N0GW Log Periodic Installation

I am particularly happy with my HF log periodic beam antenna installation. This is my first tower mounted, rotatable, beam antenna. Before retiring and moving to the Ozarks, zoning restrictions and power line proximity limited my antenna choices to wire antennas installed at relatively low heights.

My on-the-air activity is typically rag chewing. As such, the reliable, efficient, and broadband characteristics of a log periodic antenna seemed attractive. I chose the Tennadyne T6 six-element model. This is probably the smallest of the commercial log periodic antennas available. Its gain and front-to-back ratio is mediocre but that is OK for my application.

This is an analysis of my particular installation. Figure 1 below shows the configuration that I defined in EZNEC. What it shows is the tower with its three guy lines and the T6 on top.

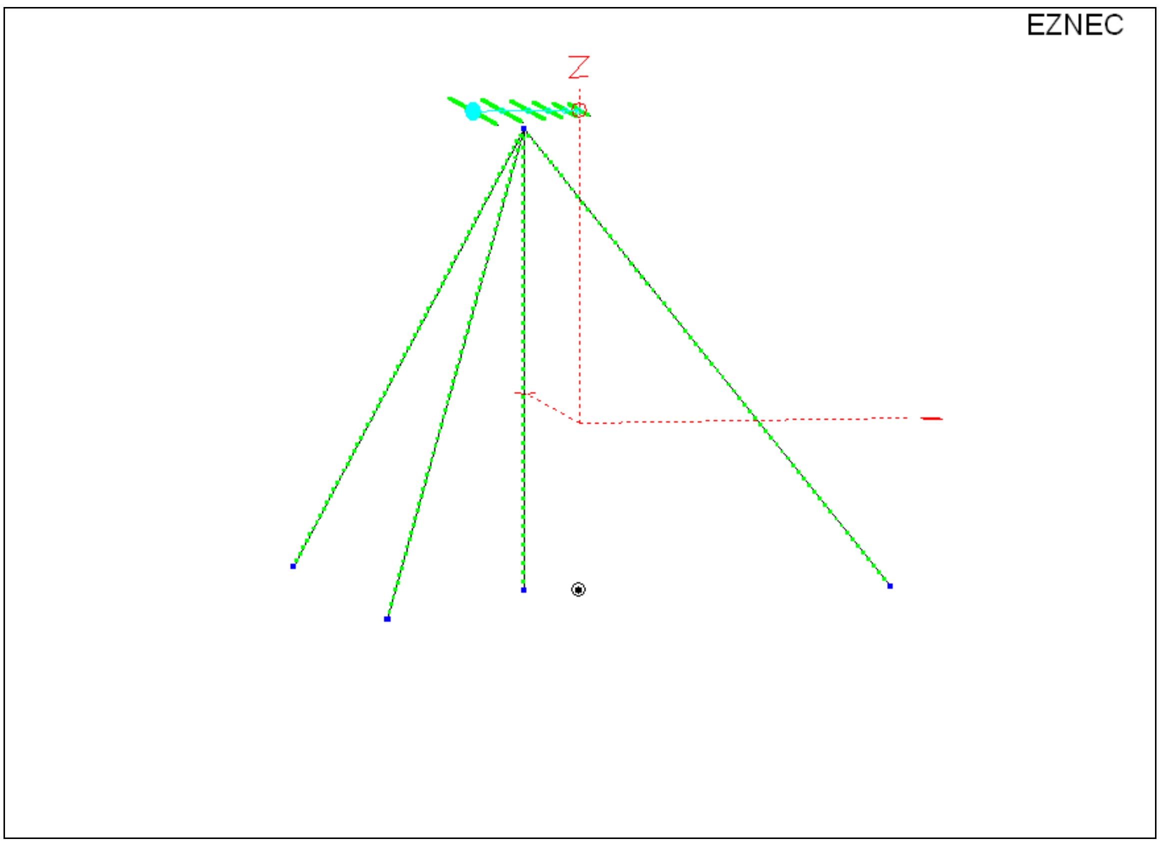

Figure 1

I used an NEC definition of the T6 that I found in the ARRL Antenna Compendium, Volume 6, on page 75. I have had to assume that definition is correct. I was so interested in getting my antenna up and trying it on the air, I didn't bother measuring it while I had it on the ground. To date, my subjective impression of the performance of my T6 matches what EZNEC shows.

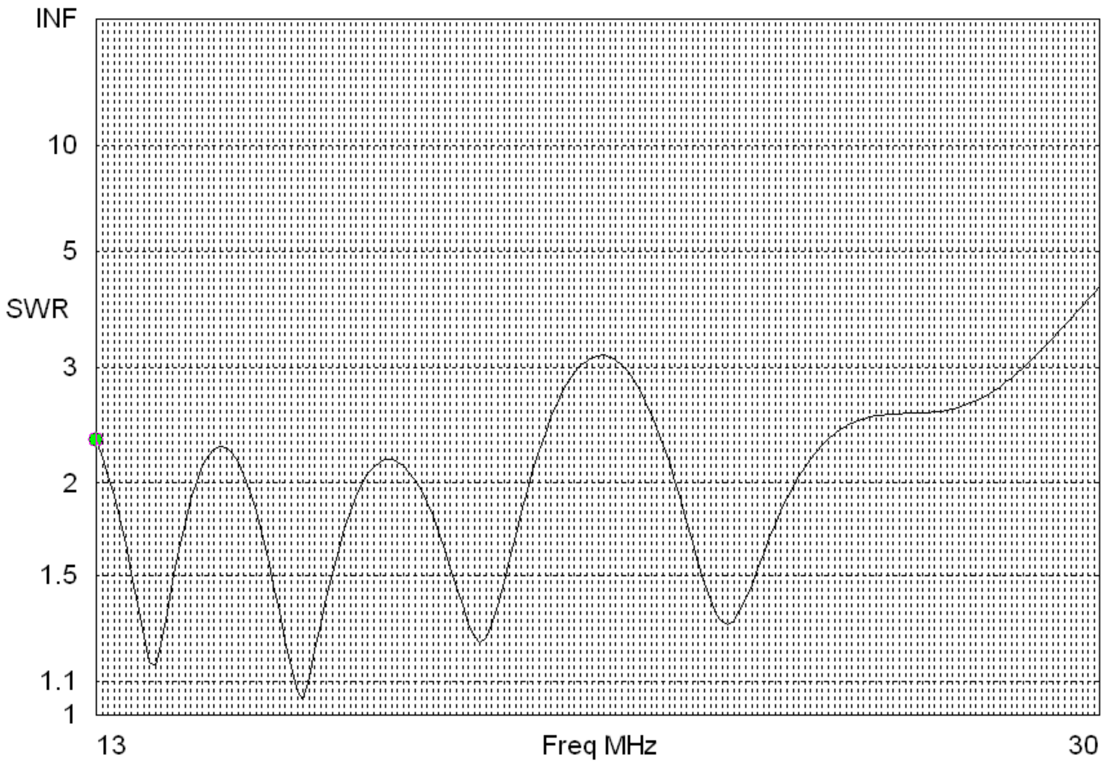

Figure 2

The figure 2 SWR plot is EZNEC's guess for the T6 mounted on top of my tower. This plot differs somewhat from what I actually measured. The primary differences are that the peaks and valleys occur at different, but nearby, frequencies and the SWR peaks are lower. The difference in frequency response could be to lack of accuracy in the model I copied from the ARRL book or some environmental factor. The lower SWR peaks could be from model errors or feedline loss. I suspect it is primarily the latter.

In the ham bands, the SWR I measure is below 1.5 to 1 on all frequencies. There are spots between the ham bands were the SWR approaches 2 to 1 but that is of no concern to me. In general, I can operate without using an antenna tuner on all the ham bands this antenna covers.

While my SWR plot does not exactly match EZNEC's calculation, the radiation patterns produced by log periodic designs are insensitive to small dimensional variations. Even if the model I am using is not precisely correct, the design is likely to be close enough to make my radiation pattern plots valid.

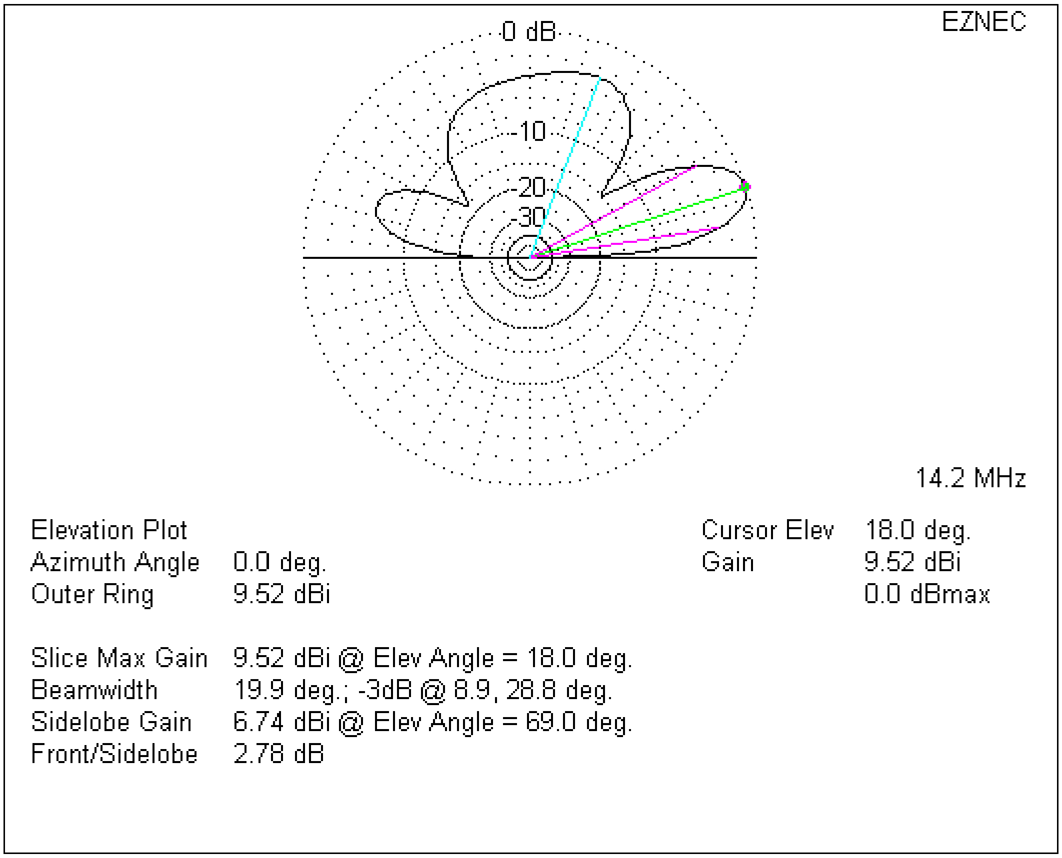

Figure 3

Figure 3 above shows the vertical radiation pattern for 20 meters. Notice that the front-to-back ratio is not outstanding. EZNEC's calculation is for about 6 dB f/b. I don't really have any way to measure this but the above plot seems reasonable, based upon my on-the-air experience. Forward gain is not particularly noteworthy either. A dipole is only about 2 dB weaker. The redeeming feature this antenna, though, is that it is virtually lossless so whatever RF gets to it gets radiated. That is not always true for a Yagi.

A point worth mentioning here is that my tower is located on the high point of our property. The ground slopes away from the tower at roughly a 5 degree angle for about 1000 feet towards Europe. The means that the angle of maximum radiation in that direction is about 5 degrees lower than what shows above. That also means my angle of radiation toward Europe is actually about 13 degrees on this band. That is important because DX signal arrival angles are typically in the 2 to 11 degree range (According to ARRL antenna manual). Having the main beam close to that range helps with signal levels to and from Europe.

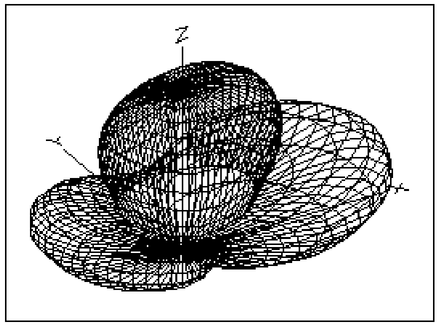

Figure 4

Figure 4 is a three dimensional plot of the radiation pattern on 20 meters. Notice that it has deep side nulls. The high angle bulge is of little concern for receiving since few signals arrive from that direction. For transmit, of course, it means some of the transmit signal is lost, spraying into outer space.

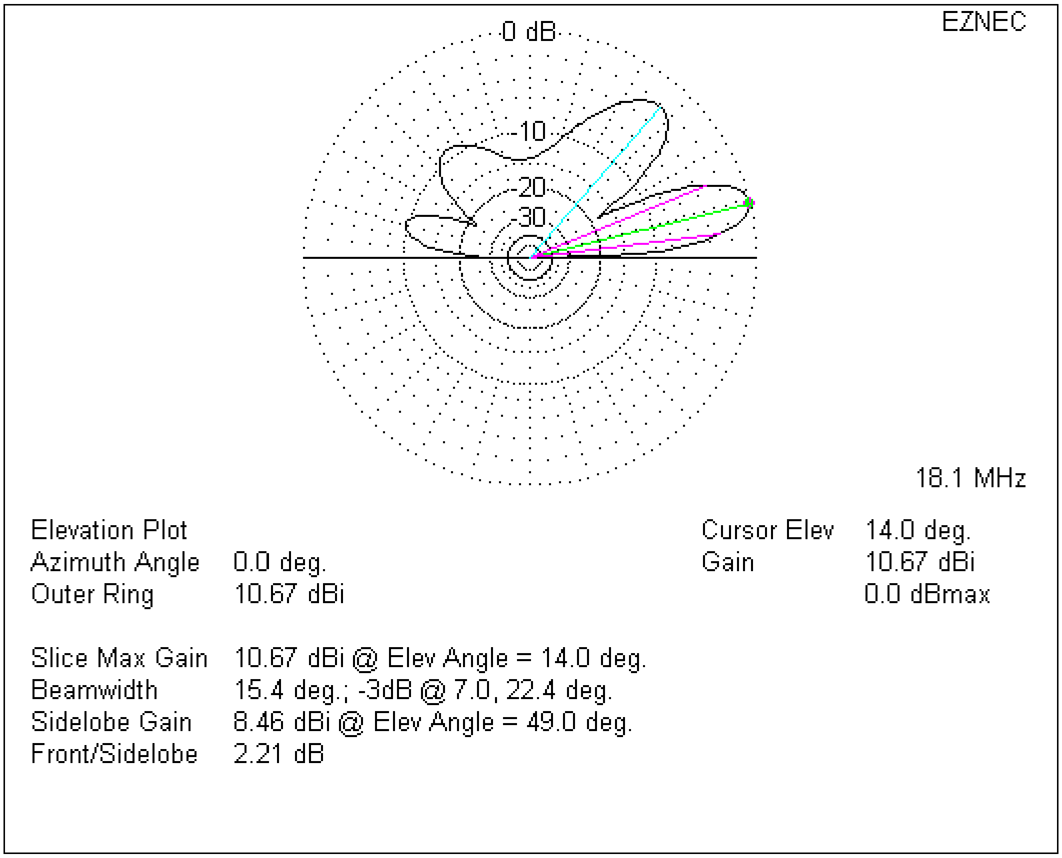

Figure 5

Figure 5 above shows the vertical radiation pattern on 17 meters. Notice that the front-to-back ratio is better than what was shown for 20 meters. This difference is noticeable in actual operation. The advantage over a dipole at the same height is about 4 dB. The ARRL antenna book shows the DX peak in the 2 to 10 degree range.

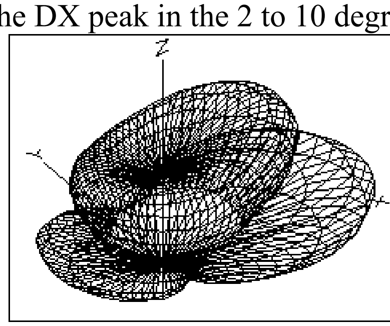

Figure 6

Figure 6 above shows the 3D radiation pattern for 17 meters. There is a fairly good null overhead. The T6 really feels like a serious beam antenna on 17 meters and above.

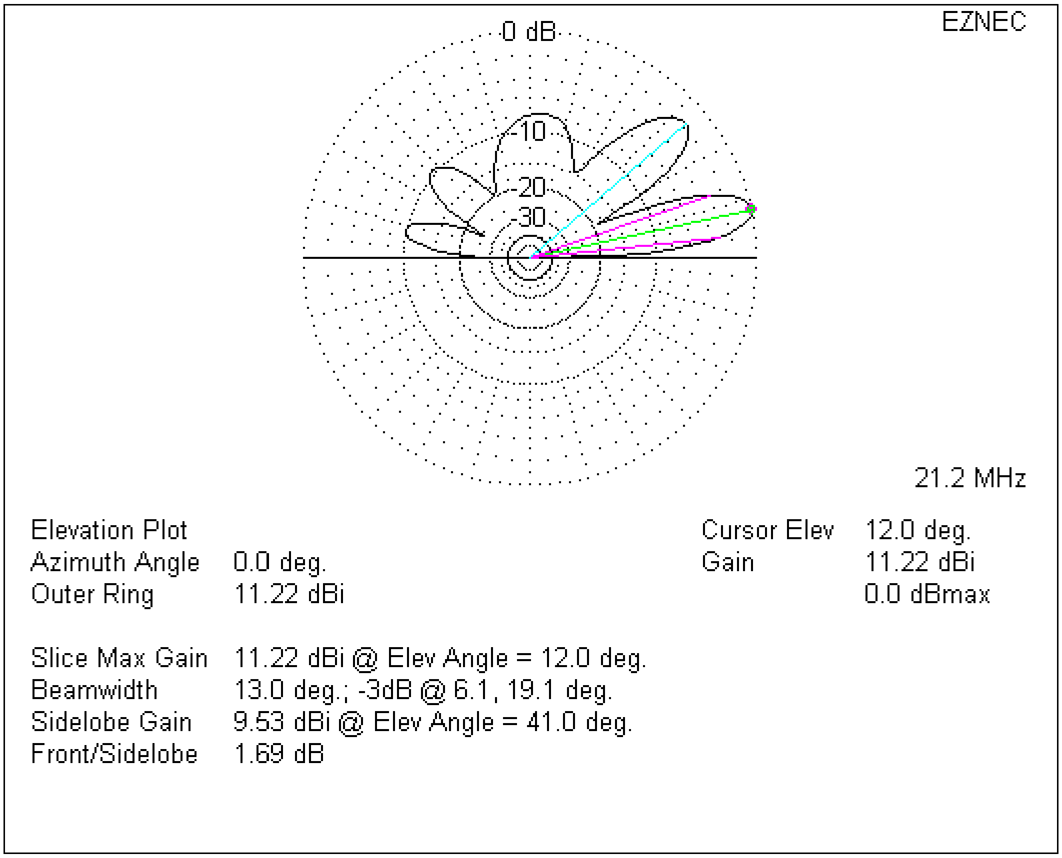

Figure 7

15 meter performance is good. Many times the front-to-back ratio is better than what EZNEC shows in figure 7 above. Again the T6 is about 3 or 4 dB stronger than a dipole at the same height. ARRL antenna book shows the main DX vertical signal arrival angle between 2 and 11 degrees. The slope of the ground around my tower brings the 12 degrees shown above down into the DX range.

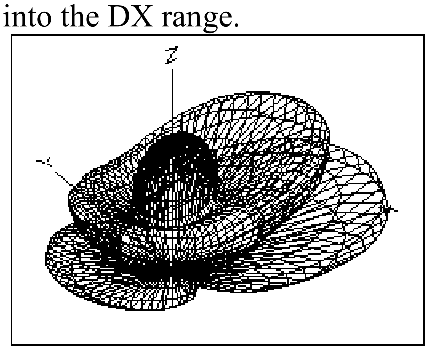

Figure 8

To me, the 15-meter antenna pattern plot in Figure 8 above looks like somebody slipped a sombrero into the picture. In practice, double forward lobes like those shown above give you two chances to favor a takeoff angle that will get through to the station you are communicating with but could produces multi-path fading.

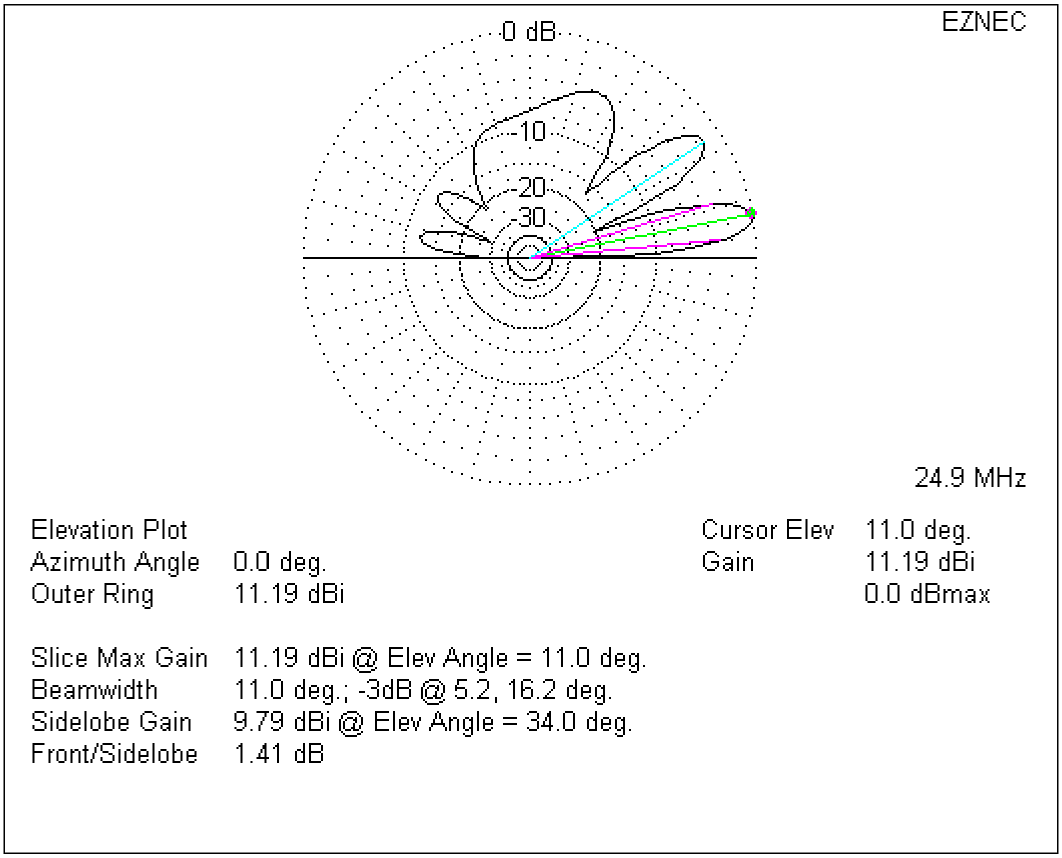

Figure 9

There is little difference between the 15-meter and 12-meter performance with the T6. There is a slightly lower main beam radiation angle but that does not make very much difference on the air. The ARRL antenna book indicates the primary DX vertical signal arrival angles are in the 2 to 11 degree range. The T6 has about 4 dB gain over a dipole at the same height.

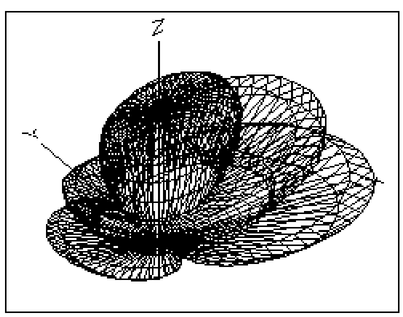

Figure 10

The three-dimensional plot in Figure 10 above shows that there is a high angle lobe on 12 meters. There is very little propagation on 12 meters at those high angles so it is of no concern.

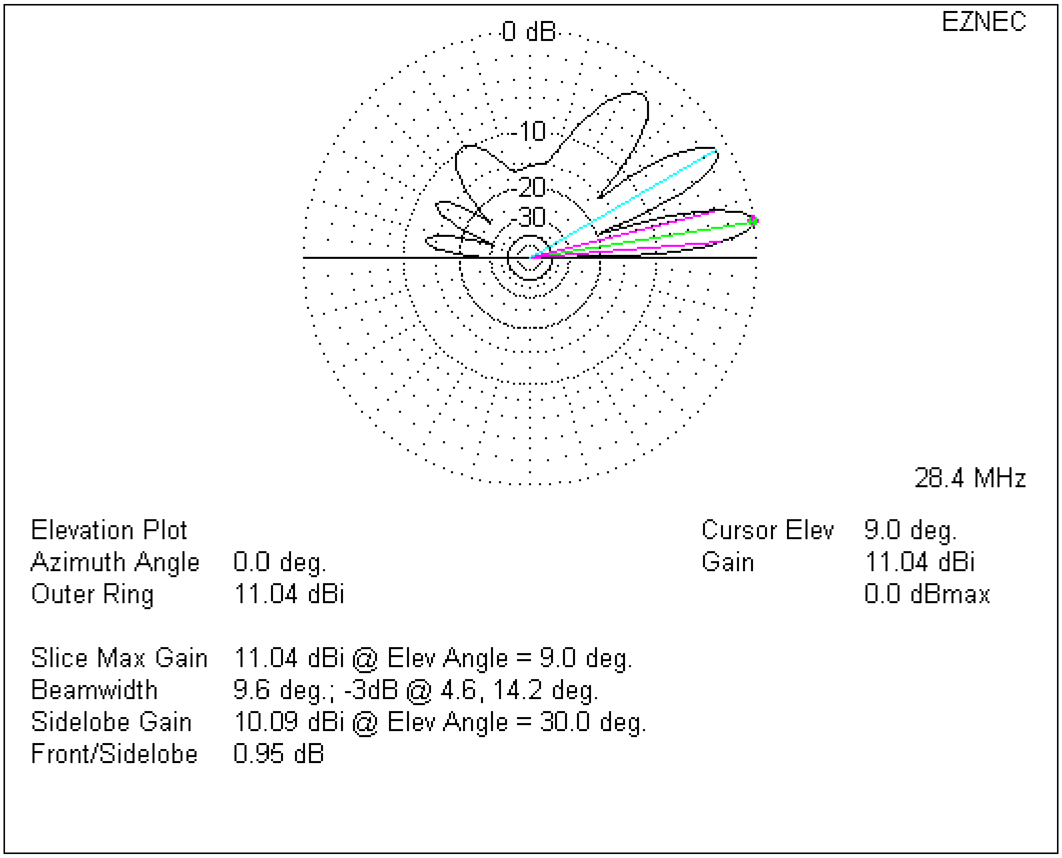

Figure 11

The 10-meter vertical radiation pattern in Figure 11 above shows that 50 feet above ground is probably as high as needed for antennas on this band. Notice that while the main lobe is down at 9 degrees, multiple lobes are forming above it thus reducing the gain of the main lobe. A 9 degree main lobe angle is within the 2 to 10 degree DX angle mentioned in the ARRL antenna book. Taking into account the 5 degree down slope away from my tower, the actual radiation angle toward Europe is only about 4 degrees. That is probably good enough for my purposes. Again, the T6 is about 4 dB stronger than a dipole at the same height.

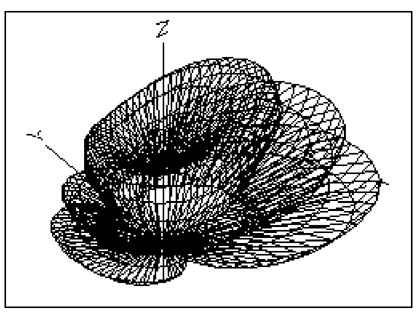

Figure 12

Figure 12 shows the 10-meter 3-D radiation pattern. Though this band has not been open very often since my tower and T6 were installed, when it was, performance was excellent.

Overall, the T6 has performed as a 6-element log periodic antenna should. Though its gain and front-to-back ratio are not outstanding, they are consistent across the entire 14 to 30 MHz range. There are no electrically lossy components on the T6 so its efficiency is close to 100%. That is not the case for typical trap antennas. A T6 is probably equivalent in gain when compared with a three-element trap antenna. In any event, its working great for me.

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May 2nd, 2005