

# Loop Antenna Array for IEEE802.11b/g

Dau-Chyrh Chang<sup>1</sup>, Win-Ming Liang<sup>2</sup>

<sup>1</sup>Oriental Institute of Technology, Taiwan

<sup>2</sup>Yuan Ze University, Taiwan

**Abstract**-Two elements antenna array with high efficiency is developed for IEEE802.11b/g in this paper. The antenna element is one wavelength loop over ground reflector. In order to matching the impedance for the desired band, the parasitic small loop is used with the main loop. The measured results of reflection coefficient are smaller than 15 dB and maximum gain 10.5 dBi with efficiency 85% for the desired band. The measurement results are agreed with that of simulations.

## I. INTRODUCTION

In nowadays, the WiFi IEEE802.11b/g is popular as part of personal communication systems. The band for IEEE802.11b/g is within 2.414 GHz to 2.4835 GHz. The maximum data transmission rate for 802.11g is 54 Mbps (Mega bit per second). In order to maintain the data throughput, the signal to noise ratio S/N should be large. The bandwidth and efficiency of traditional patch antenna element is narrow and low to support the high transmission data rate. In order to overcome the defect of traditional patch antenna element, high efficiency loop antenna is considered and parasitic element for wideband matching is implemented. In order to increase the antenna gain of the loop antenna element, antenna array with two elements and the ground reflector is used to enhance the directivity and gain.

## II. RESULTS OF SIMULATION

In order to design this antenna array, commercial available simulation tool is used to design the antenna array. The size of the two elements antenna array is 40 mm x 100 mm x 8 mm with FR4 0.4 mm thickness substrate. In order to test the antenna array, the size of ground reflector is 100 mm by 120 mm. The spacing between substrate and ground reflector is about 12 mm. The length of loop is around one wavelength at 2.45 GHz. The purpose of small parasitic loop is for impedance matching. Figure 1a is the top view of the antenna array and figure 1b is the side view of the array. Figure 2 is the simulation result of reflection coefficient. The bandwidth of reflection coefficient at -10 dB is 87 MHz. Figure 3 show the simulation current distribution at 2.45 GHz. The maximum current distribution is in y direction on the loop. That means the E-plane pattern is yz-plane. Figure 4 is the simulation power gain pattern at E-/H-plane at 2.45 GHz. The gain of the array is about 10.8 dBi. The half power beamwidth are 58 degrees and 52 degrees at E-plane and H-plane respectively. The null beamwidth is about 180 degrees in H-plane. Figure 5 is the simulated power gain and efficiency versus frequency. The power gain are 10.6 dBi,

10.8 dBi, and 10.9 dBi at 2.4 GHz, 2.45 GHz, and 2.5 GHz respectively. The overall efficiency inside the band is over 95%.

## III. RESULTS OF MEASUREMENT

Figure 6 is the hardware implementation of the antenna array. Figure 7 is the measured reflection coefficient. The value reflection coefficient is smaller than 14 dB in the band. Figure 8 is the measured power pattern in both E-/H-planes at 2.4 GHz. The power gain is about 11 dBi. The beamwidth are 58 degrees and 52 degrees at E-/H-planes respectively. Figure 9 is the measured power gain and efficiency with respect to frequency. The measured gain at 2.45 GHz is about 11 dBi. For the desired band the gain is over than 10.5 dBi. The maximum efficiency is about 90% at 2.4 GHz. The overall efficiency is over than 85% for the desired band.

## IV. CONCLUSION

The two elements antenna array for IEEE802.11b/g is developed. The element is loop antenna above ground plane. The simulation gain is 10.9 dBi and the measured gain is 11 dBi at 2.45 GHz. The simulated efficiency is about 95% and the measured efficiency is 85% at 2.45 GHz. The measurement results of gain, efficiency, and beamwidth are quite close to that of simulation. Future four elements antenna array based on this construction with higher antenna gain and dual bands for IEEE802.11a/b/g is also under developed.

## REFERENCES

- [1] US 6525694 B2. High gain printed loop antenna. 25, Feb. 2003.
- [2] Cai, M. and M. Ito, New Type of Printed Polygonal Loop Antenna, IEE proceedings -H. vol. 138, No. 5, Oct. 1991, pp. 389-396.
- [3] Johnson, R.C. and H. Jasik, Antenna Engineering Hand Book, McGraw Hill (2d, Ed. 1984), Chapter 5.

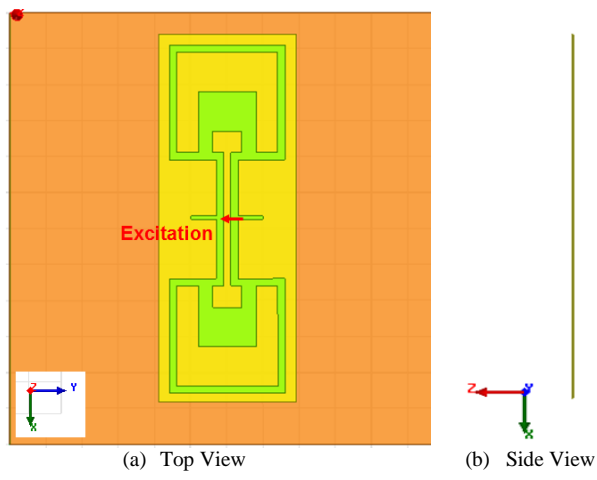


Fig. 1 Simulation model

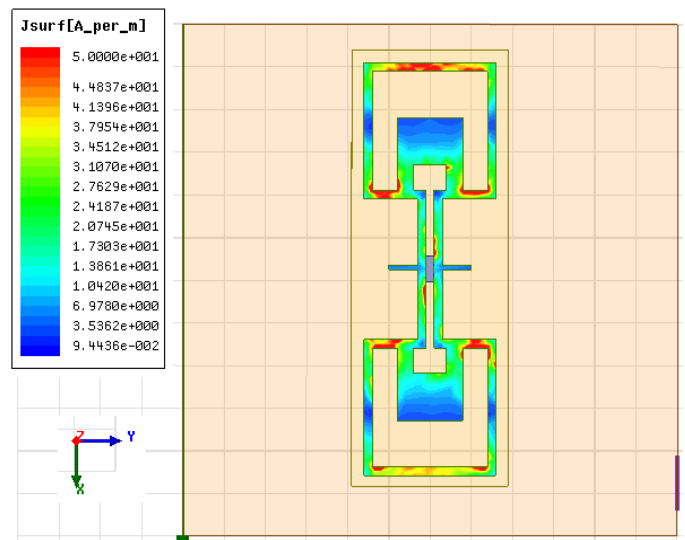


Fig. 3 Current Distribution at 2.45 GHz

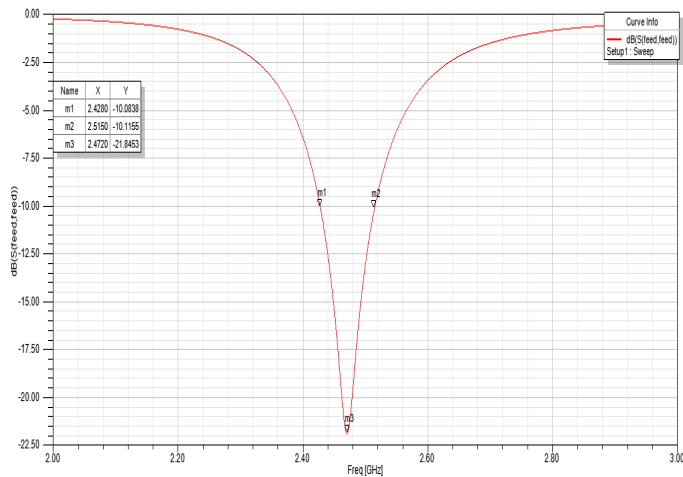
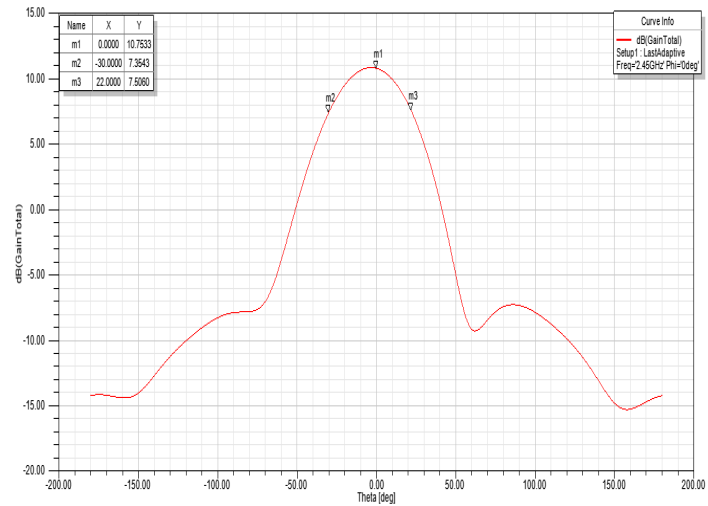


Fig. 2 Simulated S11



(a) H-Plane

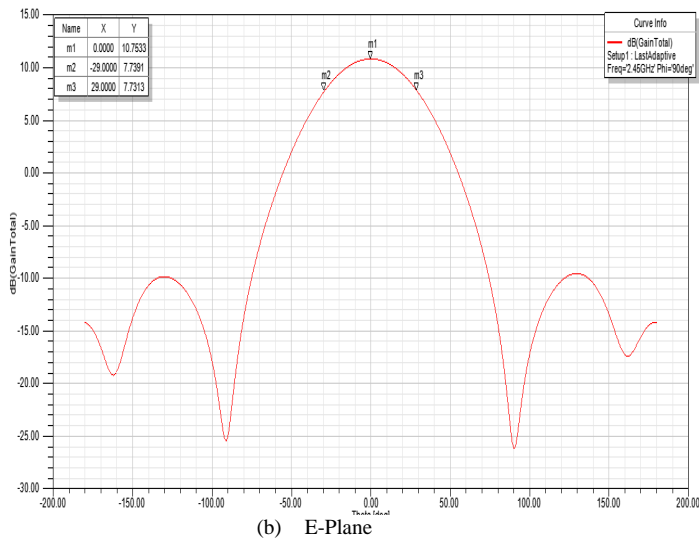


Fig. 4 Simulated power patterns

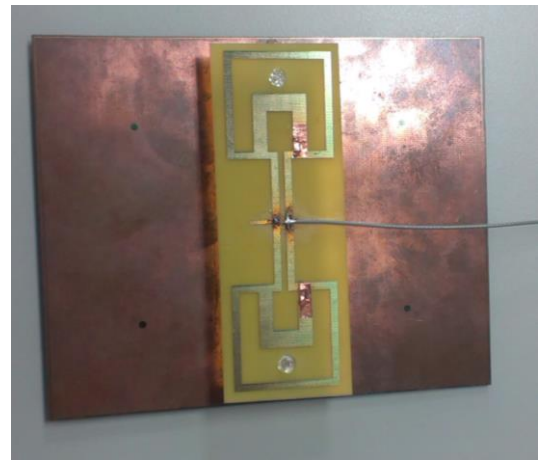
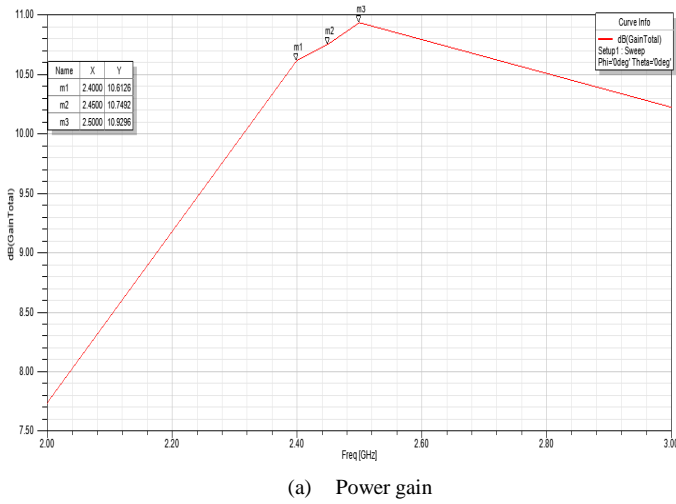


Fig. 6 Hardware implementation



(a) Power gain

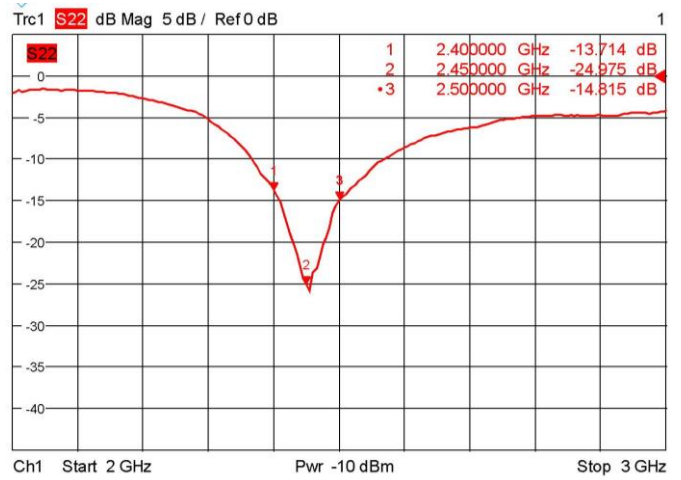
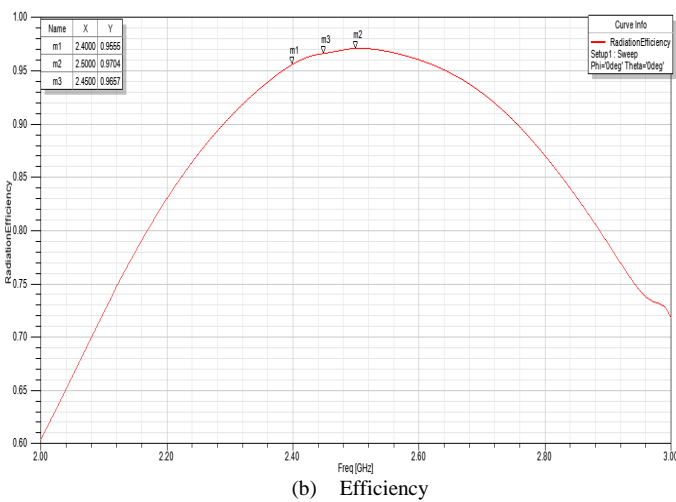
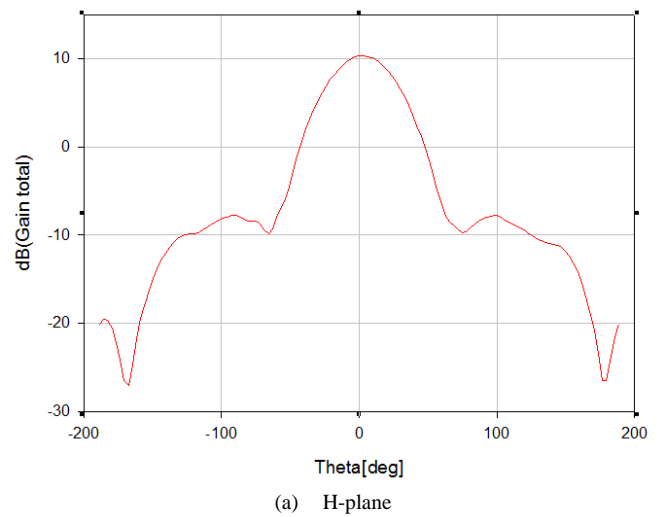


Fig. 7 Measured reflection coefficient S11



(b) Efficiency



(a) H-plane

Fig. 5 Simulated power gain and overall efficiency versus frequency

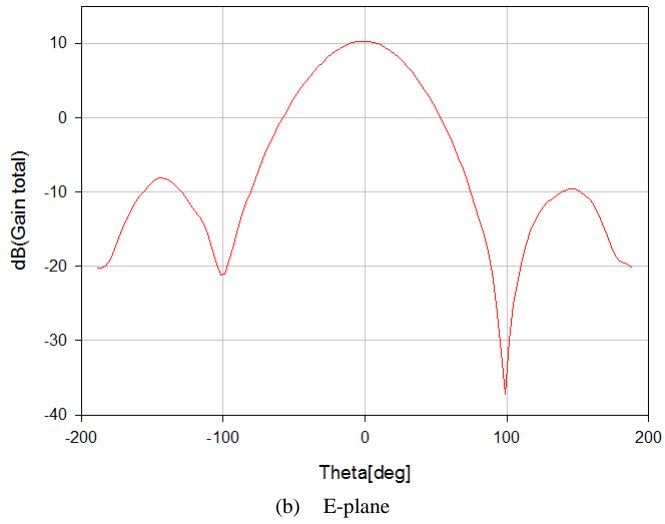


Fig.8 Measured antenna power patter

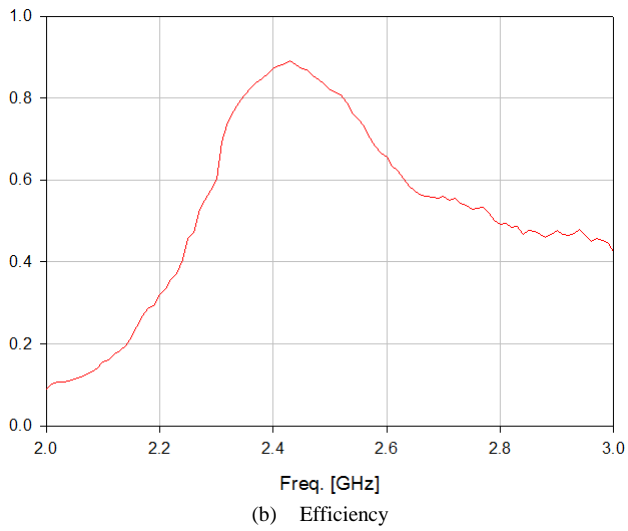
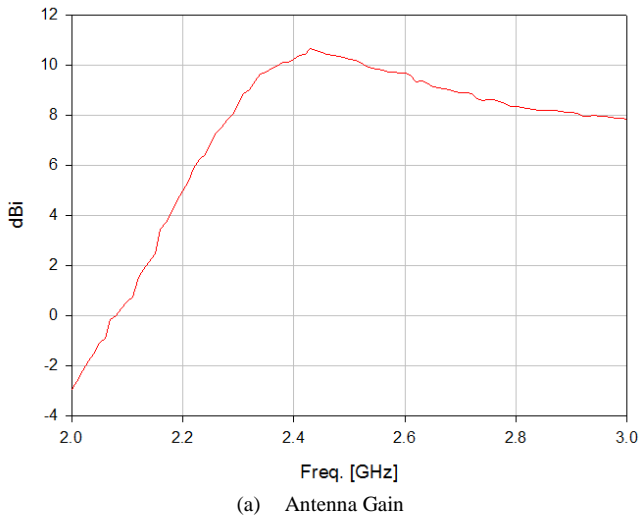


Fig.9 Measured antenna gain and overall efficiency versus frequency