Design Considerations for Wireless Antenna Testing

Donald G. Bodnar, Ph.D.
MI Technologies
1125 Satellite Blvd, Suite 100
Suwanee, Georgia 30024-4629

ABSTRACT

This paper describes a new measurement system for testing antennas used in wireless communication system. A two-axis dielectric AUT positioner is used to reduce pattern perturbations, a vector network analyzer is employed for the receiver, and a broadband source antenna is utilized. RF test system design considerations are discussed including chamber design size. Software requirements that are unique to the needs of the wireless communication community are covered. The system is capable of making both far-field and spherical near-field measurements. A wide variety of antenna types can be tested using this system including handsets, laptop computers, and base station antennas.

Keywords: Wireless, Antennas, Testing

1.0 Introduction

Wireless communication systems are being imbedded in many commercial products including laptop computers, wireless LAN's, and PDA's. It is important to have nearly omni directional coverage from these devices to prevent signal dropout. Most developers of these products have a limited budget and limited space for antenna testing. Hence, a cost effective antenna measurement system is required. The frequency of operation of these devices is typically 0.8 to 6 GHz and the lowest frequency of operation drives much of the design of the measurement system.

2.0 Positioner Requirements

A key component of a wireless antenna measurement system is the AUT positioner. If not covered by absorber, metallic positioners can produce reflections that corrupt the measured results. However, thick absorber is needed at the low end of the band in order to be effective. Such thick absorber causes excessive shadowing of the AUT and limits the angular coverage of the pattern that can be measured. Dielectric positioners provide less reflection at lower frequencies than do metal positions as seen in Figures 1 and 2 and so were selected for this application. Figure 3 shows the roll over azimuth positioner used in the system. Everything above the azimuth turntable is dielectric and the positioner is capable of handling a 34 kg (75 lb) AUT.

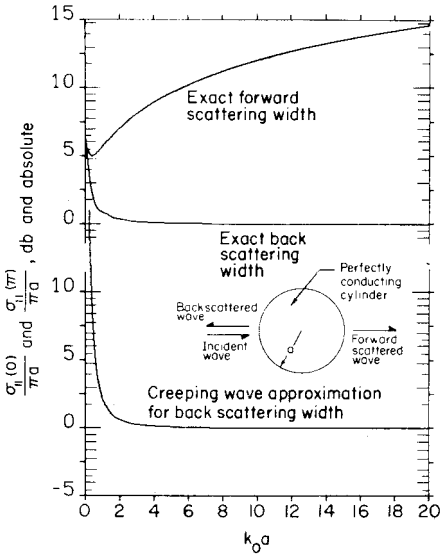

Figure 1. Backscatter and forward scatter from an infinitely long, perfectly conducting circular cylinder at normal incidence for parallel polarization.

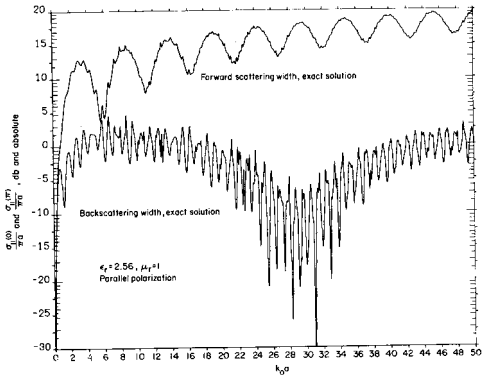

Figure 2. Backscatter and forward scatter from an infinitely long, lossless homogeneous dielectric cylinder at normal incidence for parallel polarization.

Figure 3. Two-axis dielectric positioner

2.0 Chamber

The chamber can be tailored to specific test requirements. A typical chamber for wireless application would have a 6 m range length and a 1 m quiet zone at 800 MHz and a 0.35 m quiet zone at 6 GHz. The chamber is 4.3 m (H) x 4.3 m (W) x 7.9 m (L) chamber and is covered with absorber that provides reflectivity of -30 dB at 800 MHz and –40 dB at 1900 MHz.

3.0 Software

Control of the instrumentation is via the IEEE-488 General Purpose Interface Bus (GPIB). Special analysis software is required since many of the patterns of interest are nearly omni-directional and peak, average and RMS gain values are of more interest that beamwidth and sidelobe levels (see Figure 4).

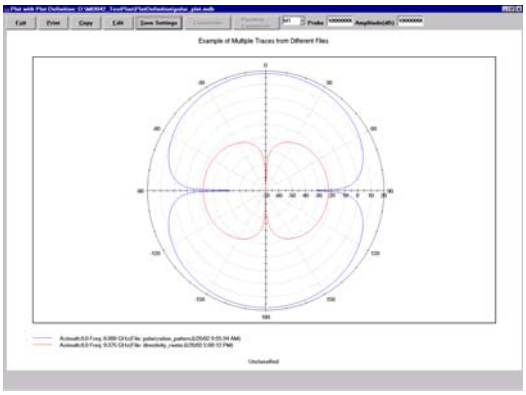

Figure 4. Broad beam pattern analysis.

4. Far-Field and SNF Operation

The size of the quiet zone decreases as test frequency increases. Spherical near-field measurements can then be employed to test larger antennas then can be accommodated with the far-field range.

7. Summary

Testing wireless antenna presents unique challenges due to their omni-pattern characteristics and their low frequency of operation. Dielectric positioners are required to reduce perturbations to the measurements. Simpler receivers such as spectrum analyzers can be used when phase is not required. Spherical near-field measurements can also be made with the system to extend the size of the AUT's that can be tested.

8. REFERENCES

[1] G. T. Ruck, D. E, Barrick, W. D. Stuart and C. K. Krichbaum, Radar Cross Section Handbook, Vol. 1, Plenum Press, New York, 1970, Chapter 4.