

A Broadband Vertical Polarized Antenna for Wireless Communications

G. Deng[†] M. Hunton[†] B. Vassilakis[†]

Abstract – A folded metal dipole is of considerable interest as a broadband antenna element, and has good potential for use in low cost wireless base station antenna applications. In this paper, experimental and simulation results are presented which include a metal vertical polarized dipole alone and arranged in a staggered six element array. The results show that this dipole element and the six staggered dipole array have excellent gain performance and radiation pattern profile. The measured and simulated results for both the element and the array are in good agreement.

1 INTRODUCTION

An ideal base station antenna for use in wireless communications would have broadband performance, small aperture, high gain, low side lobe levels, and the required appropriate beam width for cell sector design. In addition, power handling (500 Watts for Cellular band) must be adequate, intermodulation levels must be low, and assembly and manufacturing must be easy and geared for high volume. Increasingly, cost is a major factor, especially for applications in the emerging markets. In existing designs, the use of parabolic reflectors and aperture-coupled stacked patch elements, lead to good performance, but have had difficulty achieving required cost targets due to the use of extensive cabling and high cost printed circuit boards.

The proposed new folded metal dipole with broadside coupled paired stripline feed provides broadband performance of ~18% bandwidth (806 – 960 MHz for AMPS/CDMA/GSM). As it is composed of bent sheet metal, it provides the high power handling required, and provides for ease of assembly as needed for volume production. Figure 1 illustrates the single dipole. This dipole is fed from a broadside coupled paired stripline which also supports the dipole from the ground plane. The antenna element is composed of two conductors formed from a sheet of conductive material, in this case aluminum. One conductor is attached to ground with the dipole arm towards one side, while another conductor attaches to a microstrip input feed line spaced above the ground plane with the dipole arm towards the opposite side. The dipole radiator input has intrinsic impedance, and the impedance of the supporting broadside coupled

paired stripline is adjusted by varying the width of the conductor sections and the gap. Therefore, the input impedance of the dipole is matched to the impedance of the microstrip by adjusting the impedance of the broadside coupled paired stripline. The two legs supporting the dipole form a balanced broadside coupled stripline transmission line. The transmission line is balanced, so it is unnecessary to provide a balun.

The structure described above and shown in Figure 1 provides a vertical dipole element with very wide impedance bandwidth. Figure 2 shows a prototype of the Figure 1 design including side reflectors on the ground plane. As will be shown, this prototype has Half Power Beam Width (HPBW) of 90° in the ground plane azimuth plane. Based on the single element prototype in Figure 2, a staggered six element array prototype was constructed as shown in Figure 3 was designed with a goal of achieving an azimuth plane 65° HPBW. Simulated and prototype measured results for both the single dipole and the staggered six dipole array antennas are presented below.

2 THEORY AND DESIGN

The single dipole element, as shown in Figure 1, consists of a dipole element supported by a Broadside Coupled Paired Stripline (BCPSL), and a one-stage quarter wavelength transformer in microstrip line. The BCPSL is balanced, and provides excitation to the dipole. Moreover, the bandwidth of the BCPSL is ultra wide. The length of the dipole is approximately a half wavelength (~170mm) at the center frequency of the 806 – 960 MHz band which is 883 MHz, and the height of the dipole above the ground plane is about a quarter wavelength (~85mm). This geometry will provide the optimal gain performance with the expected 90° HPBW in the azimuth plane and 65° HPBW in the elevation plane based on the expected reflector size.

The energy transfer between the BCPSL and the dipole was designed using the Method of Moments (MoM) software IE3D of ZelandTM software Inc. The analysis results show the input impedance of the

[†] Powerwave Technologies, Inc., R&D, 1801 St. Andrew Pl., Santa Ana, US 92705,
e-mail: gdeng@pwav.com, mhunton@pwav.com, bvassilakis@pwav.com, tel.: +001 714 466 5800 .

