The 7-Hex Driven Vertical Array at N6RK

The array consists of 7 vertical antennas arranged as 6 verticals in a hexagon shape plus 1 additional vertical in the center of the hexagon. Each vertical is spaced 3/8 wavelength from its nearest neighbors. This is shown in perspective view in fig. 1 and plan view in fig. 2.

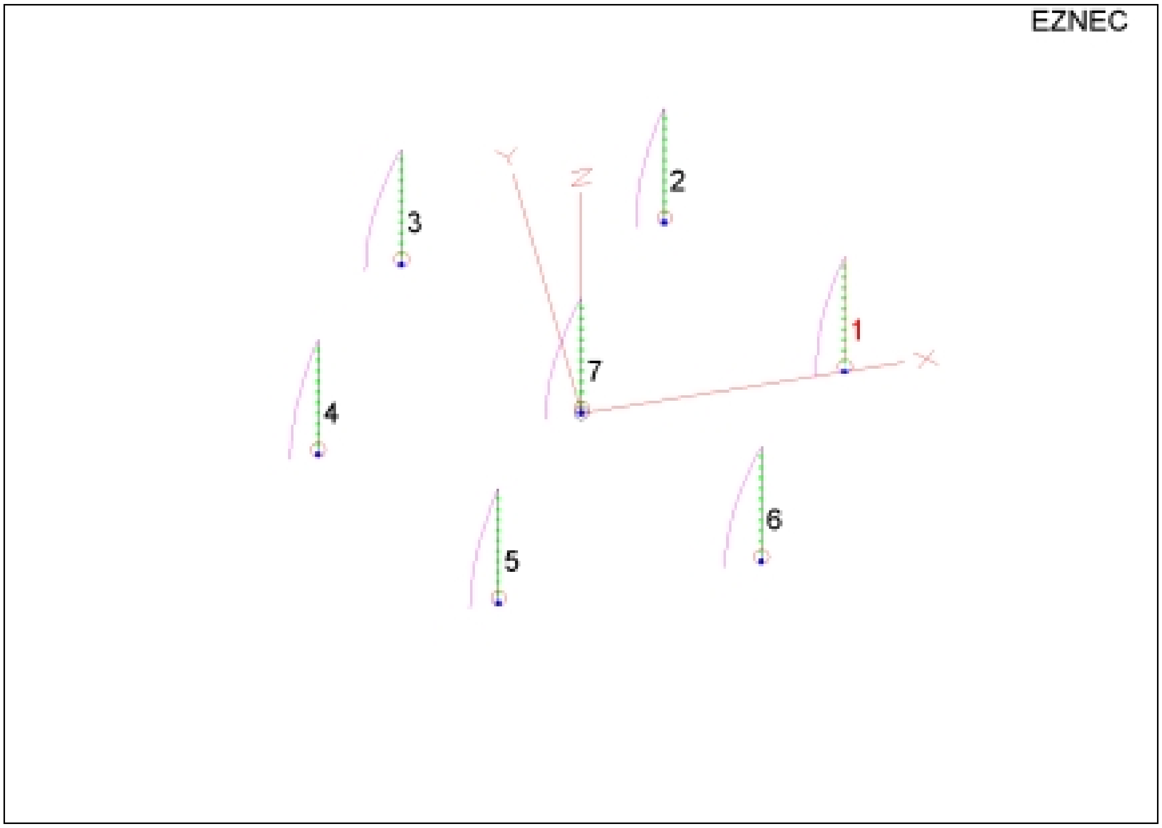

Figure 1. Perspective view of array.

The array has 3 phasing configurations. Configuration #1 fires in the direction of one of the outer elements (ie off a vertex of the hexagon). Any of six possible directions can be selected, spaced at 60° angles. This configuration has a pattern gain of 9 dB; this is, the array will have 9 dB gain over a single vertical. The EZNEC plot is shown in fig. 3. For comparison, the plot for a single vertical is shown in fig. 4, with the usual 5.3 dBi gain over perfect ground. Configuration #2 fires midway between two of the outer elements (ie perpendicular to a side of the hexagon), and has a gain of 8 dB (fig 5). Configuration #3 is omni-directional in azimuth, but has directivity in elevation giving it a gain of over 2 dB (fig 6).

Currently, a 40 meter version has been built and put on the air. An 80 meter version is under construction, and a 160 meter version is being planned. There are also contingency plans for a 60 meter version in the event the FCC opens up that band. The ground system consists of a wire grid filling up a hexagonal area 230 from vertex to vertex. This grid has wires running north-south every 3 feet and wires running east-west every 3 feet, and the crossovers are silver soldered. The 40 meter verticals have 60 radials 25 feet long, with the end of each radial soldered into the grid. The 80 meter verticals use similar radials inward to the grid. Outward, there are 30 conventional half-wave radials. We consider this ground system essentially “perfect” so the EZNEC simulations are done with perfect ground. Whatever far field effects that there are, such as PBA, they should be the same for the array as a single vertical, so the array gain should always exceed the gain of an individual vertical by the pattern gain.

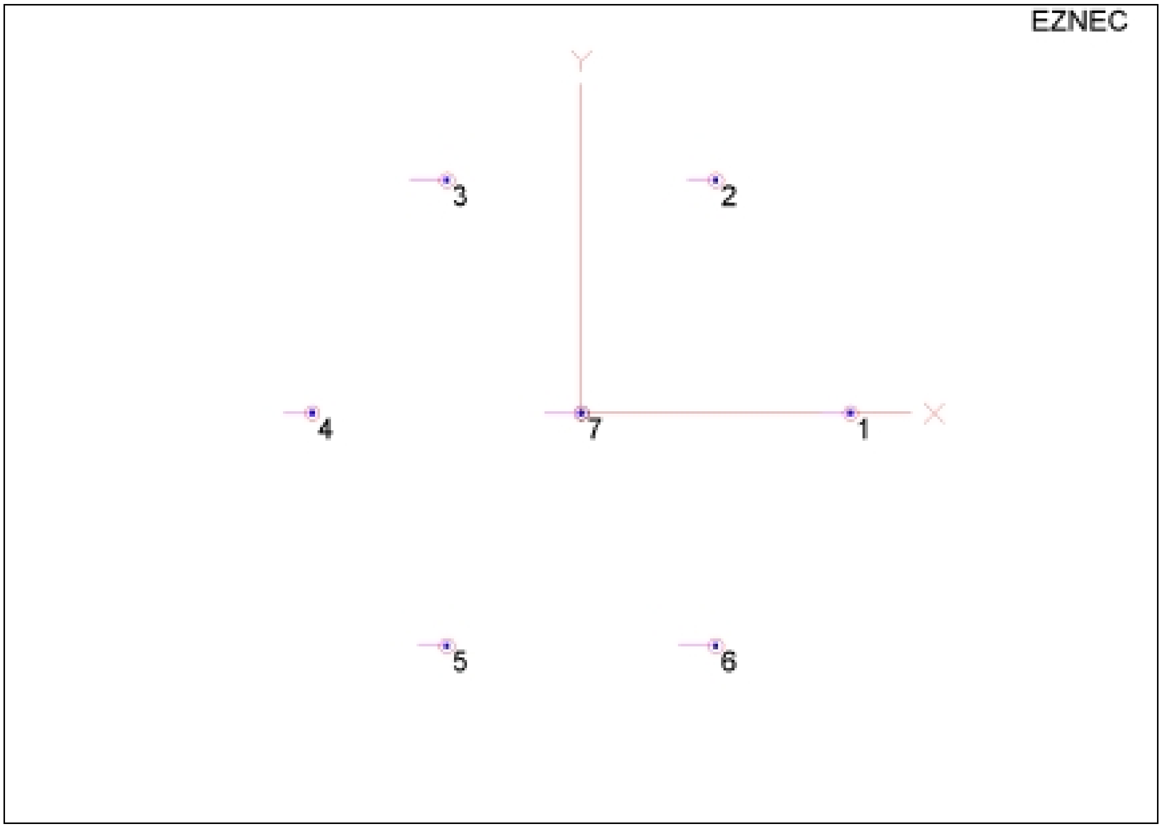

Figure 2. Plan view of array.

This array is intended as a transmitting antenna. It trades off relatively high sidelobes for higher gain and easier drive conditions. We use an ensemble of beverages for receiving at N6RK. The gain vs sidelobe tradeoff is implemented by using a 33% excess phase gradient compared to cophasal excitation. Thus for example, the phase of element #1 in configuration #1 is –180° instead of –135°, which it would be for cophasal excitation, since the elements are spaced 3/8 wavelength apart. Similarly, the phase of element #1 is +180° instead of the cophasal value of +135° (I realize that "-180°", "+180°" and "180°" are synonymous, but I use the sign for clarity.) "Cophasal" means that the relative phase of the elements is just right so that they add in phase after taking into account the physical time delay of the signal to get from one to the other.

The excitation currents for the verticals fortuitously give a decent pattern and at the same time are amenable to practical phasing networks, which are certainly non-trivial for any 7 element transmitting array. However, this array is really no more difficult to drive than a 4 square because of the excitation chosen. For details of this, see "Driving the 7-Hex array."

Table 1 shows the excitation currents for the array. This assumes that the array fires in the positive direction on the x-axis off of element 1 for configuration #1. Configuration #2 fires between elements 1 and 2 at 30° above the x-axis.

Table 1. Element excitation currents.

	Configuration #1		Configuration #2		Configuration #3	
Element #	Magnitude	Angle	Magnitude	Angle	Magnitude	Angle
1	1	-180°	1	-130°	1	180°
2	1	-90°	1	-130°	1	180°
3	1	+90°	1.28	0°	1	180°
4	1	+180°	1	+130°	1	180°
5	1	+90°	1	+130°	1	180°
6	1	-90°	1.28	0°	1	180°
7	1	0°	1.28	0°	2	0°

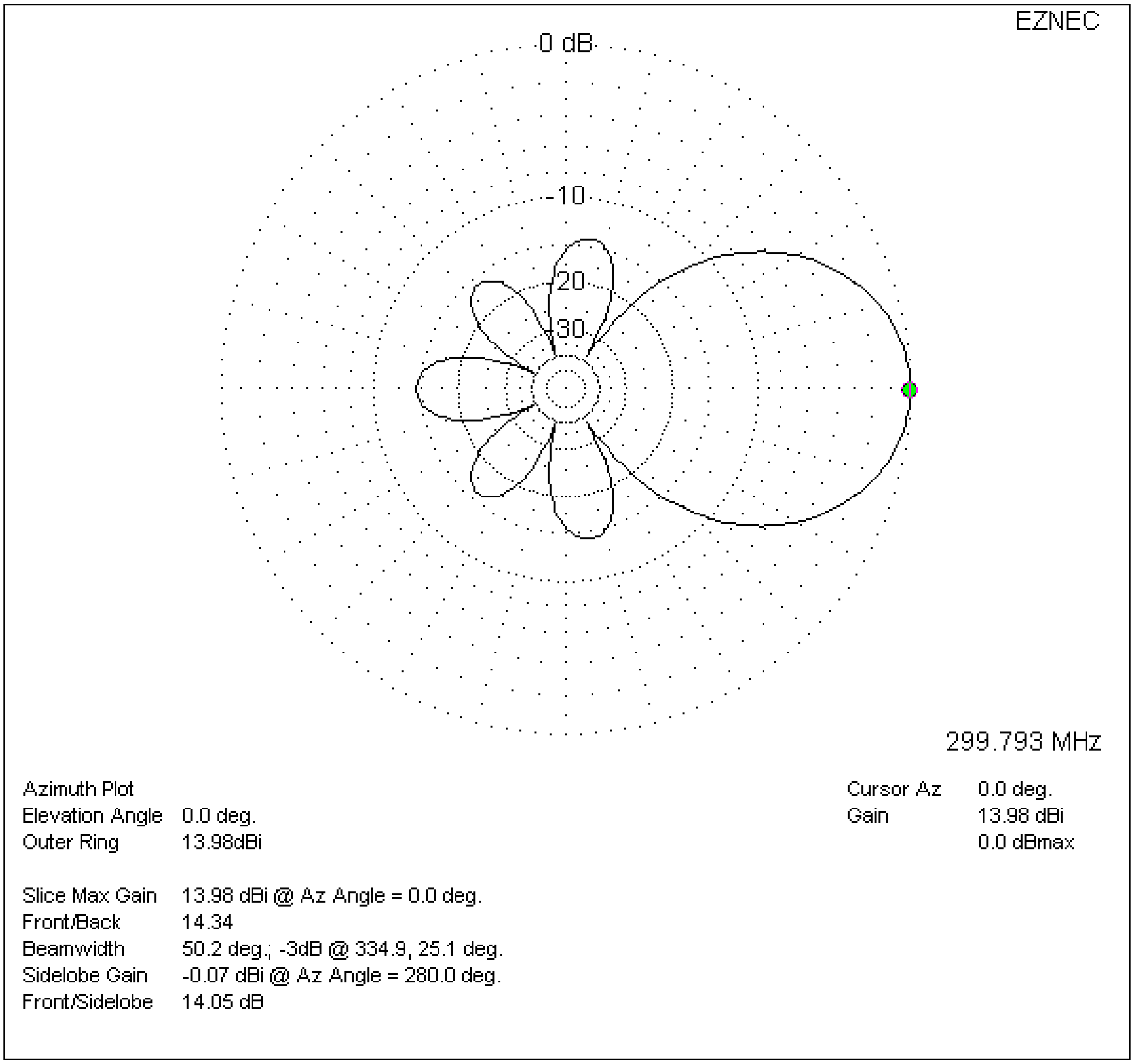

Figure 3. Pattern for configuration #1.

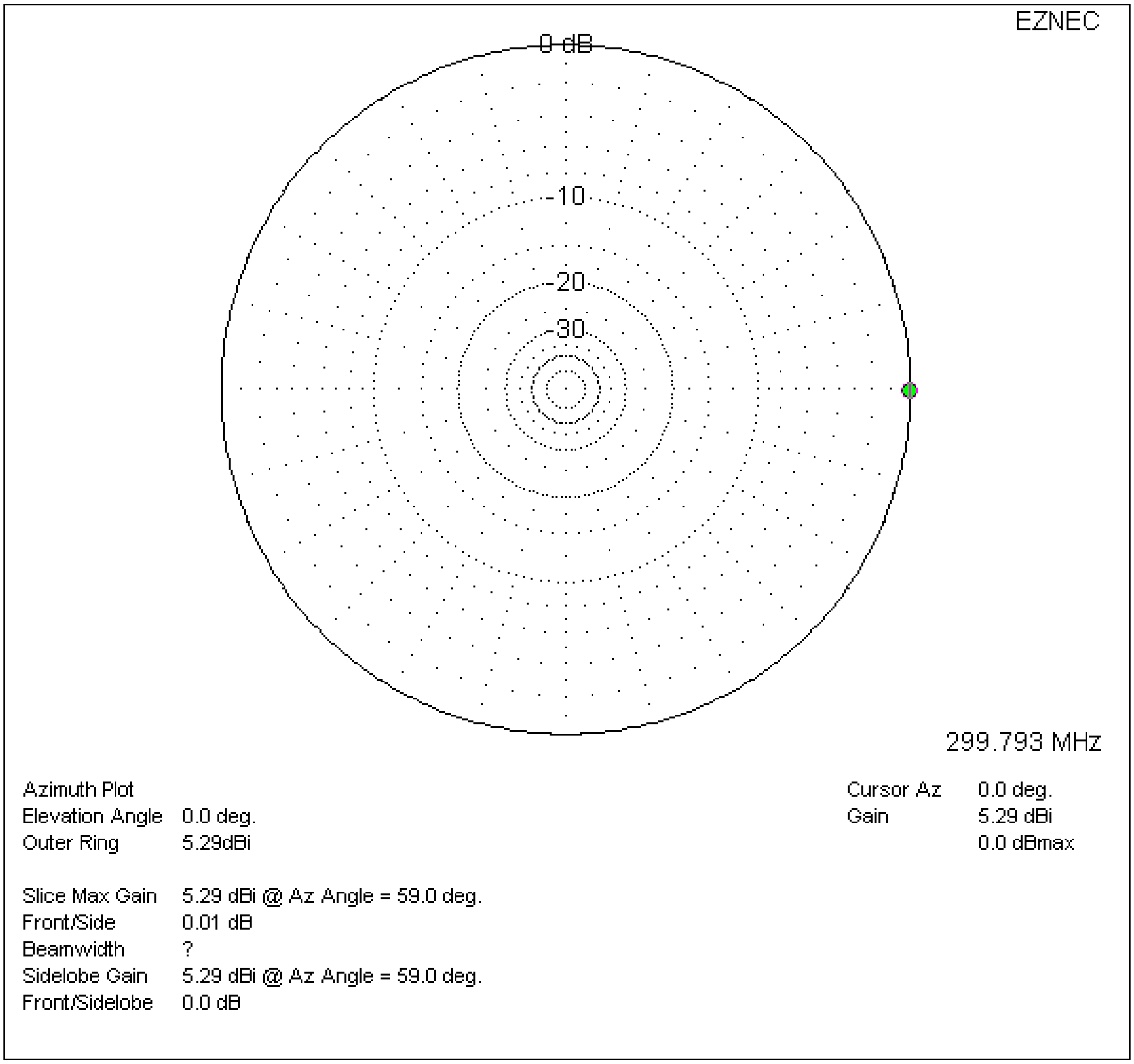

Figure 4. Pattern for individual vertical.

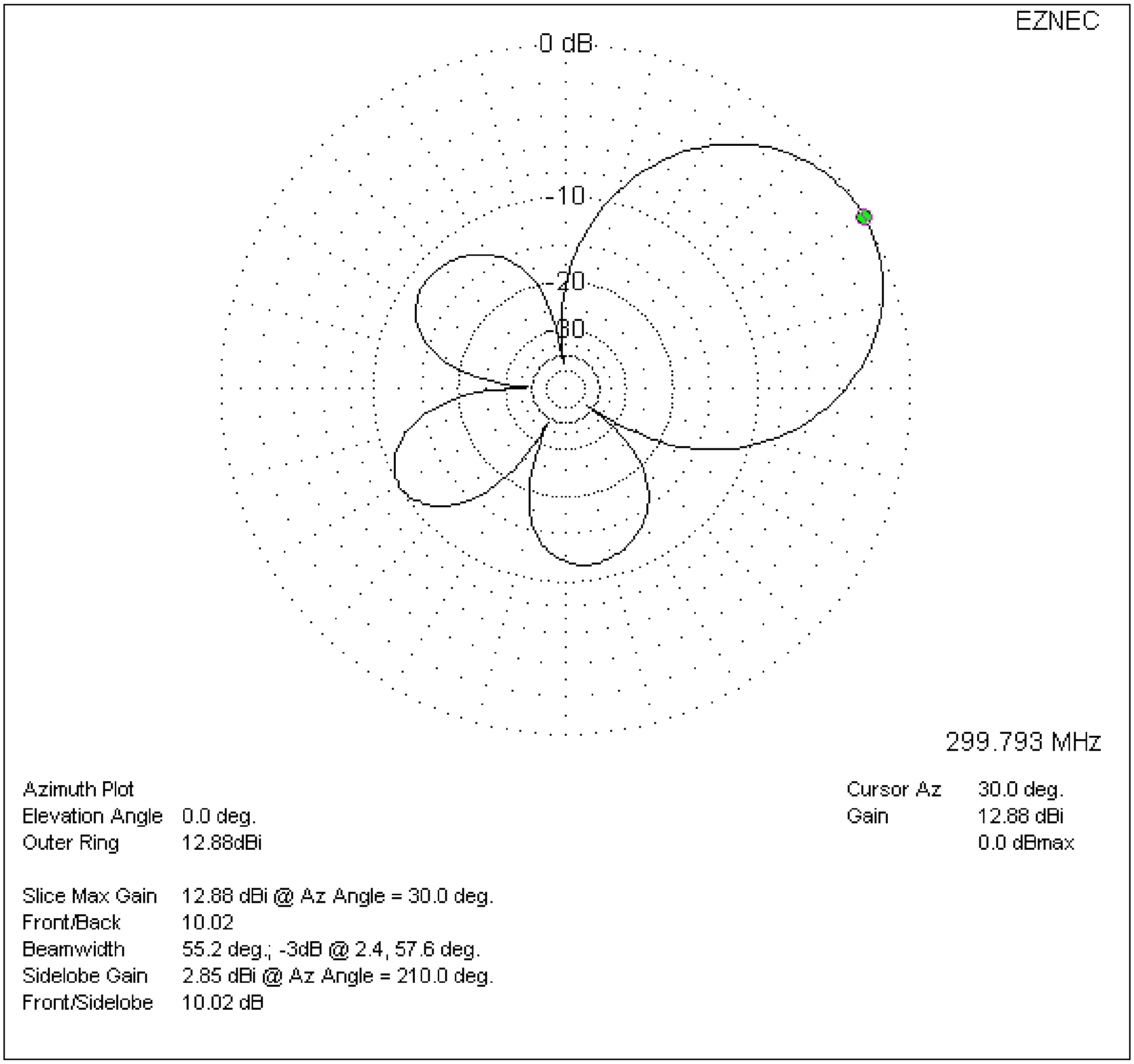

Figure 5. Pattern for configuration #2.

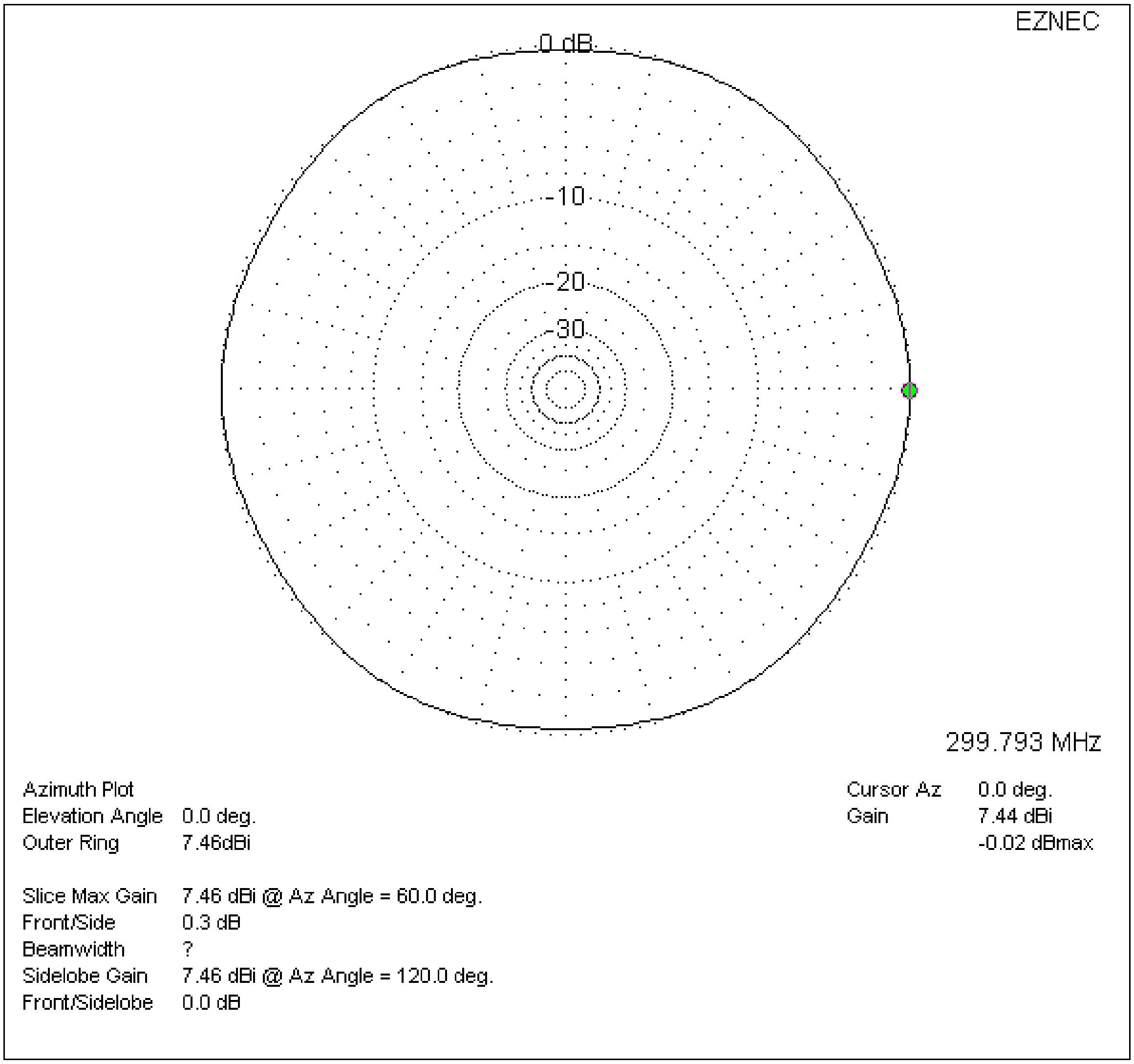

Figure 6. Pattern for configuration #3.