YAESU STEALTH ANTENNA -- Part 2

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15 March 2014

In last month's issue of BARC's BARK, I introduced you to the idea of using a "screw-driver tuned", mobile antenna as a stealthy, home base station vertical antenna. In particular, I used the Yaesu ATAS-120 mobile antenna which auto-tunes from 40 meters to 6 meters. This month, I would like to share with you the results of my antenna modeling of this antenna to determine it's anticipated gain on the various ham bands.

For modeling the antenna, I used the great computer program EZNEC written by Roy Lewellan, W7EL. (http://www.eznec.com/) I described EZNEC for BARC readers in my article "EZNEC Antenna Modeling" in the Jan. 2005 issue of BARC's Bark. Then in the Feb. 2008 issue of BARC's Bark, I wrote another article entitled "EZNEC Modeling of a Mobile Antenna". This modeled the Yaesu ATAS-120 installed on my old Audi convertible. If you can not find your back issues of BARC's Bark and want a copy of these previous articles, shoot me an e-mail request at: kh6htv@arrl.net

The basic model for the ATAS-120 antenna starts with a base vertical, 43cm long vertical wire, W1, and then a top flexible whip wire of 100 to 116cm, W2. A loading coil of adjustable inductance is inserted between wires W1 and W2. The coil is modeled as a "trap" with parasitic shunt capacitance and series resistance. Table 1 in the Feb. 2008 article gave the initial starting points for the parameters of L, C and R. In my EZNEC model these wires and choke were mounted from the origin on the vertical Z axis. In the X-Y ground plane, I arranged a symmetrical radial pattern of sixteen, 14 ft. radial ground wires. To be realistic, I specified the antenna was working over real earth. Here on Maui, we have extremely rich, moist, red volcanic earth. Thus, I did not use W7EL's recommended "typical earth" model of 0.03 Siemens/m conductivity and 20 dielectric constant. I found on a University of Hawaii web site values given for typical Hawaiian agricultural soils. I thus used 0.2 Siemens/m and a dielectric constant of 25 for my EZNEC modeling.

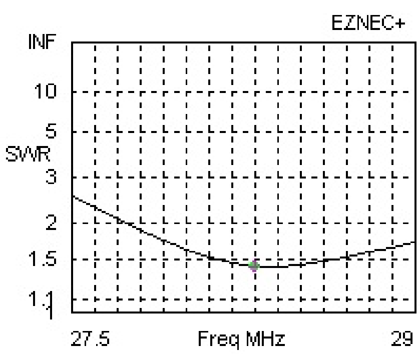

Fig. 1 Antenna VSWR

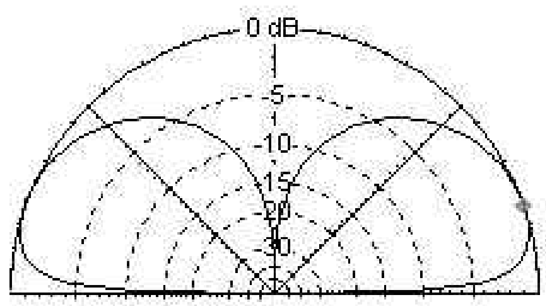

Fig. 2 Antenna Elevation Gain Plot

Running the EZNEC program, one can do a frequency sweep to compute the VSWR, Fig. 1. Then at a single designated frequency, the program will calculate either a 2-D or 3-D antenna gain plot, Fig. 2. By running the swept VSWR plots, I was able to fine tune the loading coil L, C & R parameters to resonate the antenna on the various desired ham bands. The final values obtained were close to those which worked for the antenna when I modeled it in 2008 on my Audi. The max. gains were about the same either mounted on the car or over a set of ground radials, however, the antenna patterns were quite different. With the antenna mounted on the right rear fender of the Audi convertible, the antenna patterns were quite directional with the max. gain occurring on a diagonal drawn from the right rear fender to the left front fender. Mounted over the symmetrical ground radials, the pattern was the typical, omni-directional pattern for a vertical monopole antenna, Fig. 2.

Using the original system of sixteen, 14 ft ground radials, EZNEC demonstrated a problem with a considerable loss of gain at 12 and 10 meters. Bill, K0RZ, said this indicated the problem of using ground radials approaching a half wavelength, $\lambda / 2$, and suggested adding more, shorter radials. I thus added four more, shorter radials uniformly spaced around the antenna. Using EZNEC simulations, I then adjusted the lengths of these radials and computed VSWRs and Gains on the various bands, 40m through 6m. I found the optimum length to be about 9 ft. Thus, the results reported here are for a total of twenty ground radials, sixteen of 14 ft, and four of 9 ft.

For comparison purposes, I next ran a series of EZNEC simulations for a full height, quarter-wave ($\lambda / 4$), vertical monopole antenna, also over a set of twenty ground radials, sixteen of 14 ft, and four of 9 ft. This was to show the penalty paid by using the much shorter, mobile antenna. These $\lambda / 4$ calculations are what one would expect to achieve with a tunable, model BIG-IR, vertical antenna from STEP-IR (http://www.steppir.com/vertical-antennas) The table below shows the resultant Gains for the two vertical antennas. The max. radiation angles were all typically in the range of 16-22 degrees. These are both for operation with twenty. ground radials over real Hawaiian soil. The worst case, as expected, was for 40 meters where there was a 10 dB difference between the very short mobile antenna, and a full height (34 ft.) $\lambda / 4$ antenna. This amounts to almost two S units. On the higher bands of 20 meters and above, the differences are typically about 3 dB or less, or 1/2 S unit.

Band	λ / 4 Gain	ATAS-120 Gain
40 m	3.1 dBi	-7.2 dBi
30 m	2.9 dBi	-2.8 dBi
20 m	2.7 dBi	-0.4 dBi
17 m	2.6 dBi	+0.7 dBi
15 m	2.2 dBi	-0.6 dBi
12 m	2.0 dBi	+0.9 dBi
10 m	2.0 dBi	+0.6 dBi
6 m	1.5 dBi	+0.7 dBi