Sensitivity of Doppler Direction Finder with Biconical Antennas

A Technical Application Note from Doppler Systems

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1.0 Introduction

Most radio direction finders use either monopole or dipole antenna elements. The Doppler DDF7000 radio direction finders uses biconical elements. The biconical antenna was selected because it has a significantly better antenna factor resulting in a more sensitive direction finder.

Sensitivity is an important parameter in radio direction finders. In a previous application note[1] we presented the results of a series of sensitivity measurements made on our Doppler DDF7000 radio direction finder. In this document, we use this data coupled with the predicted antenna factor of our biconical antennas to predict the sensitivity of the direction finder over entire frequency range of our direction finders.

2.0 Background

In reference 1, we defined the sensitivity of the radio direction finder in two ways:

1. The level of input that produces a bearing angle stability of 2 degrees RMS.
2. The level of input that results in a 90% probability of producing a bearing measurement

For the purposes of this document, we are going to use the second definition, which yields -126 dBm for the default settings of the DDF7000 direction finder.

The DDF7000 uses three antenna arrays to cover the frequency range from 115 – 1000 MHz. Each array covers approximately a frequency octave: VHF 115 – 250 MHz, UHF 250 – 500 MHz, and THF 500 – 1000 MHz. To predict the sensitivity of the system, we modeled the arrays using both dipole elements and biconical elements. We then used the measured sensitivity of the direction finder to predict the sensitivity of the direction finder over the frequency range of each antenna.

3.0 Sensitivity using the VHF Antenna

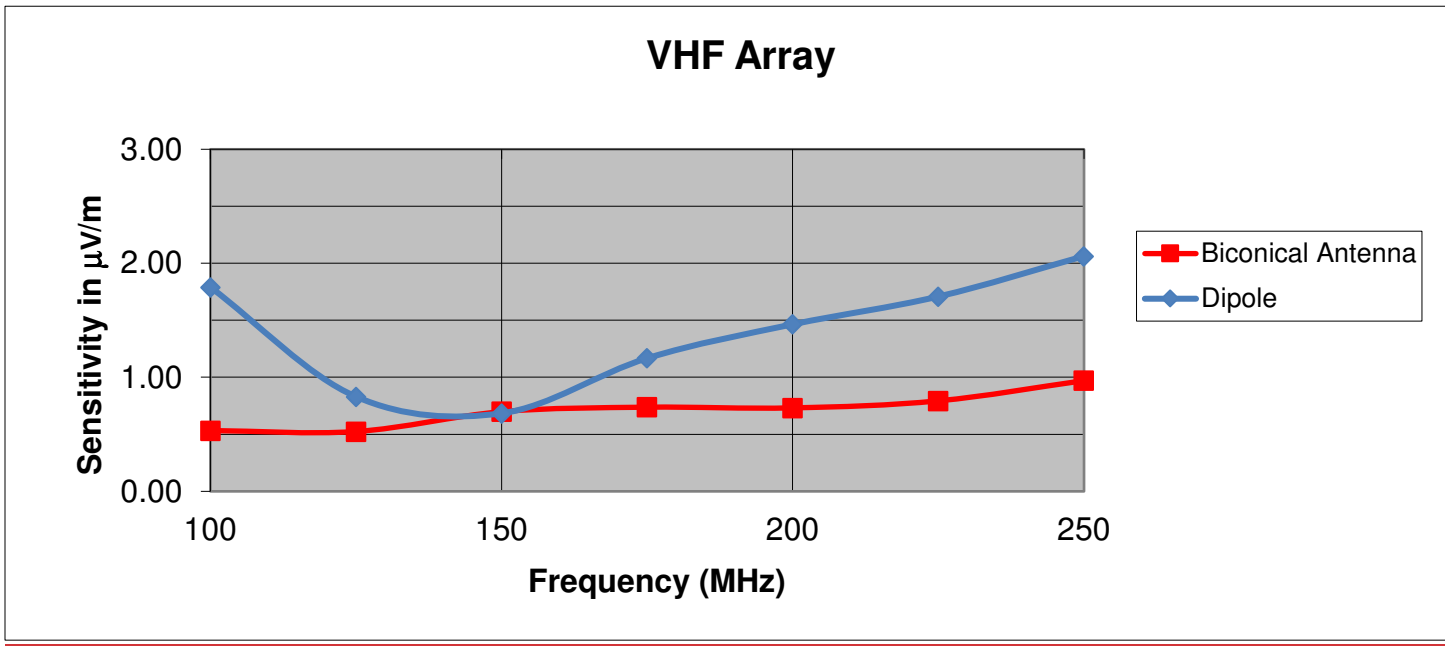

Figure 1~~Figure 1~~ compares the sensitivity of the VHF biconical array to the dipole array. The dipole array was tuned to 150 MHz. With the biconical array, the sensitivity of the direction finder is less than 1 µV/m over the entire frequency band and is more than twice as sensitive as the dipole array over a good portion of the band.

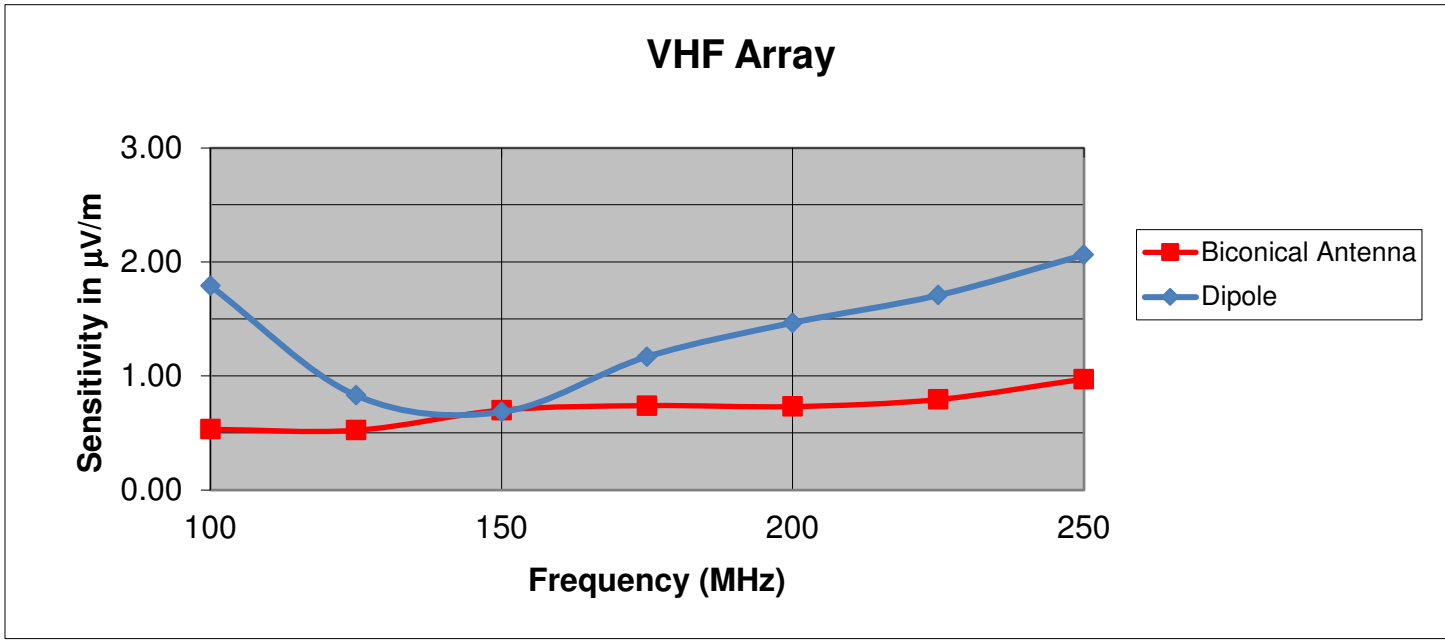

Figure 1: Sensitivity of Direction Finder with VHF Antenna

4.0 Sensitivity using the UHF Antenna

Figure 2 compares the sensitivity of the dipole array to the biconical array over the UHF band from 250 – 500 MHz. The dipole array was tuned to 350 MHz. Very marked improvement in sensitivity is shown below 300 MHz and better than 0.5 µV/m improvement is achieved at the upper end of spectrum.

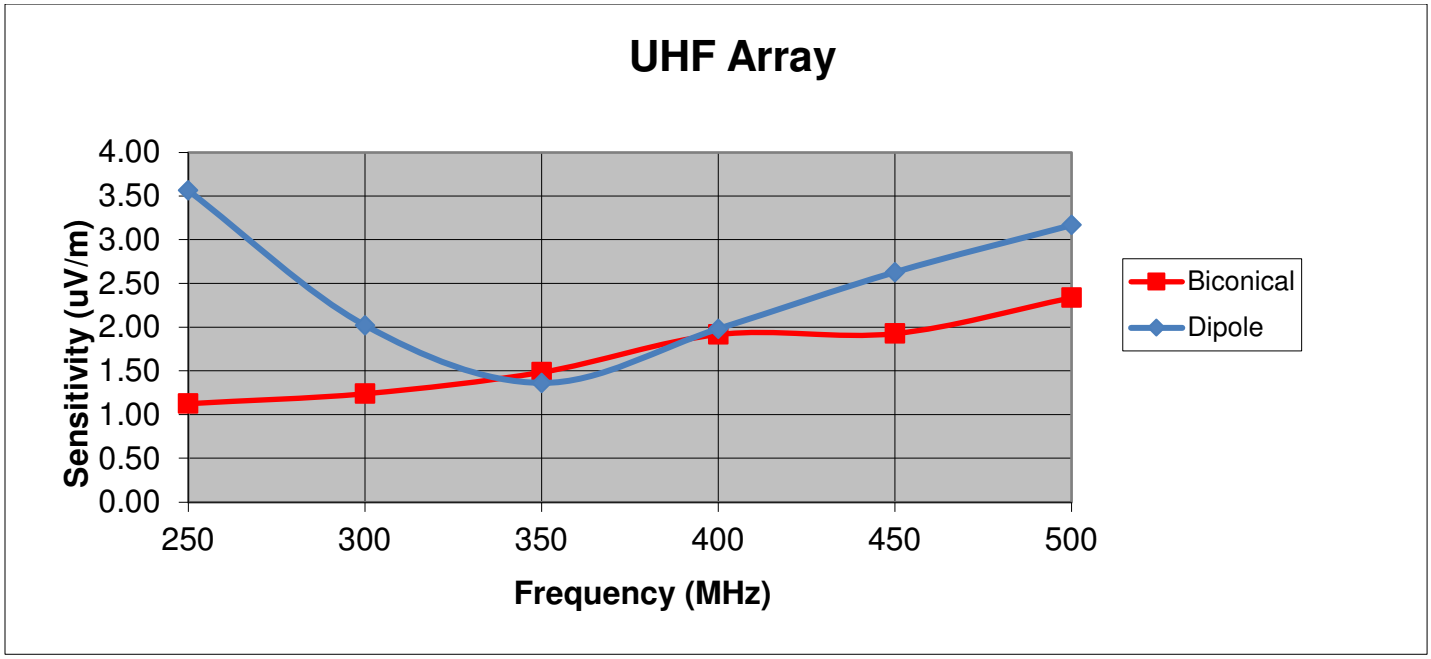

Figure 2: Sensitivity of Direction Finder with UHF Antenna

5.0 Sensitivity using the 500 – 1000 MHz Antenna

Figure 3 presents a comparison between the dipole array tuned to 850 MHz and the Doppler biconical array. The sensitivity below 700 MHz is nearly double the sensitivity of the dipole array.

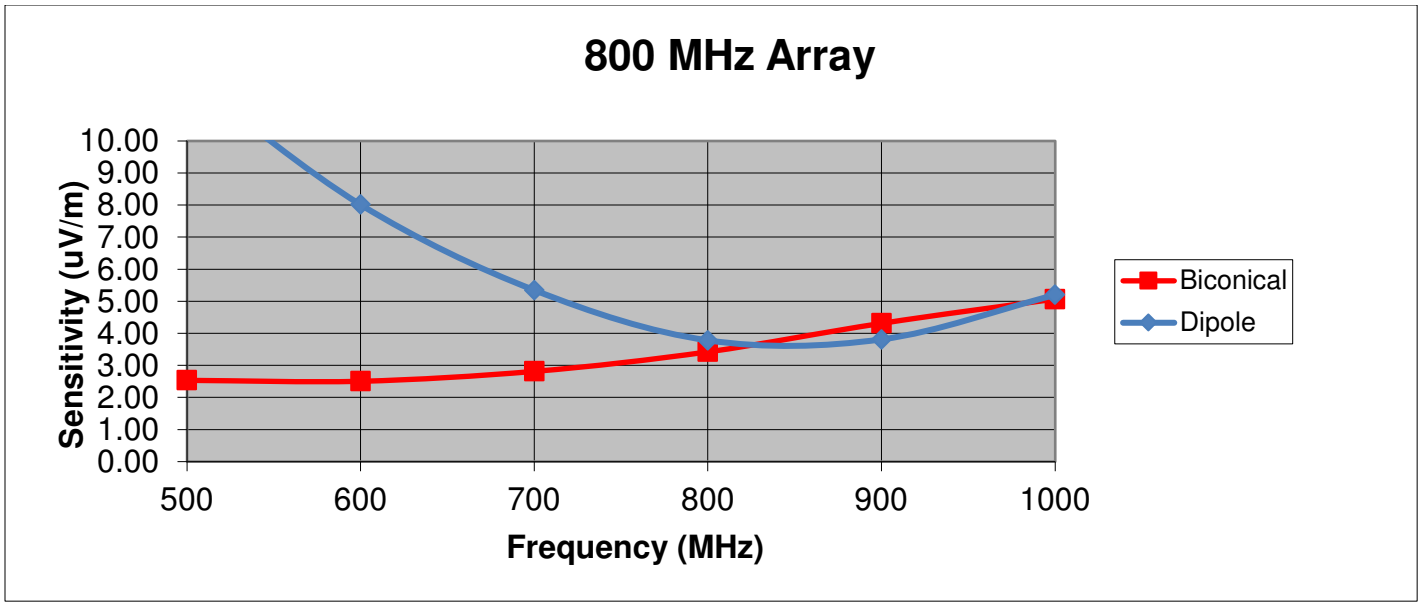

Figure 3: Sensitivity of Direction finder with 500 - 1000 MHz Antenna

6.0 Conclusion

The use of the Doppler biconical array antennas yields excellent sensitivity over a broad bandwidth.