PART 1: MINITURALIZATION PLANAR MONOPOLE ANTENNA for UWB APPLICATIONS

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ABSTRACT

Miniaturization and compact printed planar monopole antenna CPW/microstrip feed line three half semi-circular with similar ground plane is presented,design, simulation, fabrication and tasted experimentally for Ultra-Wideband (UWB) communication application especially for WLAN and HIPERLAN/2 WLAN. The antenna design has afar from the traditional antennas such as a rectangular, circular, elliptical ….etc. Generating original planar antenna has been investigated to be an effect the combine geometry shapes of the radiation element part with the same geometry shapes of the slots in the ground plane. The simulation and measuring results have a good agreement, large bandwidth and radiation pattern behavior an omni-directional with stable gain.

INTRODUCTION

Ultra wideband antennas are outdated and recent, the outdated antennas have roots in the original "Spark-gap" invented by Marconi in 1895 [1], but the recent antennas were beginning when Federal communication commission (FCC) in USA when allocated using the spectrum band width 3.1GHz to 10.6GHz for commercial purpose in February 2002 [2]. From this time UWB attractive the academia and industries to attention it due to merits of low profile, light weight, high secured data rate transmission can be transmitted in short rang local network and short-duration pulses and simple configuration. Coplanar wave guide (CPW) feed printed monopole antenna is one of the among various forms of printed antenna which has simple structure and easy to fabricated and integrated with printed circuit board[3].

The antenna is an important component which determines the performance of UWB system; moreover one of principle subjects in UWB is to design a compact antenna.

There are many methods to achieve the miniaturization feature, one of these methods is achieved by cutting the symmetrical plane along the axis for shapes which have symmetrical structure [4].Another method can be used to miniaturization the antenna by antipodal structure, these done by two step. First, the antenna's configuration is modified to enable direct connection with a microstrip feeder. Second, corrugated structures are utilized in the radiator and ground plane [5].

ANTENNA DESIGN

Generating the original antenna is present which has the dimension (32x32x1.575) mm3. After miniaturization, the final shape of the proposed antenna as shown in figure 1, and final Parameter and dimension of the proposed miniaturized CPW line feed three-half semi-circular monopole antenna in table 1, therefor miniaturization planar antenna from the original antenna has been presented in this paper by adjusting the ratio between the radius length of the slots in the ground plane and radius of the radiation element i.e the ratio between the first half semi-circle slot in the ground plane which has radius R1 with the first half semi-circle in radiation element which has radius R4 and the second half semi-circle slot in the ground plane which has radius R2 with the second half semi-circle in radiation element which has radius R5, and the third half semi-circle slot in the ground plane which has radius R3 with the third half semi-circle in radiation element which has radius R6, the consistent ratio is R1/R4= R2/R5= R3/R6=2, which reduce the size of antenna 38.96% for the CPW line feed to 48.79% for the microstrip line feed from the original antenna .

The prototype antenna is built and attached on Rogers TMM4 relative permittivity of $ε\_{r}=4.5$ and loss tangent $tanδ=0.002$ with the size (25x25x1.575)mm3 with excitation by coplanar wave guide (CPW) fed by 50Ω and (21x25x1.575)mm3 with excitation by microstrip fed by 50Ω .

In table 1(C) represent the position of half semi- circle to another half semi- circle where the position C1 is kept fixed (all dimension in mm).

RESULT AND DISCUSSION

 The design, fabricated and experimental test in the Laboratories of Department of Systems Engineering in College of Engineering and information Technology at University of Arkansas At Little Rock (UALR) in USA.

Table 1: Parameter and dimension the proposed miniaturized CPW line feed three-half semi-circular monopole antenna.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *W* | 25 | *C1* | 0 | *R1* | 10 | *C4* | 4.8 | *R4* | 5 |
| *L* | 25 | *C2* | 0 | *R2* | 9.2 | *C5* | 4.6 | *R5* | 4.6 |
| *Wf* | 2 | *C3* | -3.8 | *R3* | 7 | *C6* | 2.5 | *R6* | 3.5 |
| *Wg* | 0.25 | *S* | 0.5 |  |  |  |  |  |  |

Figure 1: Geometry of the miniaturized planar monopole antenna of the CPW line feed three-half semi-circular with dimension 25x25xmm2

To enhancement the work on the proposed antenna two software are used, (HFSS) and (CST MWS).Experimentally the miniaturized antenna (CPW line feed) exhibits wide impedance bandwidth from 2.6 GHz to beyond 12 GHz (FBW is > 128.76%) and for microstrip line feed (2.85-12) GHz (FBW is > 123.23%), while for the original antenna (FBW is > 109.35%).

The radiation pattern and gain were measured by using substitution method with an antenna of known gain. The Antenna Under Test (AUT) (known gain) was placed is the higher-frequency ETS -Lindgren Model 3126 Sleeve Dipole antennas include a radome. The radome provides improved dielectric properties for superior high frequency performance**,** the first dipole (AUT) is 5.2 GHz in the range and the other is 5.8 GHz, this dipole positioner and aligned to a horizontally polarized horn antenna (receiver).The positioner and aligned with horn adjusted by laser device.

Figure2: Measured and simulated S11 curves of the miniaturized planar monopole antenna of the CPW line feed three-half semi-circular with dimension 25x25xmm2

For WLAN applications that covers the frequency band of the IEEE 802.11a (5.15-5.35) GHz and (5.725-5.825) GHz and HIPERLAN/2 WLAN are present, experimentally the antennas CPW/Microstrip line feed exhibit good radiation pattern behavior in both E-plane and H-plane an omni-directional with stable gain reach to 5dB.

CONCLUSION

Good agreement with maintain reasonable radiation characteristic and able to operate across a very large impedance bandwidth, omni-directional radiation pattern in E-plane and H-plane, constant gain can be achieve by miniaturized the same planar antenna from the original antenna by adjusting the ratio between the slots of the ground plane and the radiation element. . These features make it good candidate for UWB application especially for WLAN communication.

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