Planar Dual-band Slot Array Antenna for LTE / WiMAX Access Points

Jui-Han Lu[1], Yen-Hung Liu[1] and Hai-Ming Chin[2]

[1]Department of Electronic Communication Engineering, National Kaohsiung Marine University, Kaohsiung, Taiwan

[2]Department of Marine Engineering, National Kaohsiung Marine University, Kaohsiung, Taiwan

***Abstract* - This article proposes a planar dual-band slot array antenna with high-gain operation for LTE / WiMAX access point. The impedance bandwidths, determined from VSWR □ 2.0, can reach about 18.3 / 14.6 % (475 / 510 MHz) for the 2.6 / 3.5 GHz operating bands, respectively, which is covering the bandwidth specification for LTE (2.5 ~ 2.7 GHz) and WiMAX (3.3 ~ 3.7 GHz) system. The proposed slot array antenna also provides maximum peak antenna gains and efficiencies of 13.9 / 14.1 dBi and 86.5 / 73.5 % across 2.6 / 3.5 GHz bands, respectively.**

***Index Terms* —LTE, WiMAX, Slot array antenna.**

I. INTRODUCTION

Due to tremendous development in wireless communication technology, especially, LTE (Long Term Evolution) and WiMAX (the Worldwide Interoperability for Microwave Access) systems for the Fourth Generation (4G) mobile communication get more attraction for broadband access in wireless metropolitan area network (WMAN) environment. For the LTE / WiMAX base stations or access points, the unidirectional high-gain array antenna is usually required for long-distance communication. The related slot array antenna designs had been presented by using planar 2 × 2 slot array [1] and two-dimensional slot-array antenna fed by CPW [2]. However, these above designs are only focused on the single operating band to be not suitable for dual-band wireless communications applications. Meanwhile, the rectangular slot array for LTE / WiMAX applications is very scant in the open literature. Therefore, in this article, we propose a novel planar dual-band slot array with high-gain operation. By properly insetting the slit into the rectangular slot element fed by the microstrip line, the operating bandwidths can reach about 475 / 510 MHz (18.3 / 14.6 %), which is enough for LTE and WiMAX systems. Also, the proposed dual-band slot array provides maximum peak antenna gain and efficiency of 13.9 / 14.1 dBi and 86.5 / 73.5 % across 2.6 / 3.5 GHz bands, respectively. Details of the proposed dual-band slot array design are described, and experimental results for the obtained high-gain performance are presented and discussed.

II. ANTENNA DESIGN AND EXPERIMENTAL RESULTS

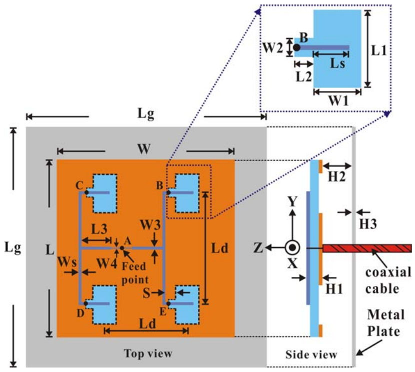

Fig. 1. Geometry of the proposed planar dual-band dipole array with high-gain operation.

Fig. 1 illustrates the geometry of the proposed dual-band slot array for LTE / WiMAX access points. This proposed slot array with the height of H2 above the metal plate as the reflector is fed at the point A by a 50Ω coaxial cable line and etched on the printed both sides of an inexpensive FR4 substrate with the volume of 150 × 150 × 0.8 mm^3, dielectric constant ε_r = 4.7 and loss tangent tan δ = 0.0245. The proposed slot array is comprised of 2 × 2 slot elements arranged symmetrically with the distance of Ld between the slot elements. In this study, the single rectangular slot element with the dimension of L1 × W1 is simpler than those slot antenna designs with the parasitic strips [3-6]. Then, the slit with the dimension of L2 × W2 is inset into the center of the longer side of the rectangular slot fed by the 50 Ω microstrip line. The first operating mode of the proposed slot array is excited at 2.6 GHz band due to the rectangular radiating slot with the distance (Ld) of 88 mm (~ 0.7 operating wavelength of 2.6 GHz band) between each slot element. And, by introducing the feed microstrip line with the length of Ls + L2 at the end of the rectangular slit as the radiating monopole, the resonant mode operating at 3.5 GHz can be excited due to the exciting length of the monopole strip (L2 + Ls) chosen to be about 18.5 mm corresponding approximately to 0.22 operating wavelength of 3.5 GHz band. The feeding network in the proposed slot array is designed to have equal powers at the four points (B ~ E) by using the quarter-wavelength transformer operating at 2.6 GHz band. To demonstrate the above deduction and guarantee the correctness of simulated results, the electromagnetic simulator HFSS based on the finite element method [7] has been applied for the proposed planar dual-band slot array design.

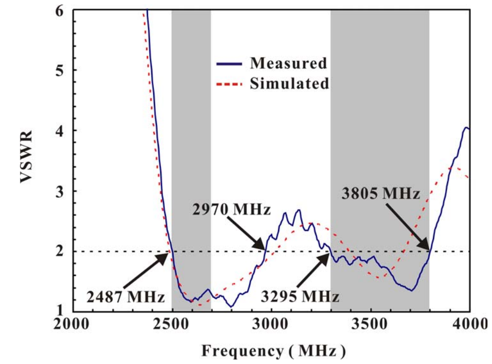

Fig. 2. Simulated and measured VSWR against frequency for the proposed planar dual-band dipole array.

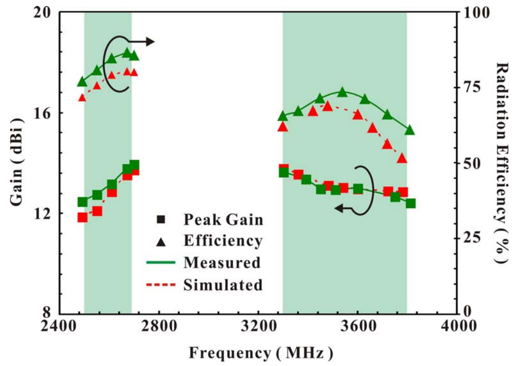

Fig. 3. Simulated and measured peak gains and efficiencies across the operating bands for the proposed dual-band dipole array.

Fig. 2 shows the related simulated and experimental results of the VSWR for the proposed planar dual-band slot array. Results show the satisfactory agreement for the proposed planar slot array operating at the 2.6 / 3.5 GHz bands. From the experimental results, the measured impedance bandwidth (VSWR ≤ 2.0) can reach 18.3 / 14.6 % (475 / 510 MHz) for 2.6 / 3.5 GHz bands, respectively, to provide more impedance bandwidth to meet the specifications of LTE and WiMAX systems. The 3D radiation patterns of the proposed dual-band slot array are measured in anechoic chamber by using NSI-800F with Agilent PNA N5230A. Fig. 3 shows the simulated and measured peak gains and efficiencies of the slot array with dula-band operation. The maximum measured peak antenna gains and efficiencies are 13.9 / 14.1 dBi and 86.5 / 73.5 % across 2.6 / 3.5 GHz bands, respectively. Fig. 4 shows the simulated and measured 2D radiation patterns of the proposed planar dual-band slot array operating at 2.6 / 3.5 GHz band. It can be easily seen that the radiation patterns are with good unidirectional radiation patterns in the XZ- and YZ-plane, which resemble typical patterns in symmetry with respect to the antenna axis (θ = 0) since the proposed slot array' structure is symmetrical.

III. Conclusions

The unidirectional dual-band slot array with high-gain operation for LTE / WiMAX access points has been proposed and investigated. It provides relatively wider impedance bandwidth of 18.3 / 14.6 % (475 / 510 MHz) to meet the specifications of LTE (2.5 ~ 2.7 GHz) and WiMAX (3.3 ~ 3.7 GHz) systems, respectively. Also, the proposed slot array antenna provides maximum peak antenna gains and efficiencies of 13.9 / 14.1 dBi and 86.5 / 73.5 % across the 2.6 / 3.5 GHz operating bands, respectively, with good unidirectional radiation pattern in the XZ- and YZ-plane.

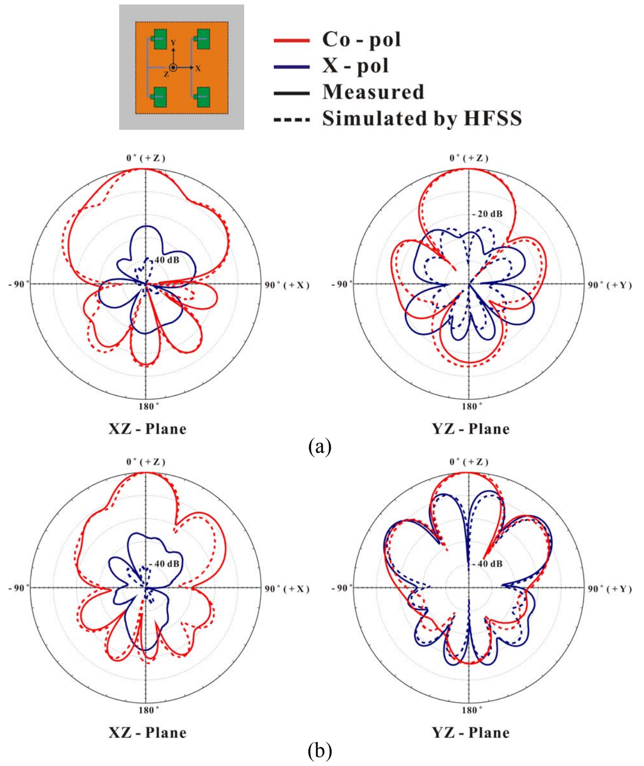

Fig. 4. Simulated and measured 2D radiation patterns for the proposed dual-band dipole array. (a) f = 2600 MHz. (b) f = 3500 MHz.

Acknowledgment

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