High Gain Antenna Array for the Application of IEEE802.11a Access Point

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Abstract

Array antenna with six antenna elements for the application of IEEE802.11a AP (Access Point) is developed. The operation frequency range is 5~6GHz. The gain of simulation and measurement with complicated structure of AP is about 11.7 dBi and 11 dBi respectively. The approximately beamwidths are 27º for E-Plane and 40º for H-Plane respectively. The test results of power gain and return loss are agreed with that of simulation.

Keywords: antenna array, IEEE802.11a, access point

1. Introduction

In nowadays microstrip print circuit board (PCB) antenna is widely used for communication systems which include wireless LAN, GSM, RFID…etc. Recently, various types of antenna with wireless LAN systems are also widely used. In general, both the requirements of electrical performances and environment conditions of outdoor wireless AP are very critical. For special point to point outdoor AP antenna, compact, high gain, and narrower beamwidths at both planes are required. In this paper, high gain and narrower antenna beamwidth is developed for IEEE802.11a.

2. Antenna Design and Simulation with 6-element array antenna

Base on the requirements of outdoor AP antenna with compact size, high gain, narrower beamwidth is designed as shown in Fig.1. The antenna array is composed of six antenna linear dipole antenna elements. The antenna array is quarter wavelength above ground plane of AP.

The physical dimension of the radiating array is 10 cm by 10 cm. The radiating dipole antenna elements distribute on both side of substrate. The size of each radiator is 6 mm by 9 mm. The size of impedance transformers are with W1=1.9mm, W2=1.9mm, W3=1.3mm and W4=2.45mm respectively. The substrate is FR4 with dielectric constant of 4.4, and the thickness of the substrate is 0.5mm.

The computer model is shown in Fig.1. The simulated tool is using HFSS. The simulation and measurement of return loss is compared as shown in Fig.2. The result of return loss is smaller than 10 dB for the whole band. Figs.3&4 show the simulation patterns for both E- and H- planes at 5 GHz, 5.5 GHz, and 6 GHz respectively. The simulation gain for the above three frequencies are 11.94 dBi, 12.68 dBi and 12.47 dBi.

3. Hardware Implementation and Measurement

Fig.5a is the hardware of the array antenna. The measured return loss is shown in Fig.2. Except for the frequency above 5.9 GHz and below 5 GHz, the measured return loss is smaller than

10 dB. The difference between measurement and simulation may be caused by the complicated AP structure as shown in Fig.5b.

Figs.6 &7 are the power patterns in E-/H-planes for frequencies at 5 GHz, 5.5 GHz, and 6 GHz respectively. The measured gain are 10.66 dBi, 10.3 dBi, and 9.93 dBi for the above three frequencies. The beamwidth for E-/H-planes are about 40°. The summary antenna beamwidths versus frequencies for E-/H-planes are listed in table 1.

4. Conclusion

The array antenna has been developed for IEEE802.11a AP. The results from both simulation and measurement are quite agreed. The minor difference between simulation and measurement may be caused by the complicated structure of AP. According the measurement results, the array antenna meets the requirement of gain, beamwidth, and impedance bandwidth for IEEE802.11a.

Acknowledgments

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Frequency / Plane	5GHz	5.5GHz	6GHz
E-Plane	27.0^o	26.3^o	26.3^o
H-Plane	34.6^o	42.5^o	39.6^o

Table 1: Summary measured beamwidth of the array antenna

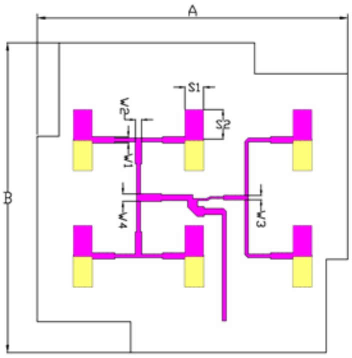


Fig.1 Simulated structure of array antenna

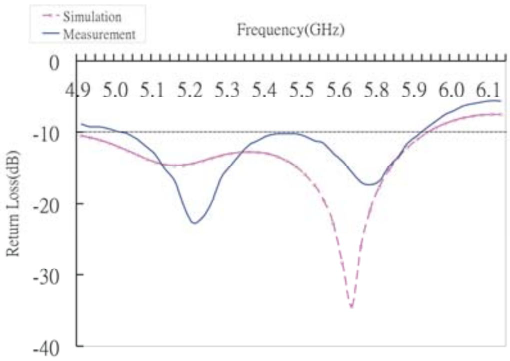
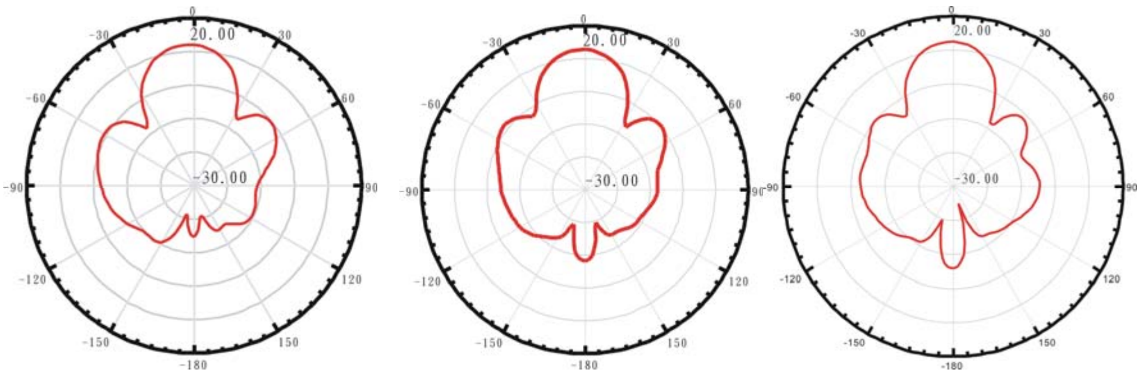
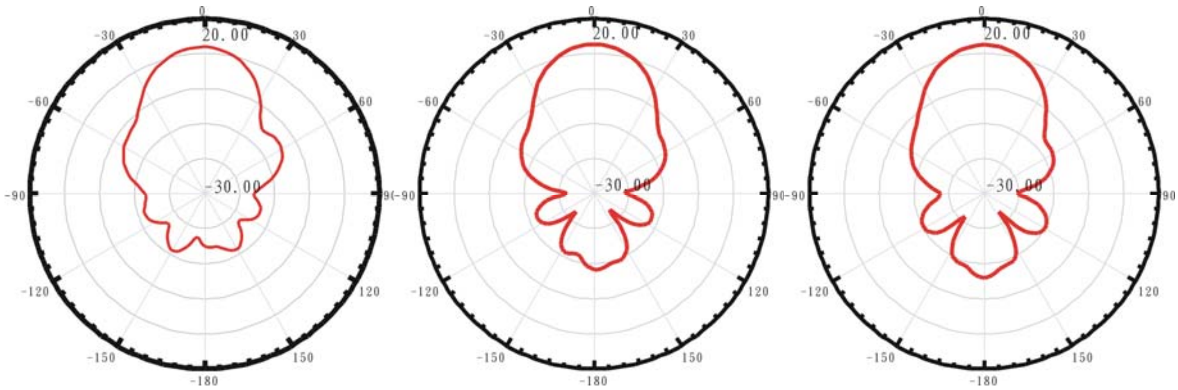


Fig.2 Return loss of simulation & measurement



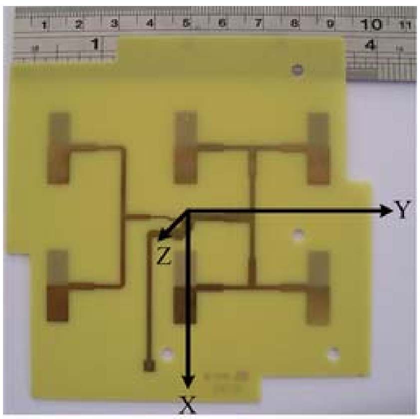
(a) 5 GHz (b) 5.5 GHz (c) 6 GHz

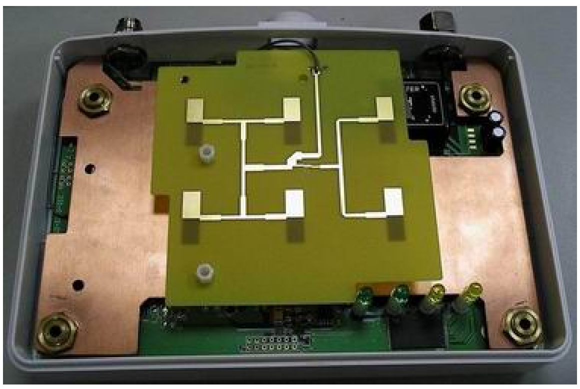
Fig.3: Simulated radiation patterns of the array antenna at E- plane.



(a) Gain=11.94 dBi at 5 GHz (b) Gain=12.68 dBi at 5.5 GHz (c) Gain=12.47 dBi at 6 GHz

Fig.4: Simulated radiation patterns of the array antenna at H- plane

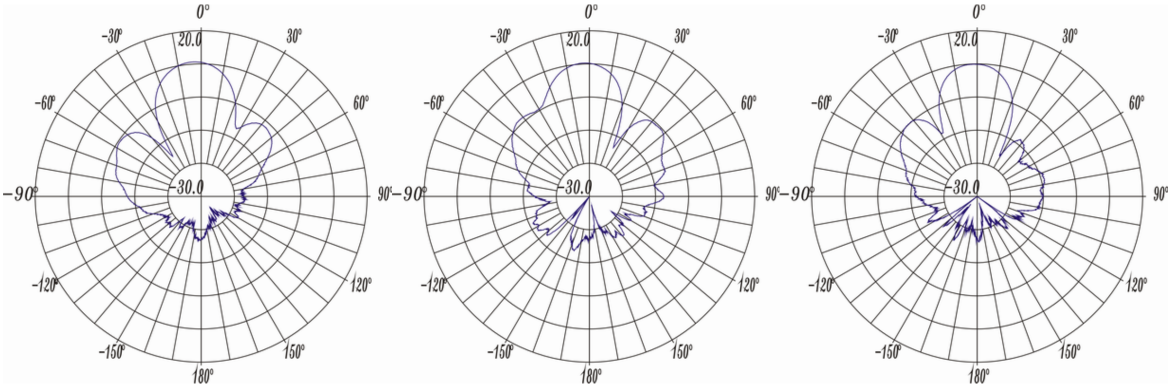




(a) (b)

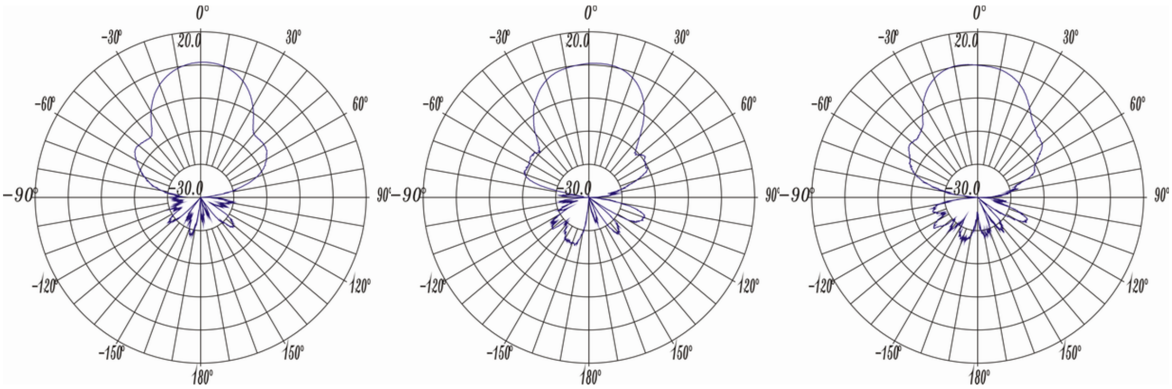
Fig.5a: Hardware of array antenna

Fig.5b: Array antenna inside AP



(a) 5GHz (b) 5.5GHz (c) 6GHz

Fig.6: Measured radiation patterns of the array antenna at E- plane



(a) Gain=10.66dBi 5GHz (b) Gain=10.3 dBi 5.5GHz (c) Gain=9.93 dBi 6GHz

Fig.7: Measured radiation patterns of the array antenna at H- plane