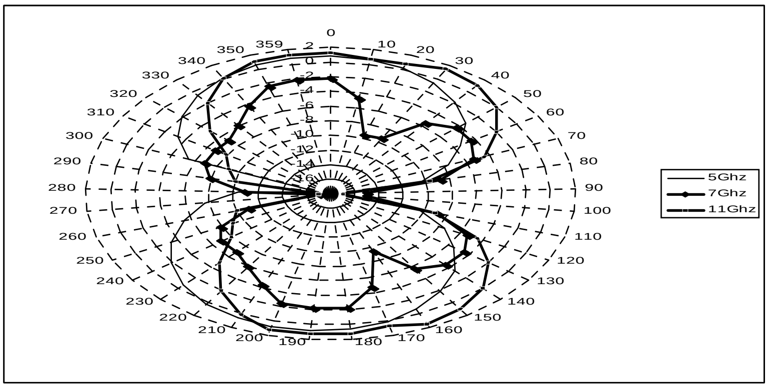

Figure 13. Measured normalized antenna radiation pattern E-plane of proposed antenna for the frequency 5, 7, 11 GHz

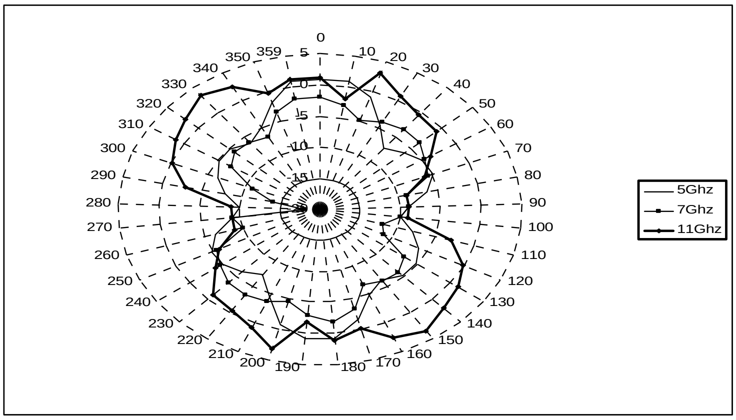

Figure 14. Measured normalized antenna pattern H-plane of proposed antenna for the frequency 5, 7, 11 GHz

4. Conclusion

A novel CPW-fed compact wideband Microstrip antenna is proposed. The measured results of the fabricated antenna show stable radiation patterns over the wide band frequencies. The good impedance-matching characteristic, and nearly omni directional radiation patterns over the entire operating bandwidth of 4.5 GHz to 11.8 GHz, make this antenna a good candidate for wideband applications and systems.

Acknowledgements

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