



Modeling 6 Long-Boom Yagis



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Over the last year or so, I accumulated designs for 5 different 20-meter Yagis with boom between 45 and 55 feet long and having either 5 or 6 elements. After the appearance of a preliminary version of these notes, a 6th was donated. All display an average free space gain from 14.0 to 14.35 MHz of over 10 dBi, with good front-to-back ratios averaging well over 20 dB across the band. It seemed to be an interesting project to model all 6 on the same versions of NEC (in this case, NEC-2 with Leeson corrections and NEC-4, using EZNEC Pro) and do some comparative assessment.

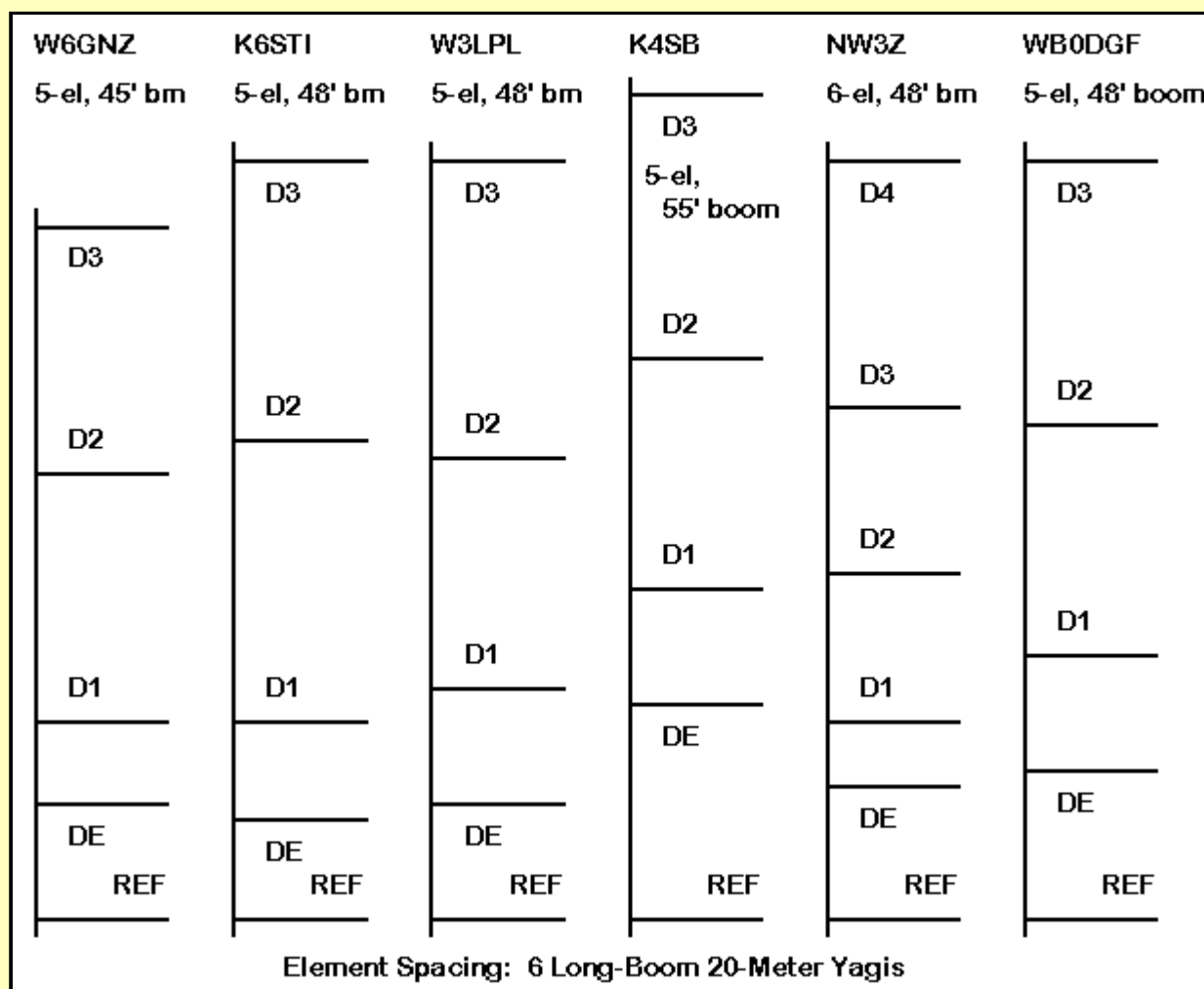
What actually emerged is a lesson in some of the difficulties in making such assessments. Some of those difficulties arise from limitations of the programs (and every version of NEC/MININEC has limitations). Others emerge from differences among models and specification sheets that cannot be resolved without additional data not at hand. Hasty modeling and simplistic conclusions can yield fog where clarity is desired.

The Six Beams

The six beams are the following:

- 1. A 5-element, 45' boom design by W6NGZ, published in *CQ* for October, 1996, p. 22.
- 2. A 5-element, 48' boom design by K6STI, published among the beams in *YA*, which accompanies the *ARRL Antenna Book*--this is a medium strength model.
- 3. A 5-element, 48' boom design by W3LPL, published on the World Wide Web.
- 4. A 5-element, 55' boom design by K4SB, originally developed in monotaper for 10 meters, modified for this study by me for a somewhat arbitrary element taper (used by permission).
- 5. A 6-element, 48' boom design by NW3Z, published on the World Wide Web.
- 6. A 5-element, 48' sent to me by WB0DGF and once published on the Hy-Gain web site as HG205XLB.

The beams are interesting for their differing design features, not the least of which is the choice in element spacing, as shown in the figure below.



The K6STI has the lowest design feedpoint impedance, which is indicated in the reflector-driver spacing. The W6NGZ design aims for a higher feedpoint impedance and uses a correspondingly wider reflector-driver spacing. The W3LPL design has a comparable feedpoint impedance and hence a similar reflector-driver spacing to the W6NGZ design, despite the differences in boom length. These three designs are similar beyond the driver in that the directors are proportionally spaced, relative to each other. However, do not ignore the ability of D2 to affect feedpoint impedance. The WB0DGF design demonstrates how a different taper schedule may influence the required spacing for a design, since its reflector-drive spacing is greater than the K6STI antenna, but the DGF version has only a moderately higher feedpoint impedance.

The longest model (K4SB) tries for a direct 50-Ohm feed and uses the widest reflector-driver spacing. D1 is not especially different in spacing from the driver relative to the first three models. The truly different design is the NW3Z 6-element Yagi, which uses a moderately wide spacing between the reflector and driver combined with the closely spaced D1 to set the basic parameters of the antenna. However, D2 also plays a crucial role in setting the feedpoint impedance: at correct spacing, the feedpoint impedance is a good coax match; with D2 40" closer to D1, the feedpoint impedance drops to the 25-Ohm neighborhood without seriously affecting the gain and front-to-back characteristics of the antenna.

These notes are not designed to recommend one design over another, either overtly or tacitly. That would require a detailed construction analysis plus the resolution to some modeling questions which I intend to leave open.

Some Modeling Preliminaries

Unfortunately, modeling Yagis within the amateur community has become somewhat of a casual process, without the care and attention to detail used by serious designers, such as the author's of the designs shown here. Whatever the source of the design--YO, Yagi-Max, or simply manual design on AO or EZNEC--evaluation of a design requires good modeling practice.

NEC-2 without a correction factor cannot accurately model a linear element using a tapered-diameter schedule. For that reason, some implementations of NEC-2 include Leeson or similar corrections, which substitute a carefully calculated mono-tapered element for each tapered-diameter element in an array. However, it is possible to disturb the substitute element by paying too little attention to segment length equality. Especially at current nodes (the center of near-1/2 wl elements), segment length needs to be equalized along a linear element whether it is a single dipole or a part of a larger array). Since the Leeson corrections modify the length and diameter of a wire but not its segmentation, segment lengths should be equalized in advance. This factor plays an especially important role where the designer may place a very-large diameter short segment at the element center to simulate boom-to-element mounting plates and hardware. Often--as with the K6STI and WB0DGF models--the length of this segment sets the approximate length of segments in the adjoining sections of the element.

Therefore, for the models at hand, segmentation was increased to yield segment lengths between 8" and 12", depending upon the model. The K6STI and WB0DGF models use the shorter lengths due to their center "lumps." (Note that the WB0DGF model omits the center "lump" on the driven element, while the K6STI model preserves it.) The W6NGZ model uses 12" segments, because they came out most even with the element sections in the design.

Other beams used 8" (W3LPL) or 10" (K4SB, NW3Z) per segment for similar reasons: the chosen segment length turned out to be the best way to achieve roughly equal length segments on the most elements. Despite best efforts, some variations inevitably result. Designers will always have, for any segment length chosen, a section that comes out to be n.5 segments long. Some will choose center sections that for any reasonable segment length seem to require an even number of segments. Adding extra segment is necessary for the driver--and hence, for the other elements in order to keep segment junctions as well aligned as possible.

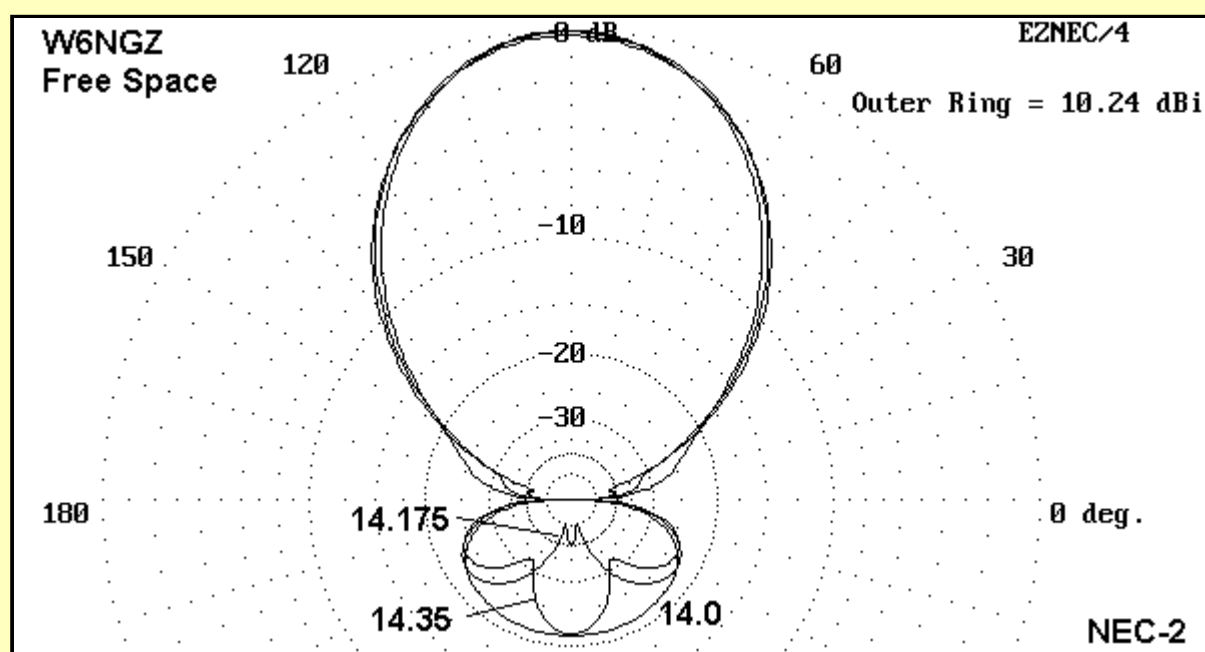
NEC-4, by its initial reports, overcomes the NEC-2 weakness with tapered-diameter elements. Unfortunately, the initial reports have proven overly optimistic. Although NEC-4 is a vast improvement over uncorrected NEC-2, it falls short of the standard set by NEC-2-corrected, which also correlates with MININEC results. (MININEC does not have a tapered-diameter element problem, although it has other limitations.)

The NEC-4 limitation is somewhat minor for general purpose modeling, unless the element shows too large a diameter change between wires in the element, especially close to the current node, with the driven element the most crucial. This condition exists with the K6STI model.

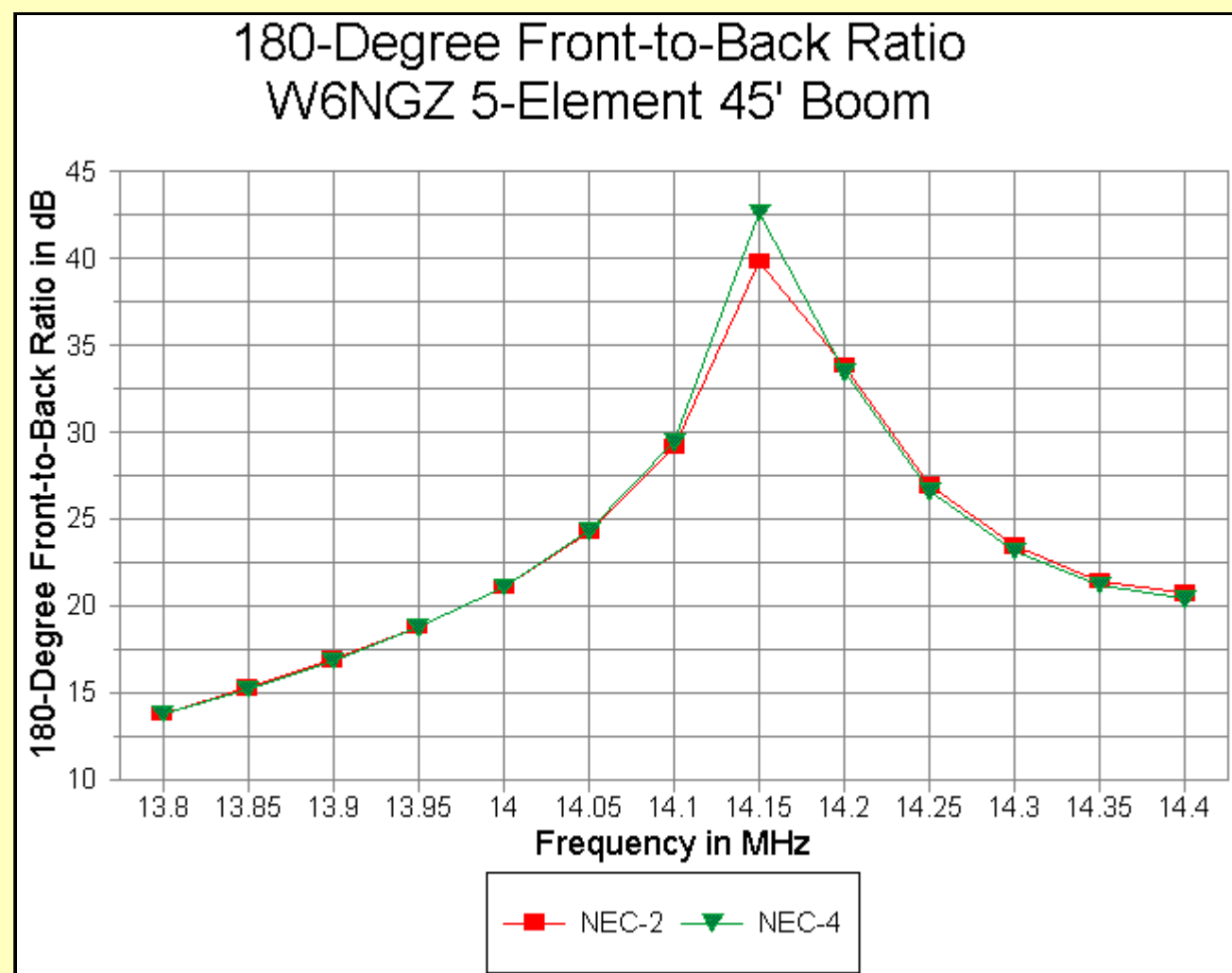
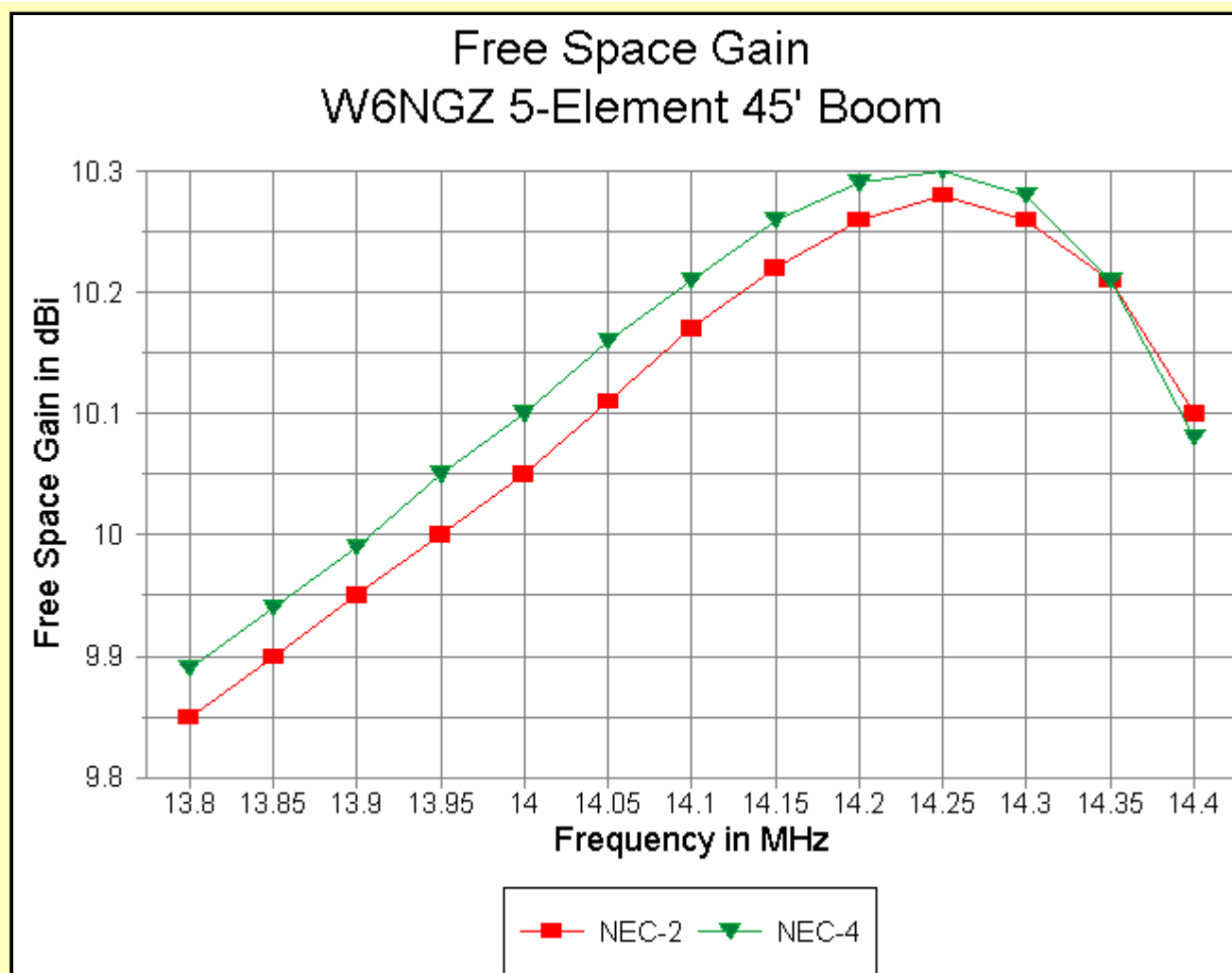
In order to show the modeling differences between NEC-2-corrected and NEC-4, I have modeled all 6 beams in both programs via EZNEC Pro. (I could have applied the Leeson equations to the NEC-4 runs, but that would have produced the same results as the NEC-2 runs.) I graphed data comparatively for NEC-2-corrected and for NEC-4, to include free space gain in dBi, 180-degree front-to-back ratio, feedpoint resistance, and feedpoint reactance. SWR data is also shown wherever the source impedance is close enough to 50-Ohms to make such data relevant. All graphs run from 13.8 to 14.4 MHz in order to show downward slides of NEC-4 curves.

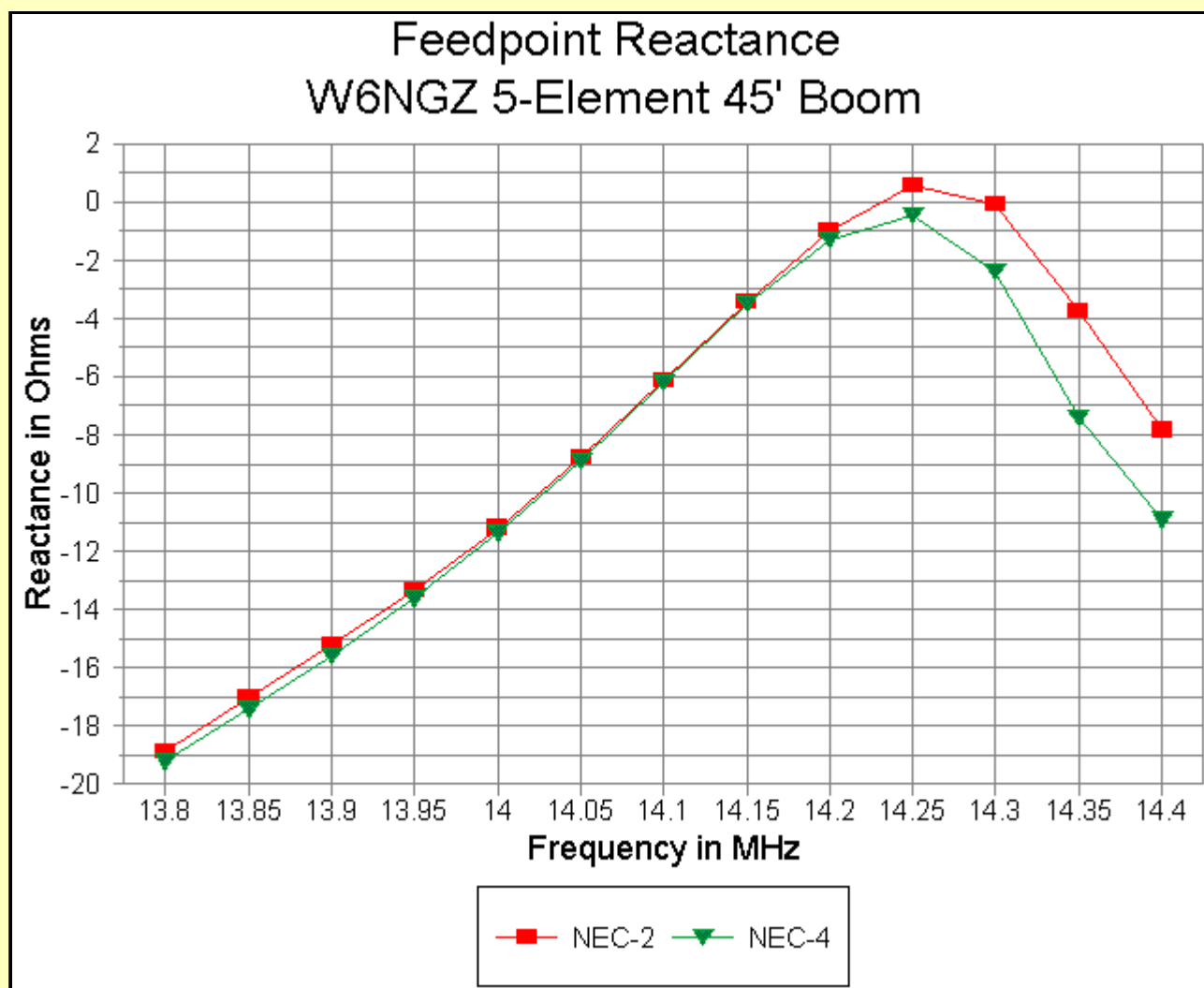
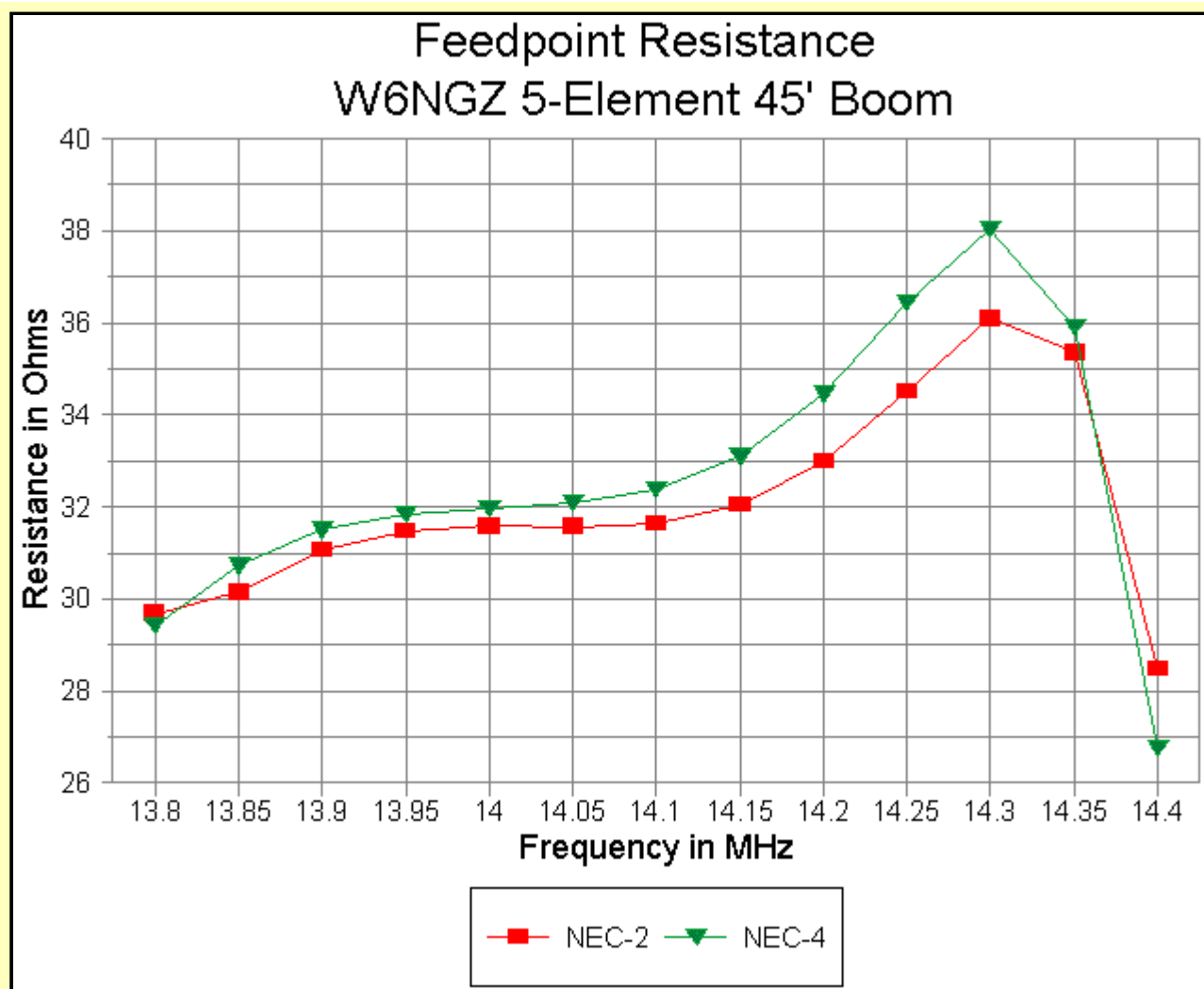
Let's look at the designs individually.

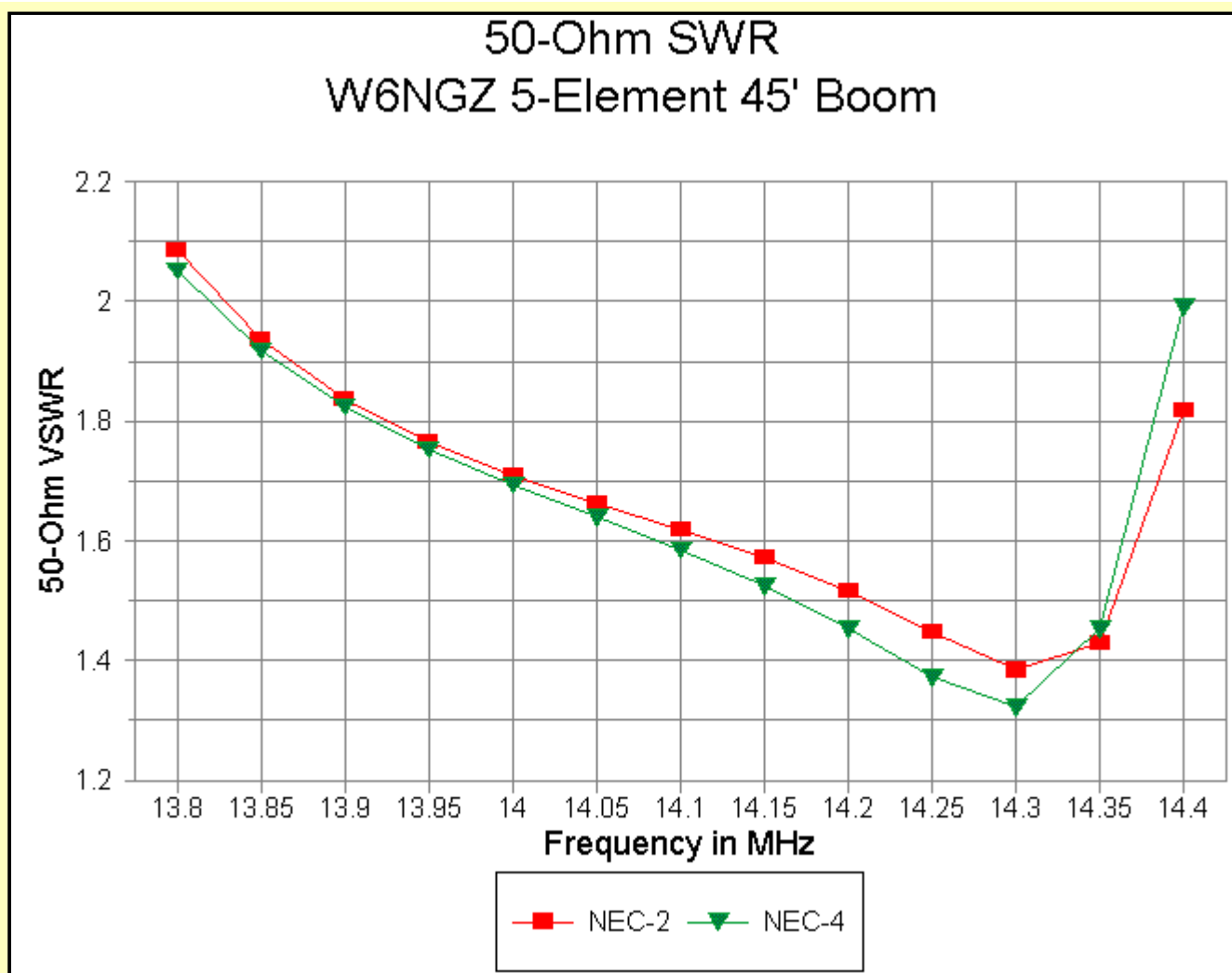
The W6NGZ 5-element, 45' boom model



The W6NGZ model is the shortest of the five, but it sustains a free space gain of over 10 dBi across the band, with better than 20 dB front-to-back ratio everywhere on 20. The element taper is from the CQ article, and it contains no compensation for element mounting plates at the element center. Within these constraints, NEC-4 and NEC-2-corrected tell very similar graphical stories about the beam. Differentials are marginal at best, although a wee bit of excess gain estimation and a slide of the curves downward in frequency are both evident.

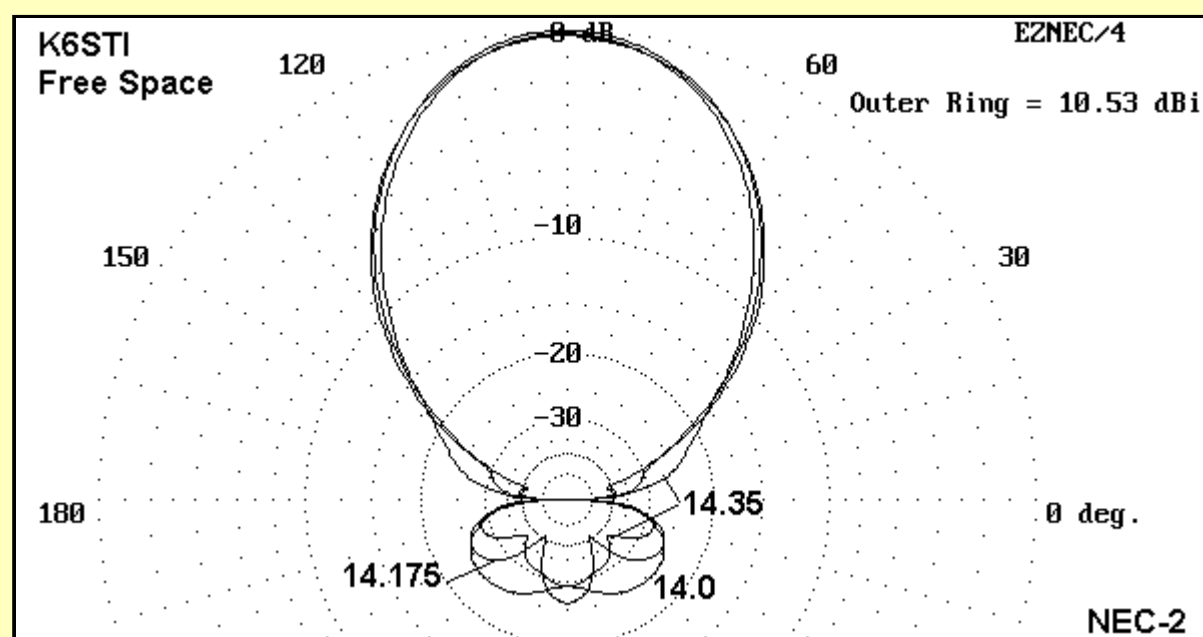






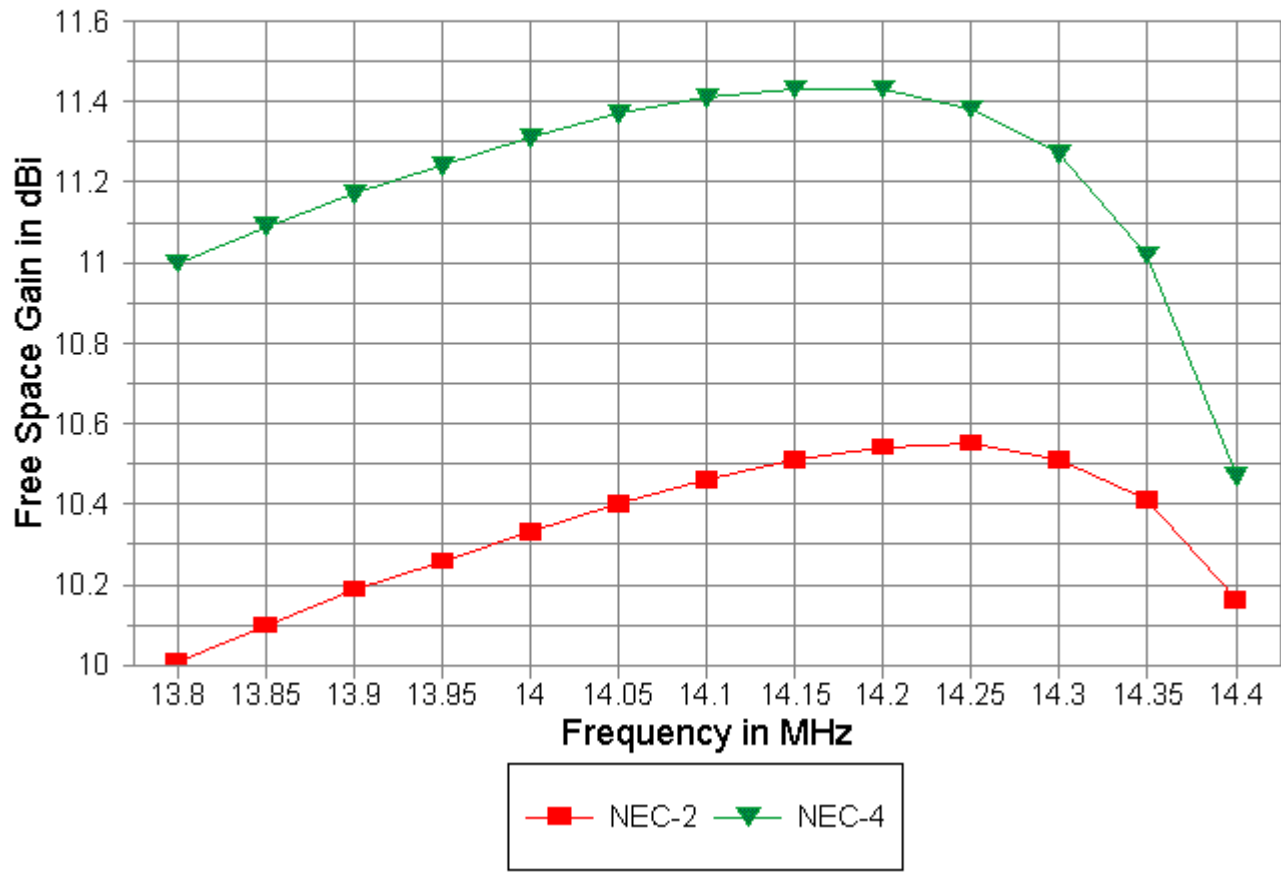
As the graphics make plain, the antenna close being a very good match for 50-ohm cable.

The K6STI 5-element, 48' boom model

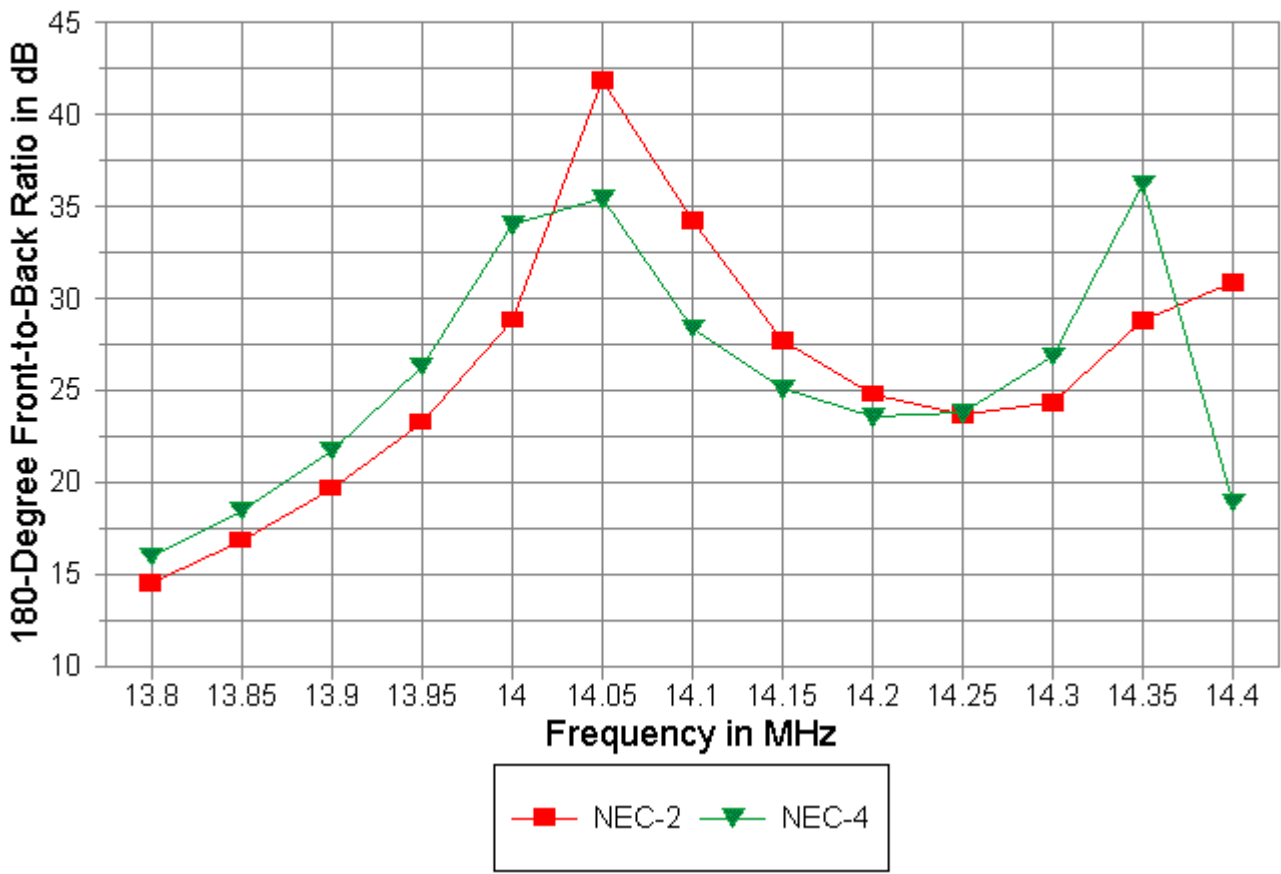


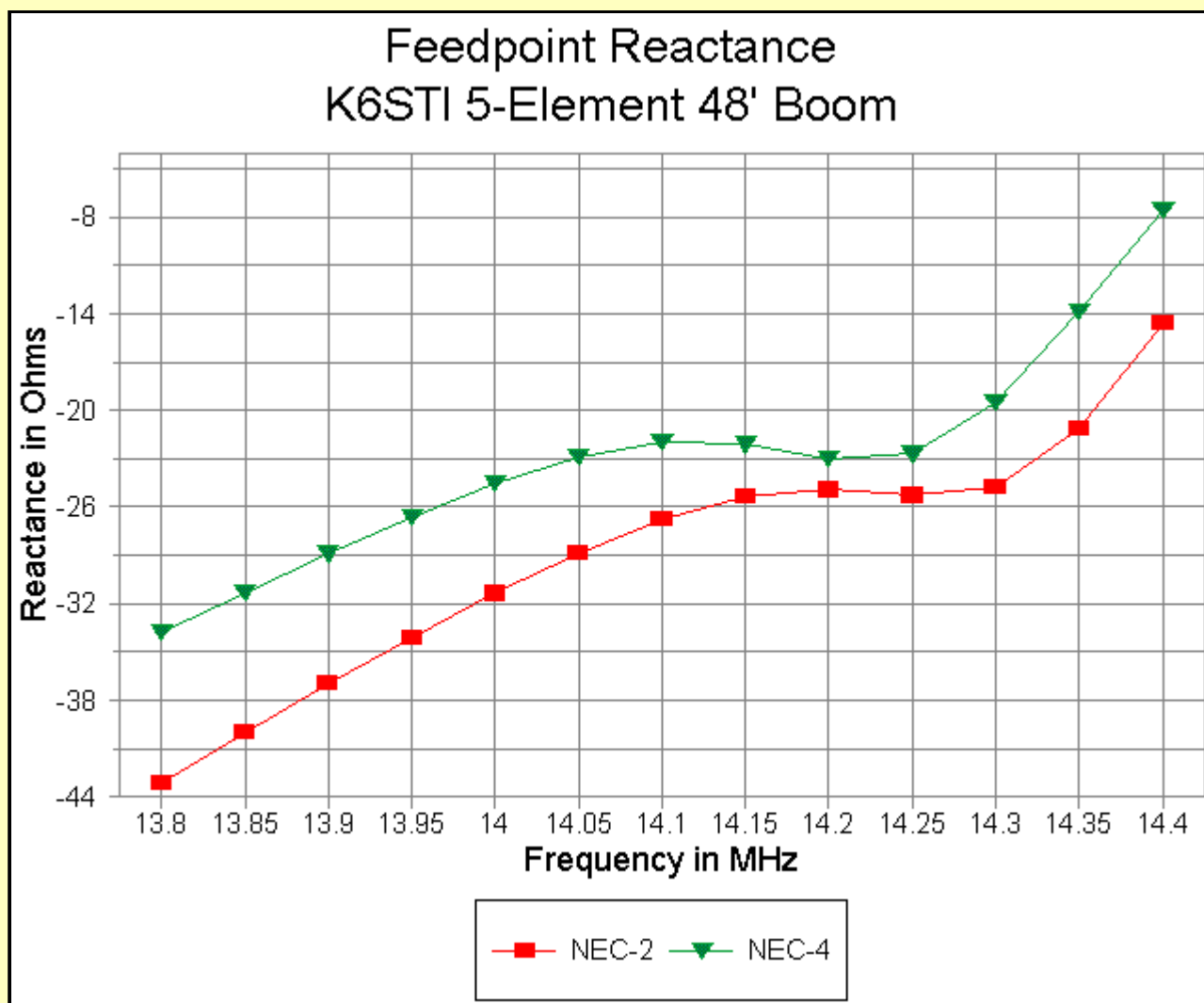
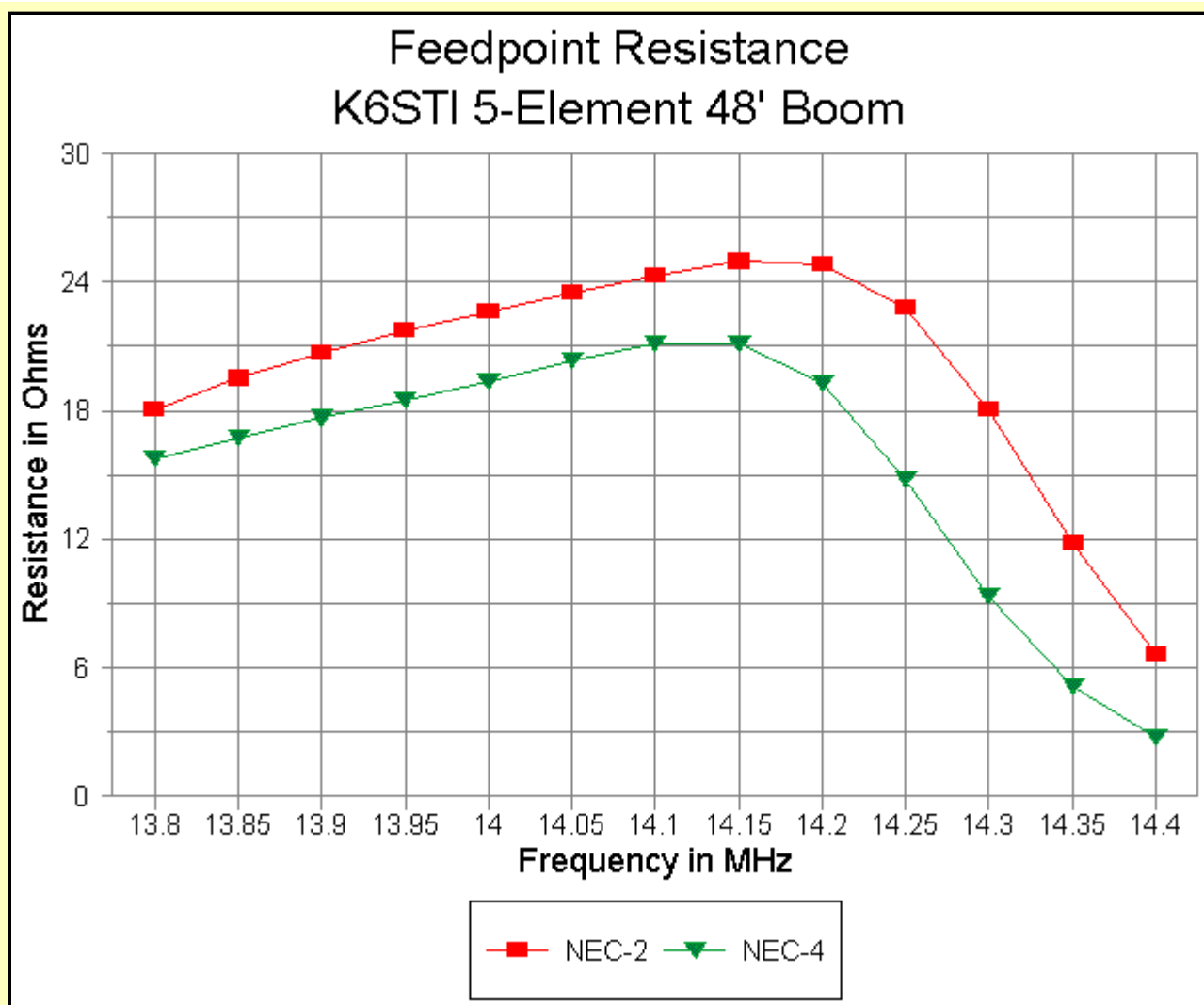
The K6STI design, with its center "bulge" in place, models quite well in NEC-2-corrected. It also displays very well the weakness of NEC-4 in dealing with the large change of diameter so close to the source or highest current point on the elements, despite extensive efforts to equalize segment lengths. NEC-4 gain data is almost a full dB higher than the more reasonable NEC-2 data, with a curve displacement lower in frequency, which also shows up on the front-to-back graph. The source resistance and reactance graphs show a similar slide, with the resistance values low in the NEC-4 run. Since current, impedance, and far field strength are related, the coincidence of these value differences from those in the NEC-2 run are not unexpected.

Free Space Gain K6STI 5-Element 48' Boom



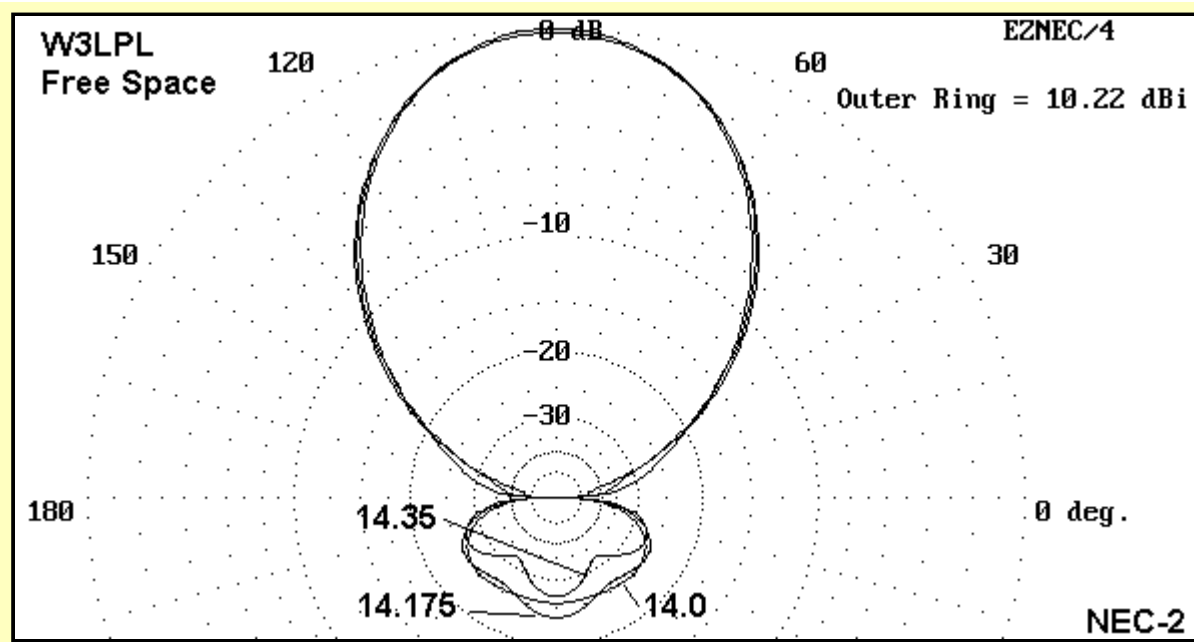
180-Degree Front-to-Back Ratio K6STI 5-Element 48' Boom



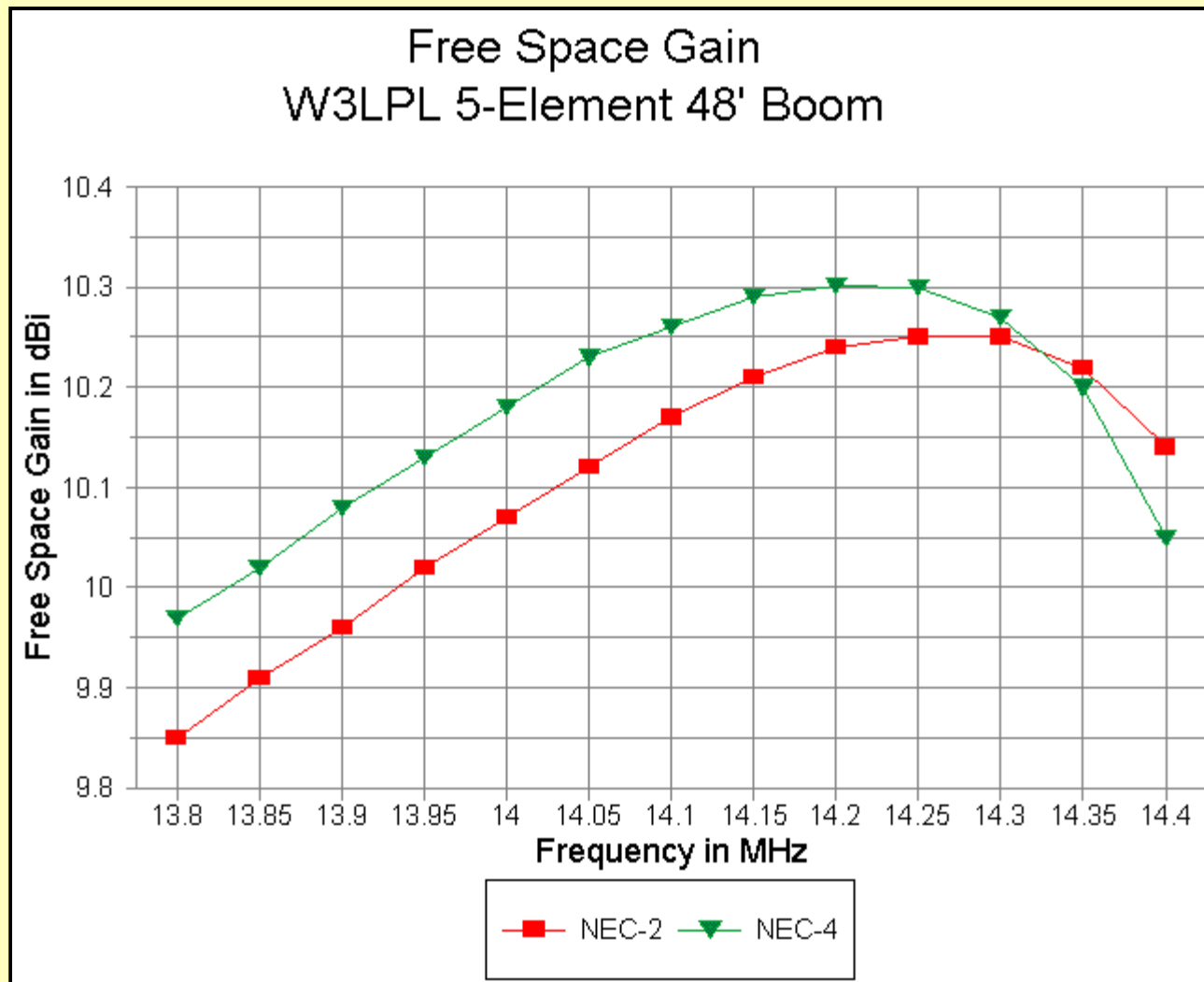


No SWR curve is shown, since the antenna is designed for a matching system such as a beta/hairpin match.

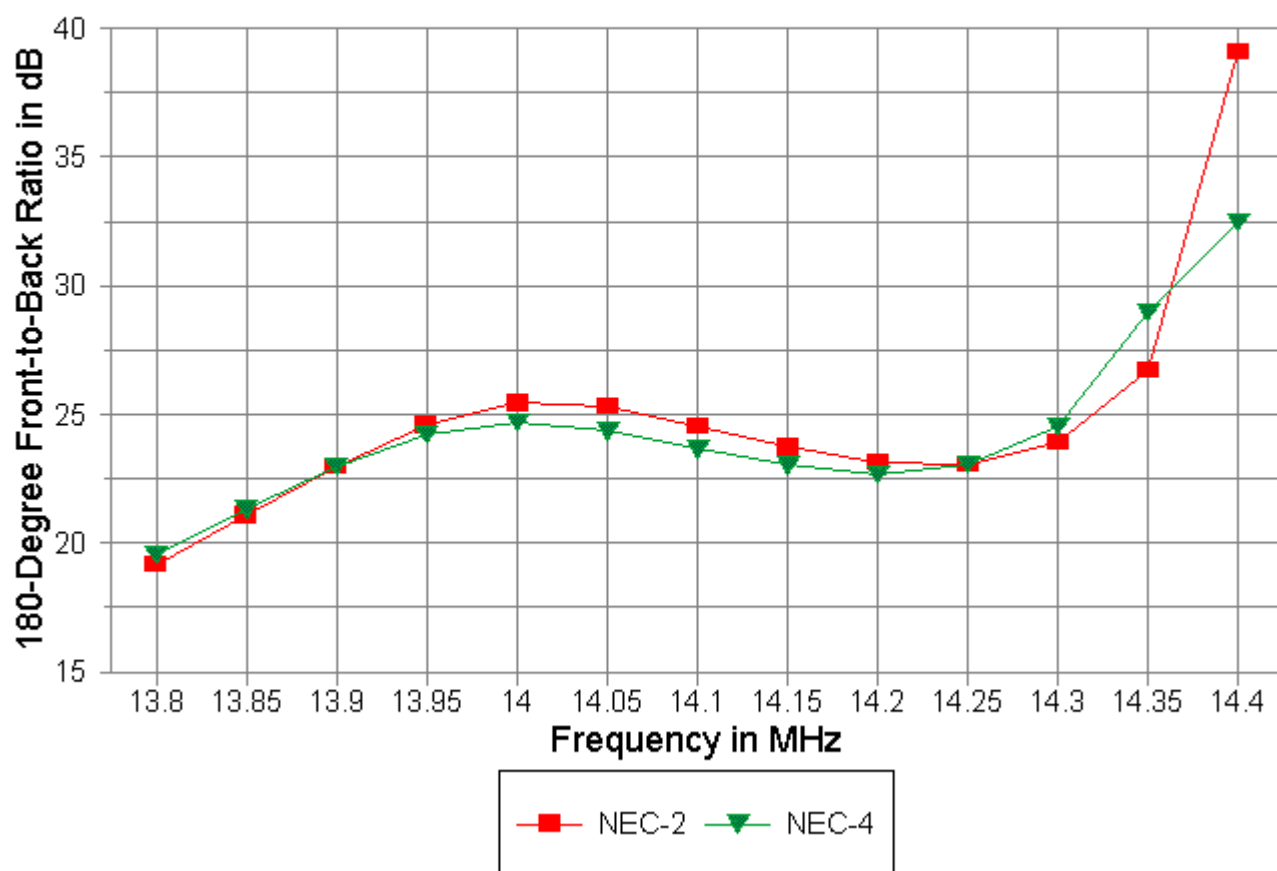
The W3LPL 5-element, 48' boom model



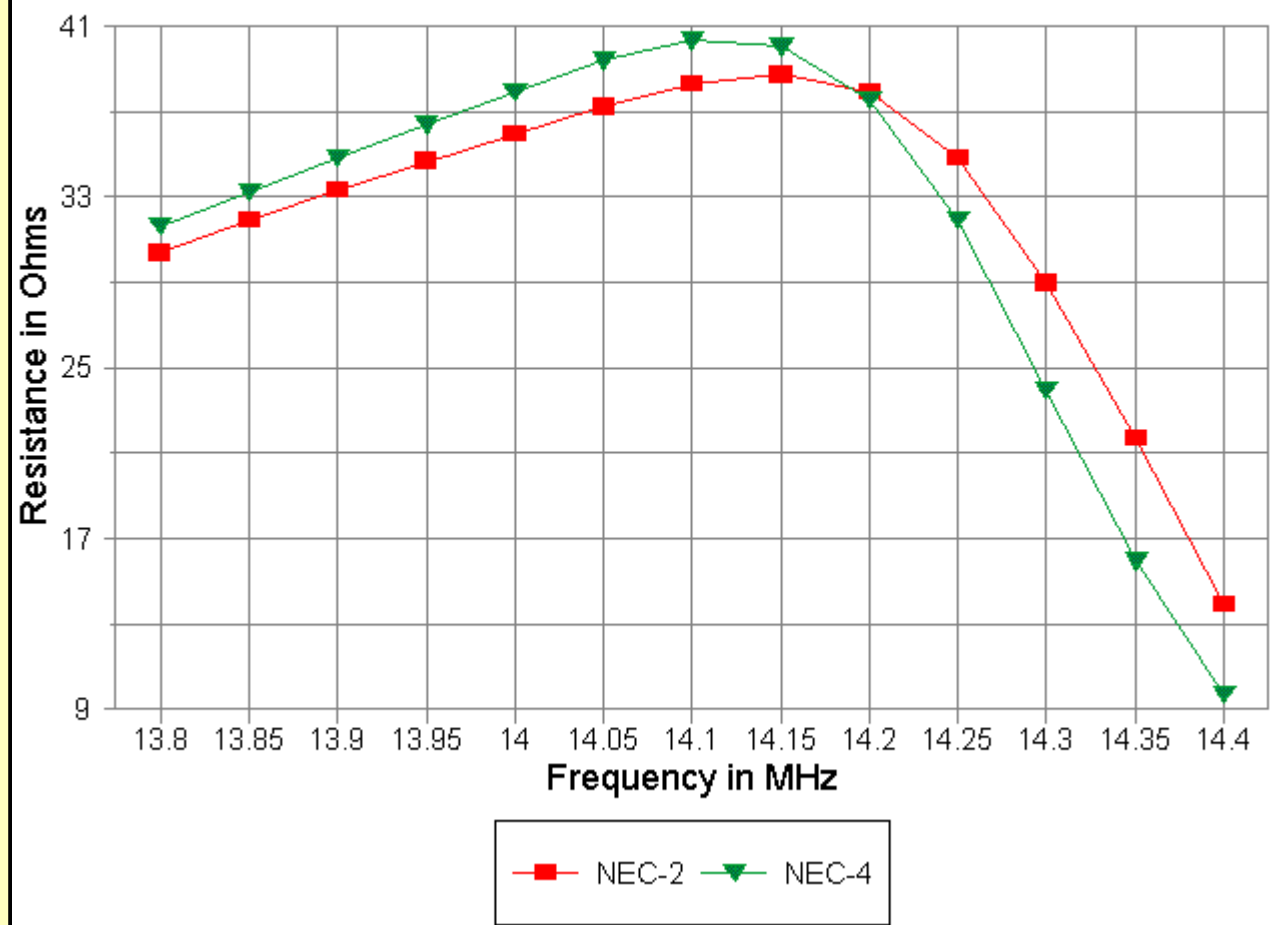
The W3LPL beam was designed for use with a Tee match, which neither NEC-2 nor NEC-4 can physically model accurately. Interestingly, W3LPL designed the antenna with non-conductive boom-to-element mounting plates in mind. Nonetheless, the curves--plus a look at the antenna characteristics just below 14 MHz--suggests that there is an approximate 50 kHz offset in frequency, with the elements in the model again playing short in the NEC-4 run, relative to the NEC-2-corrected run. Gain is still a little high in NEC-4. Given the W6NGZ model runs, this much difference is somewhat unexpected. The chief difference in the modeled data is that the W3LPL antenna shows considerable and constant inductive reactance, due to its intended use with a Tee-matching system.

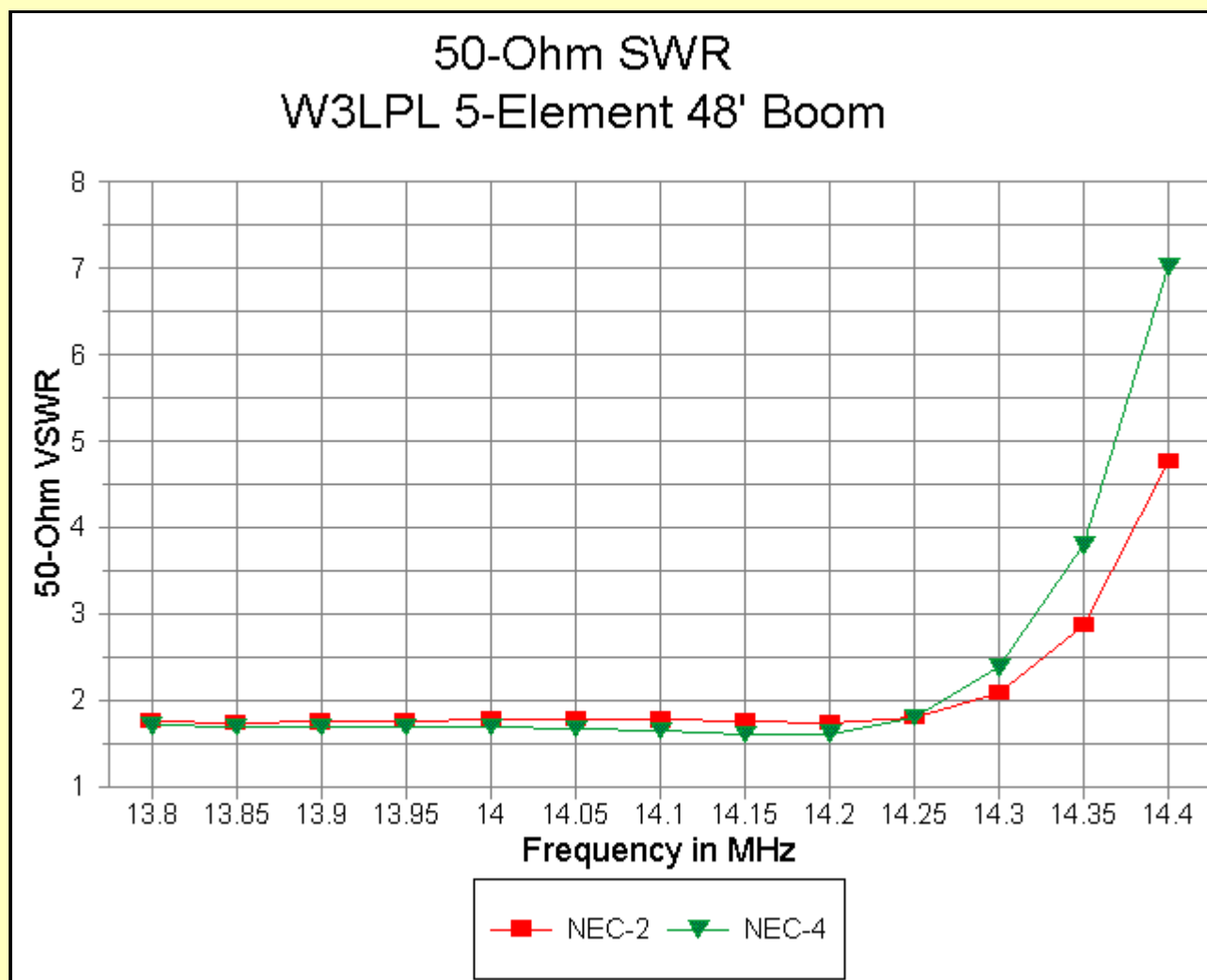
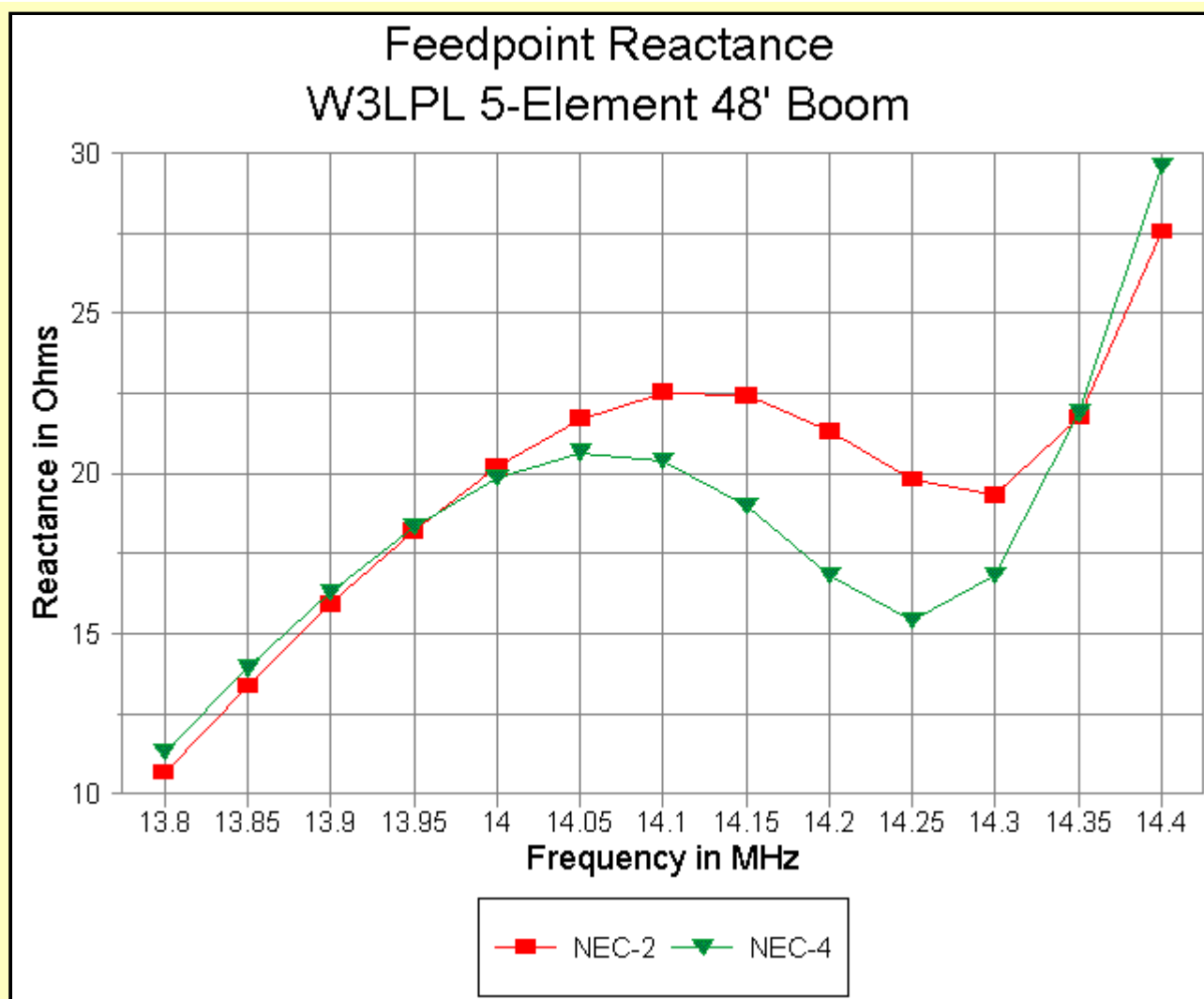


180-Degree Front-to-Back Ratio W3LPL 5-Element 48' Boom



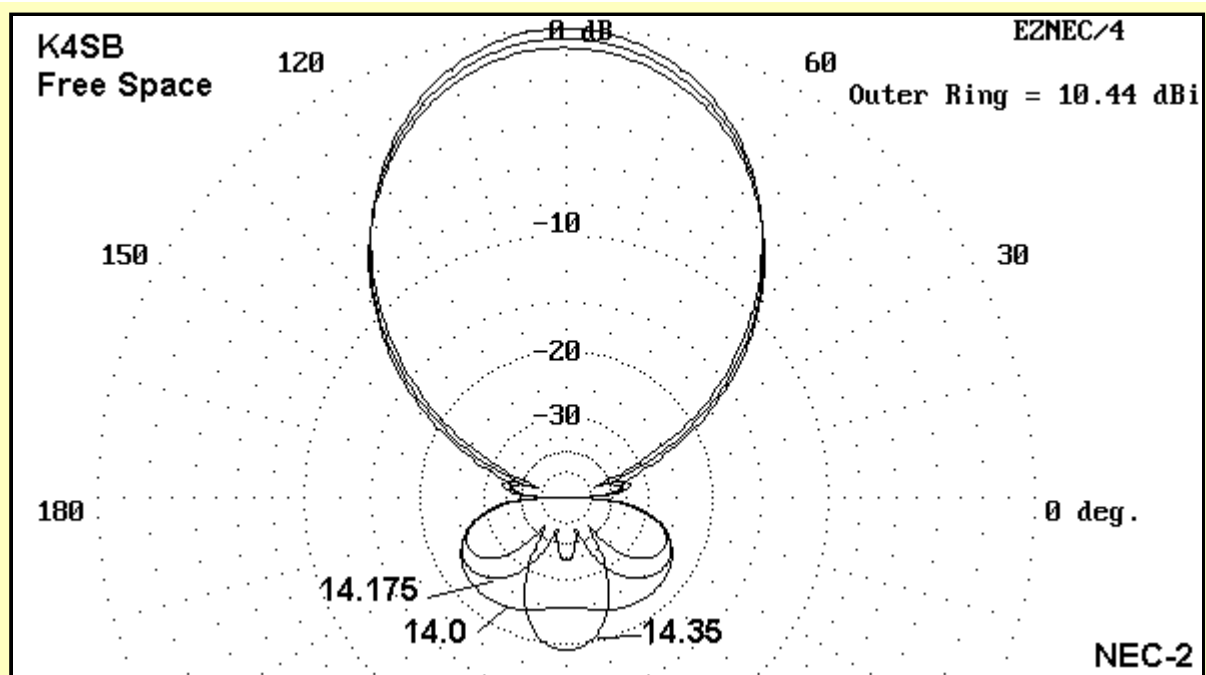
Feedpoint Resistance W3LPL 5-Element 48' Boom





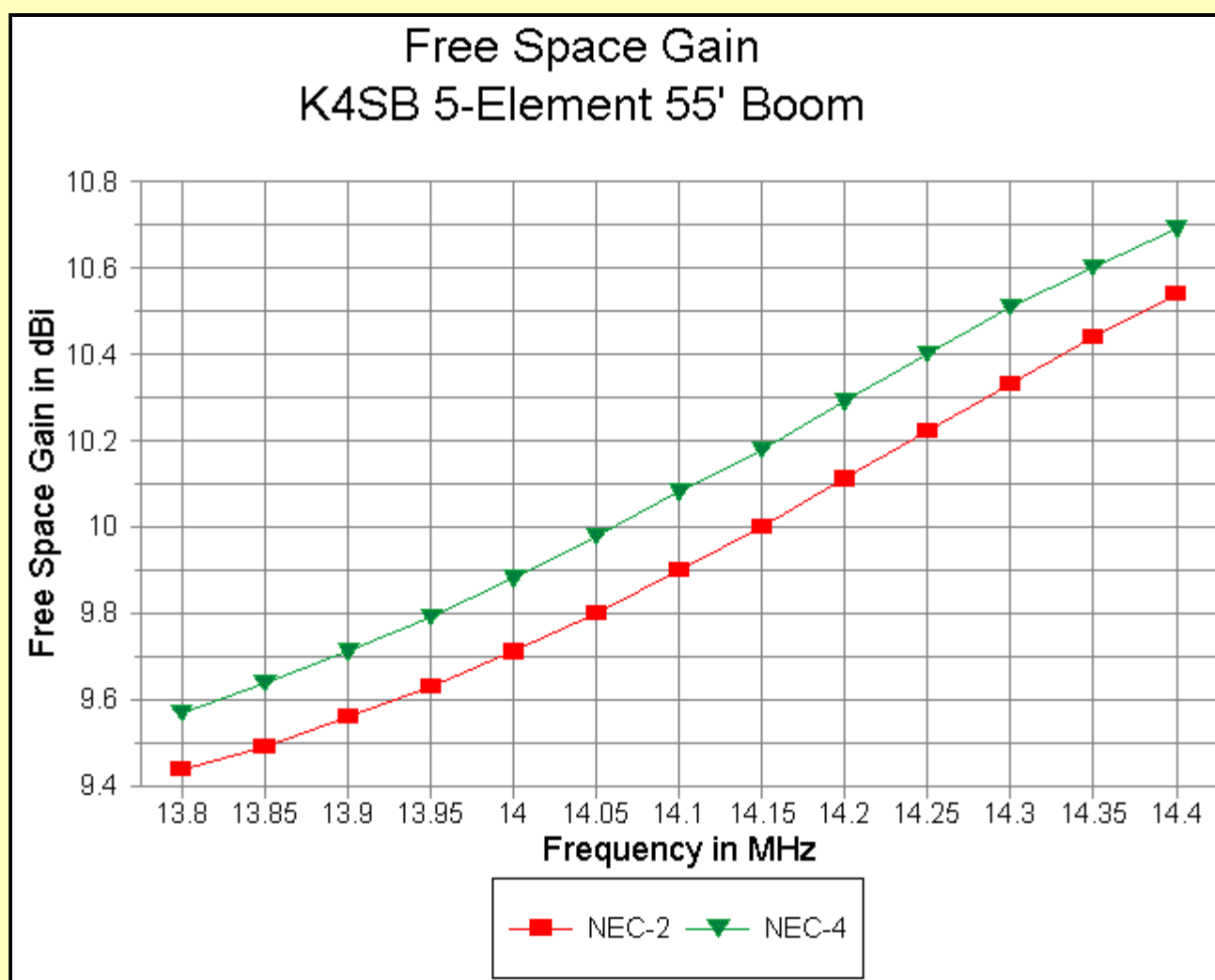
I have included the 50-Ohm SWR curve for the W3LPL antenna because it makes a good contrast with that of the W6GNZ antenna, even though the antenna designer specifically introduced the inductive reactance in the driver to set up conditions for a no-capacitor Tee match system for a 200-Ohm feed impedance. Shortening the driver to resonance in an attempt to reduce the SWR will result in a decrease in the resistive component so that no great improvement actually occurs. However, those wishing a direct 50-Ohm feed without a Tee match may wish to consider a beta match using a shunt capacitor, instead of the usual shunt inductor, which is applied when the driver element is capacitively reactive. A capacitor value of about 90 Ohms reactance (about 125 pF) with sufficient voltage and current handling capabilities would come close to serving the need.

The K4SB 5-element, 55' boom model

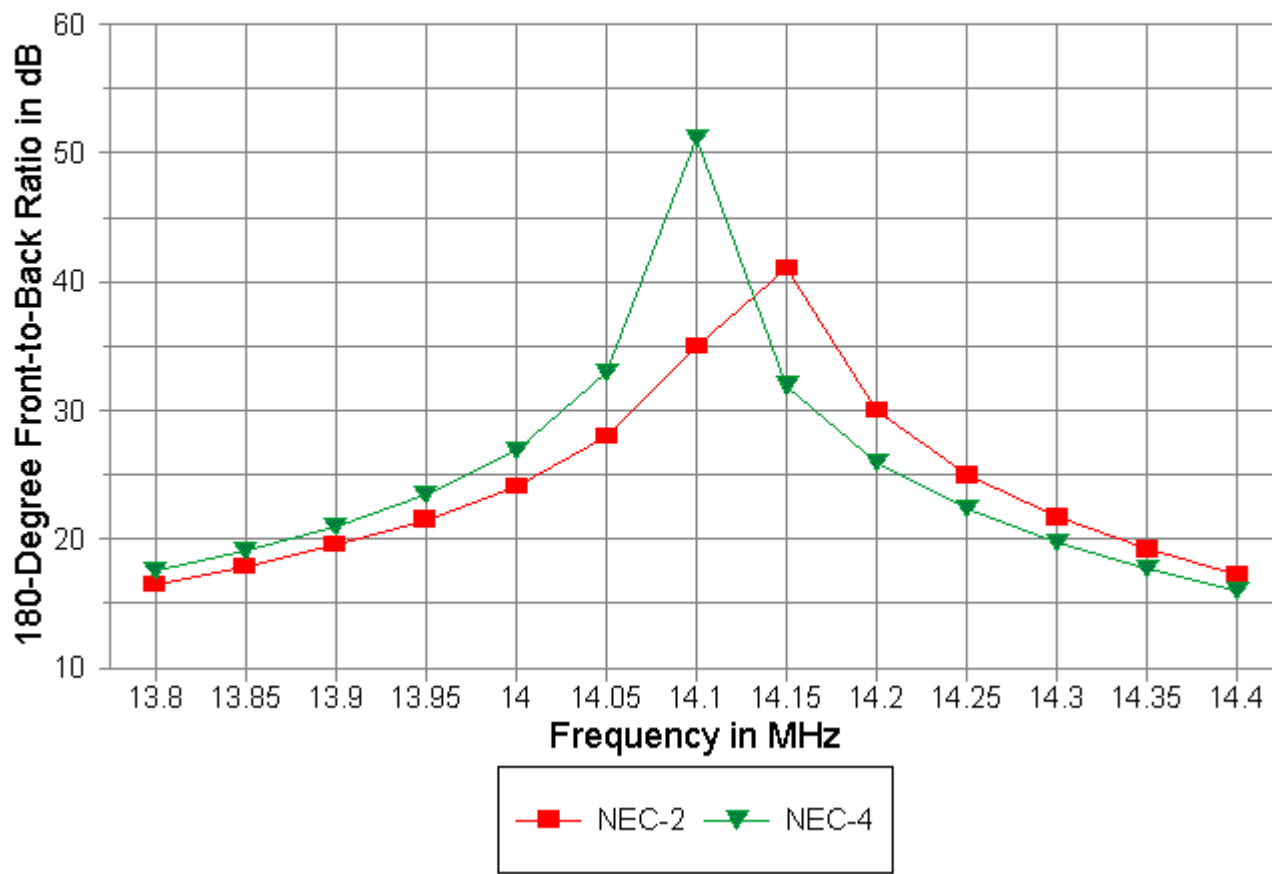


I received this model from K4SB (with whose permission it is used here) in simplified form, using monotapered elements on 10-meters. I frequency-scaled it to 20-meters and then assigned it an element taper schedule, readjusting the element lengths until it closely approximated the monotaper performance. The antenna shows the greatest gain and front-to-back differential across the band of all the models, and this exhibits the effects of using wide reflector spacing alone to raise the feedpoint impedance of the beam.

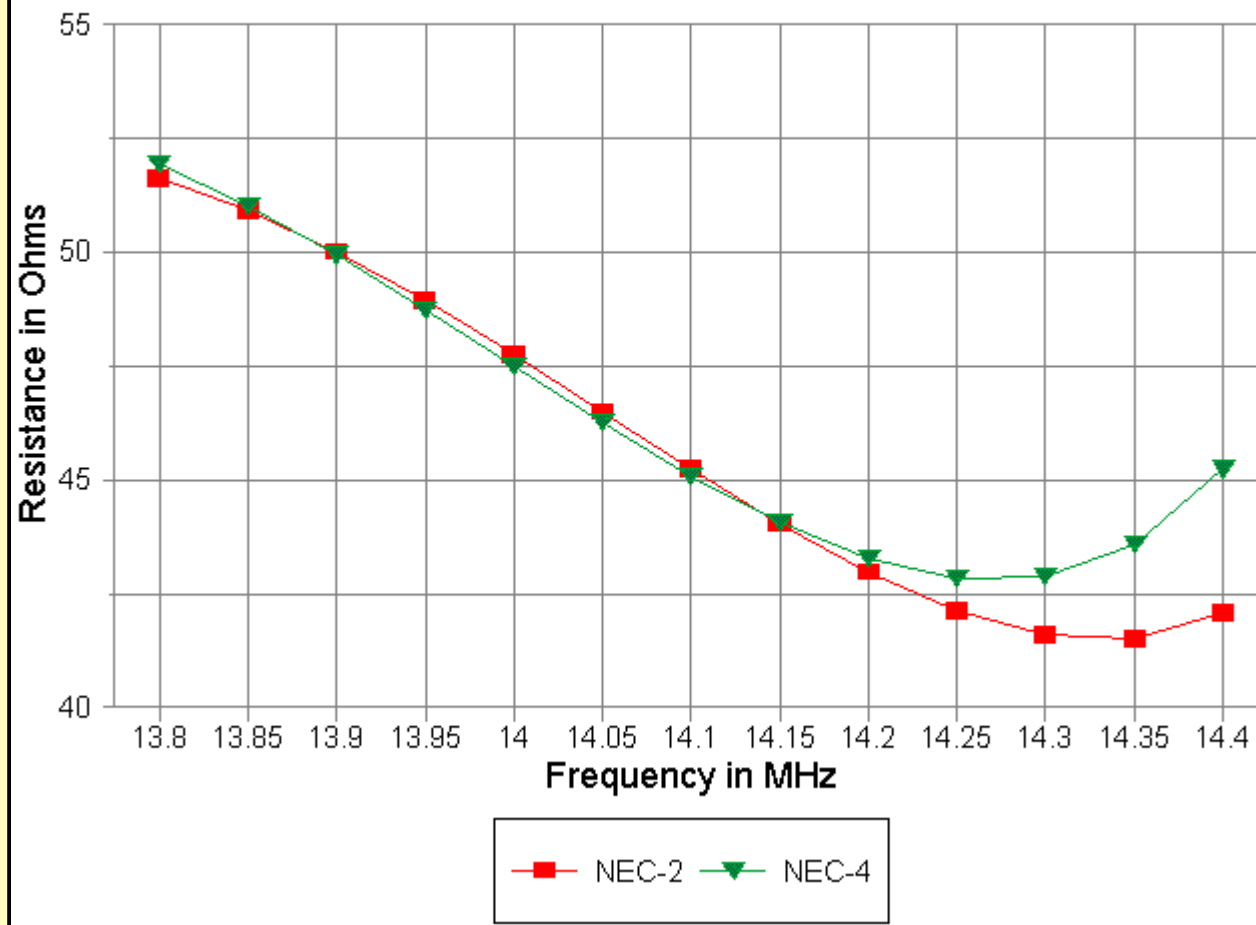
This beam is for me simply a modeling exercise and does not take into account any variations in building technique. It does not compensate for the effects of boom-to-element hardware. Considerable model tweaking would likely be required before construction.

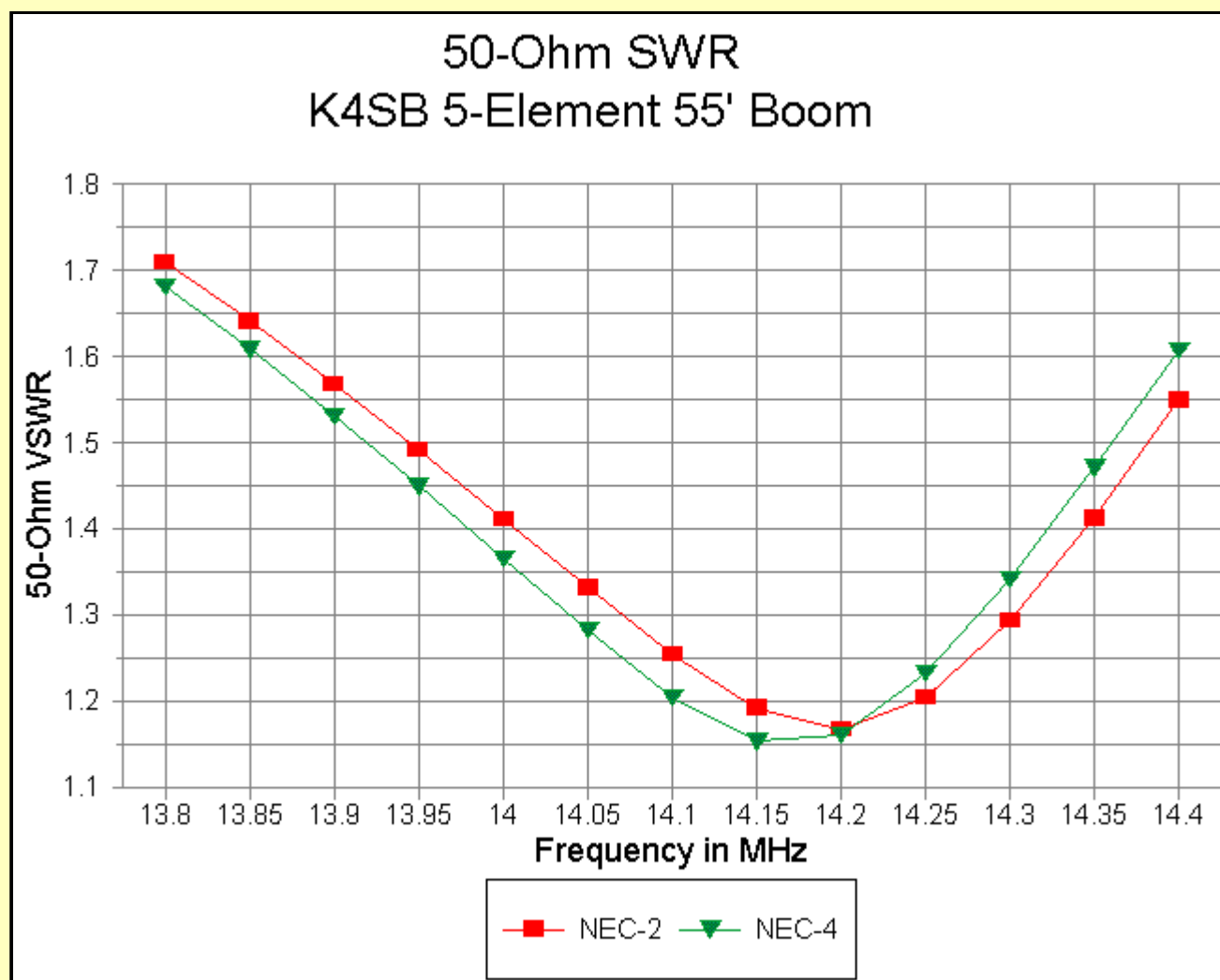
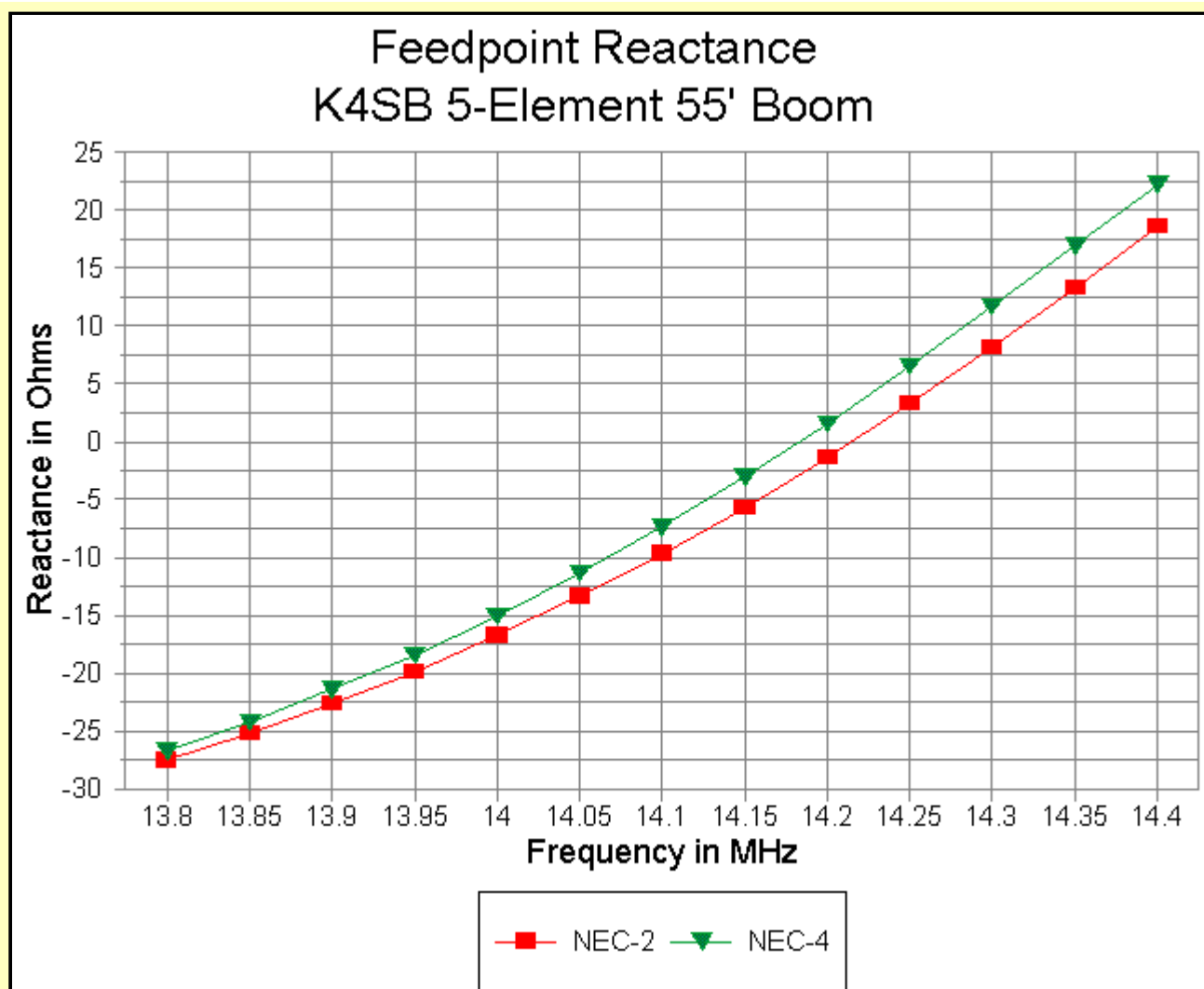


180-Degree Front-to-Back Ratio
K4SB 5-Element 55' Boom



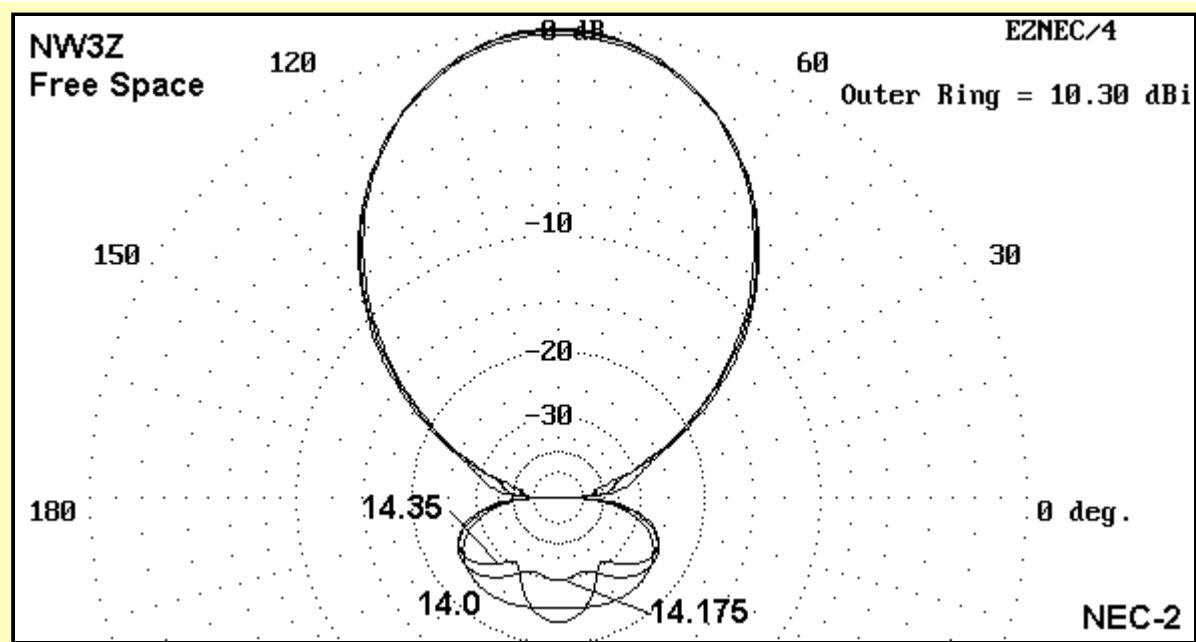
Feedpoint Resistance
K4SB 5-Element 55' Boom





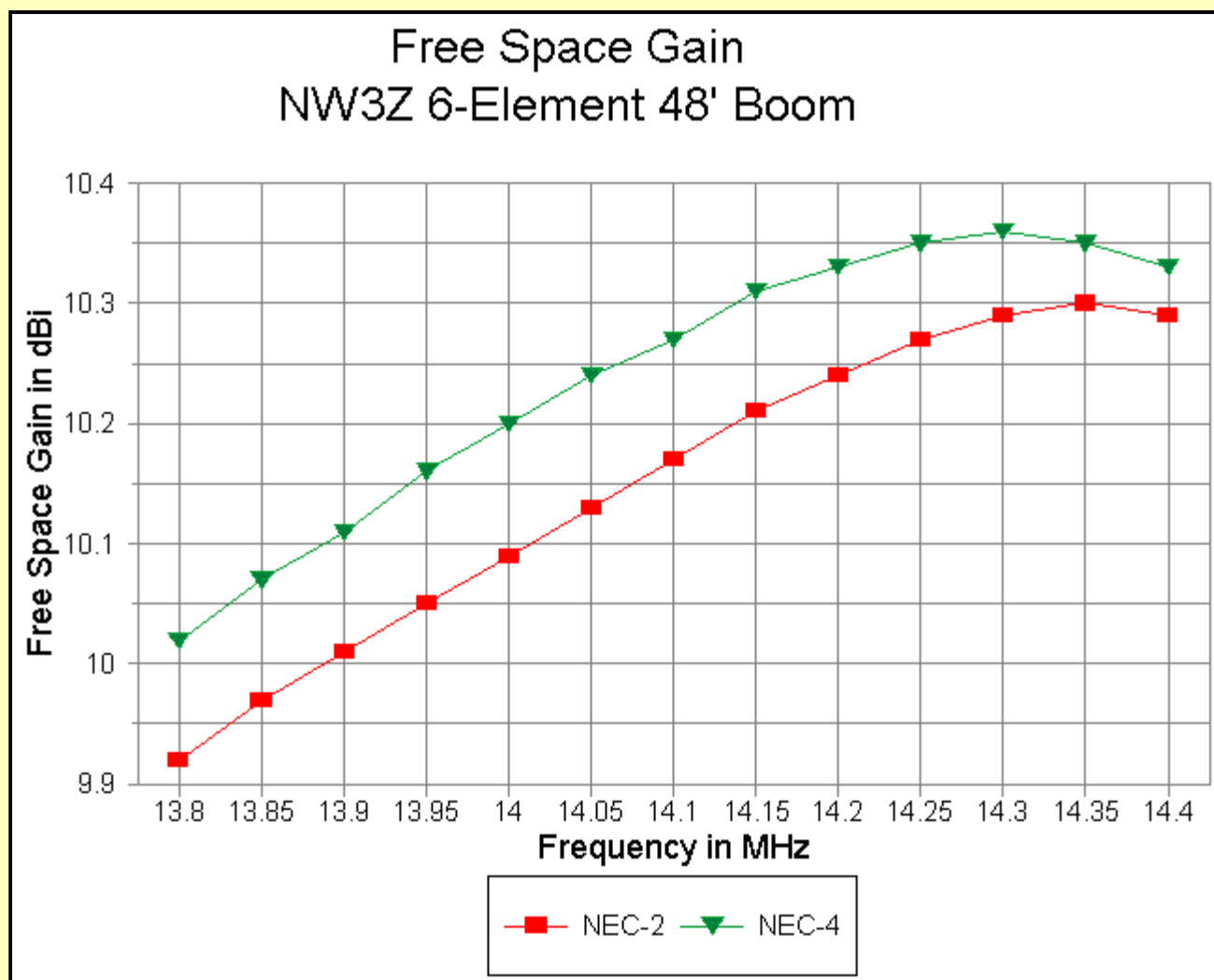
The SWR curve is quite good. There is a significant variation in reactance across the band, to go along with the variations in gain and front-to-back ratio, although the beam demonstrates close to the optimum of what may be achieved using reflector spacing alone to determine a 50-Ohm feedpoint match.

The NW3Z 6-element, 48' boom model

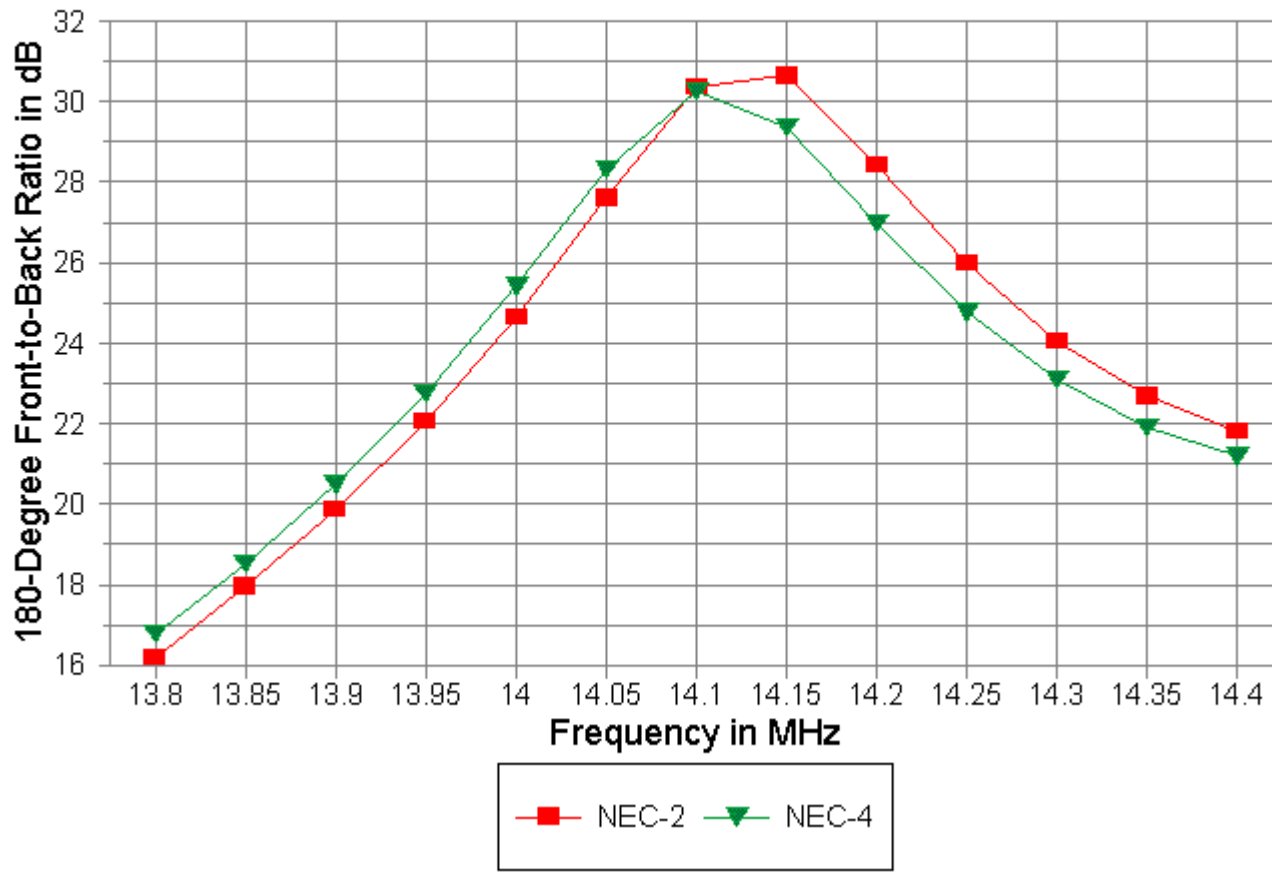


The NW3Z design adds a director close to the driven element. Along with the spacing of director D2 for impedance control and the spacing of the remaining directors for performance characteristics, this design provides a very tight near-50-Ohm feedpoint impedance with very little variation in other antenna performance characteristics across 20 meters. Indeed, everything remains stable for a little ways below the lower end of 20 meters.

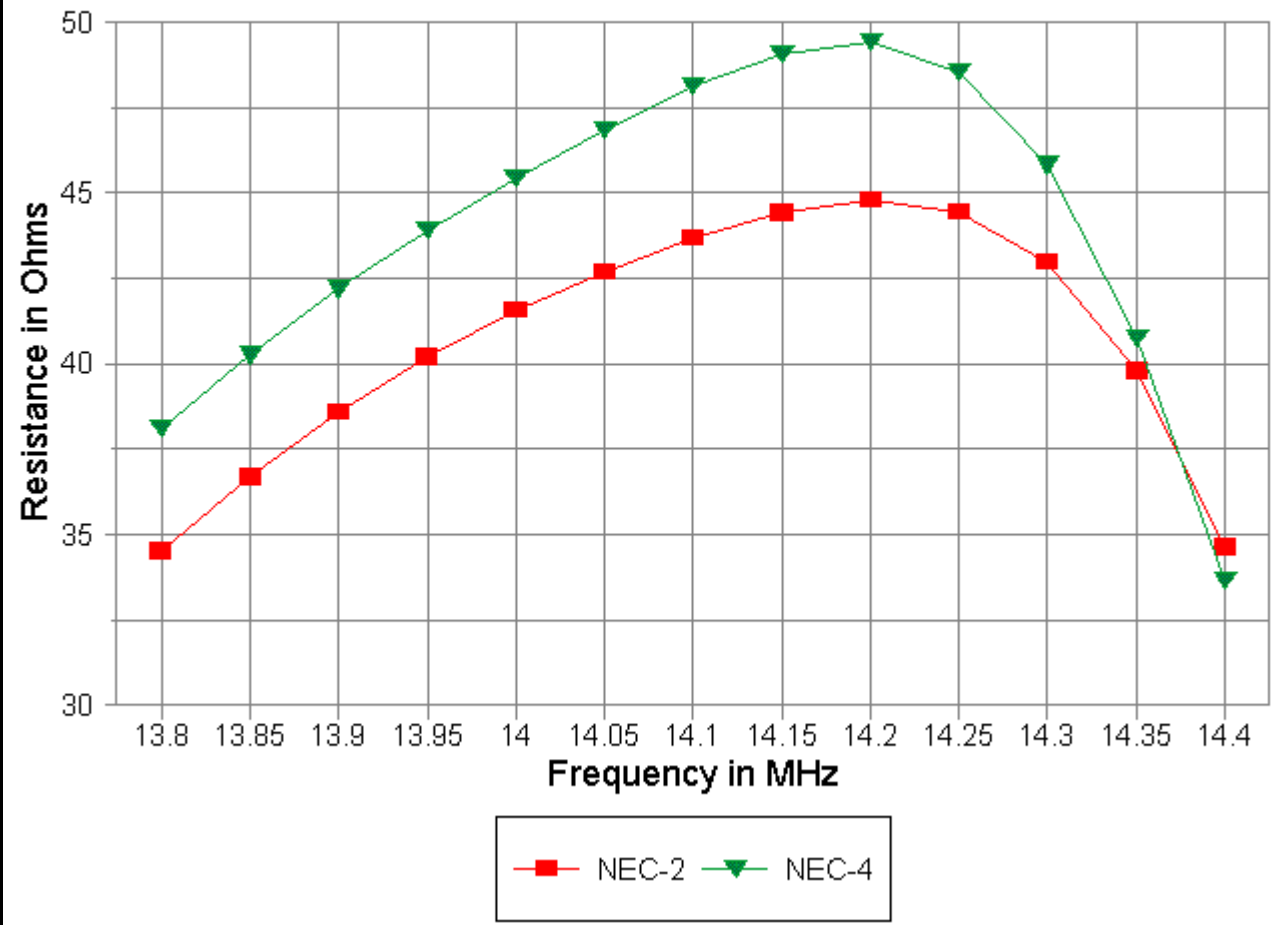
As with all other designs, NEC-4 tends to overestimate gain and move the performance characteristics lower in frequency relative to NEC-2 curves. Since this model uses a 96" constant diameter center section in each element, the effect is not too extreme, but still greater than for the W6NGZ design.

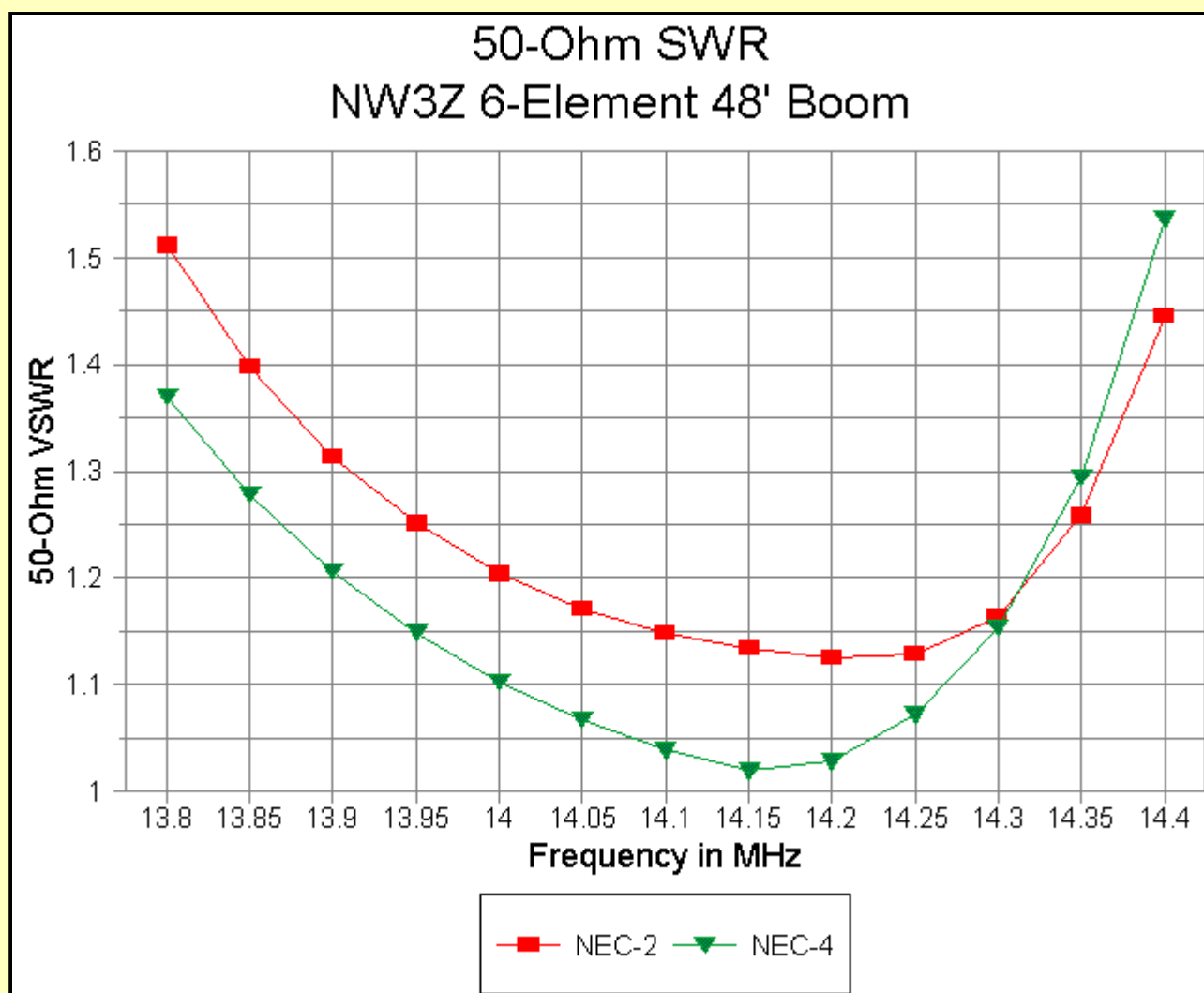
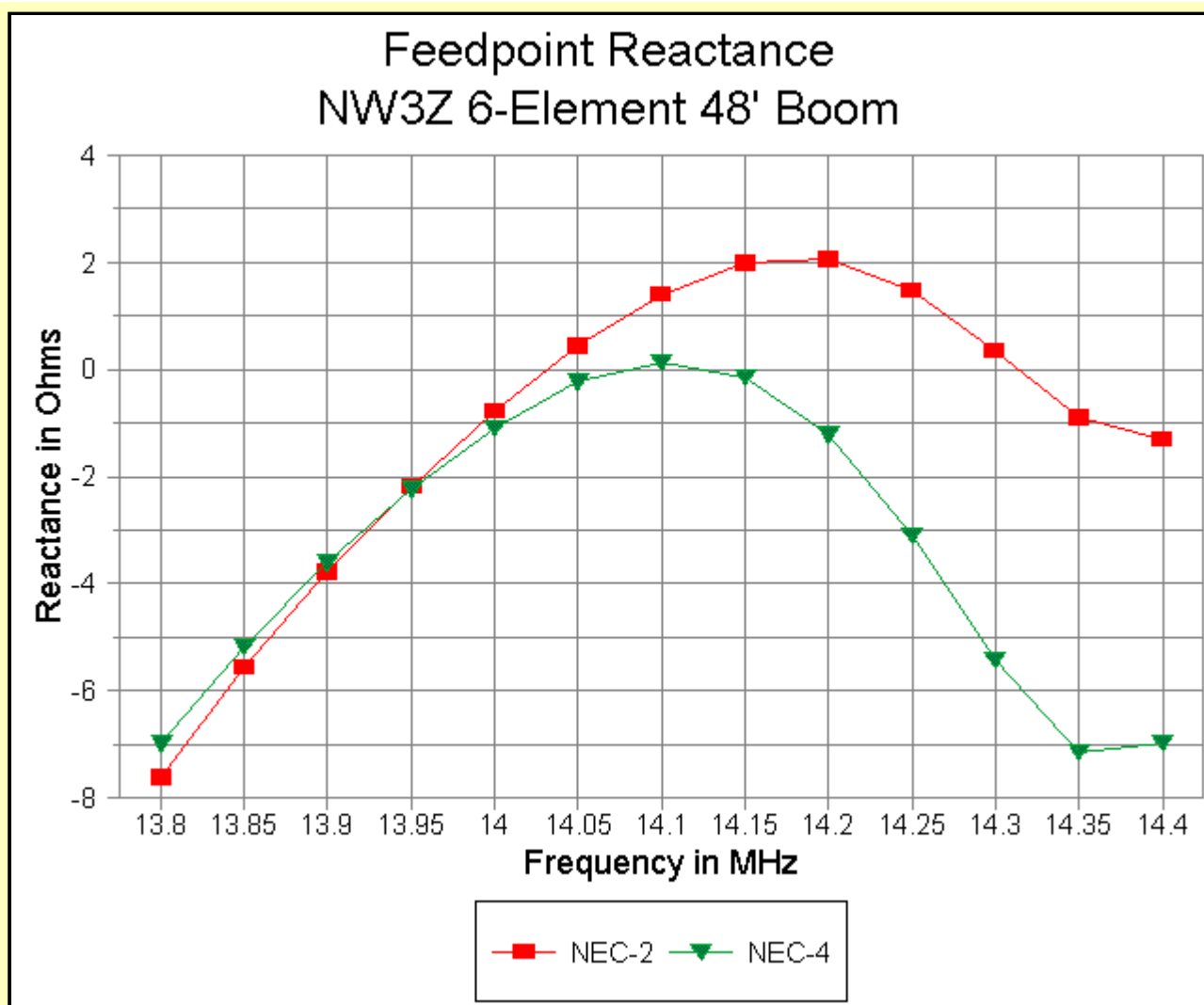


180-Degree Front-to-Back Ratio
NW3Z 6-Element 48' Boom



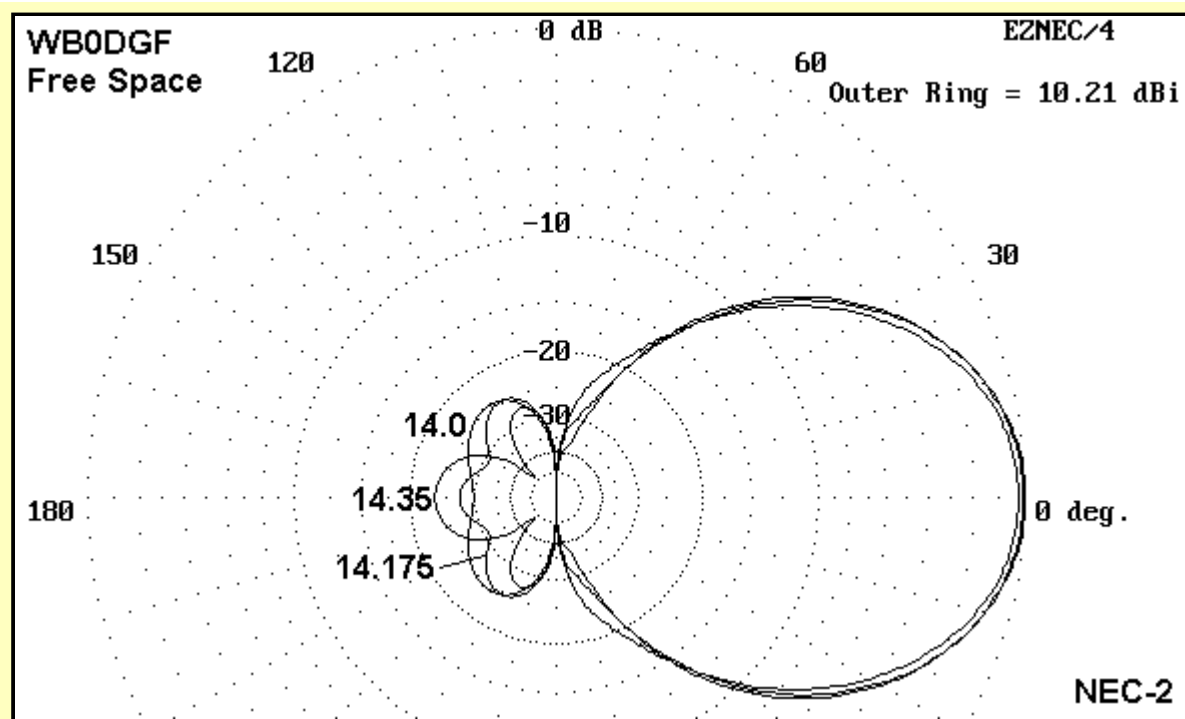
Feedpoint Resistance
NW3Z 6-Element 48' Boom





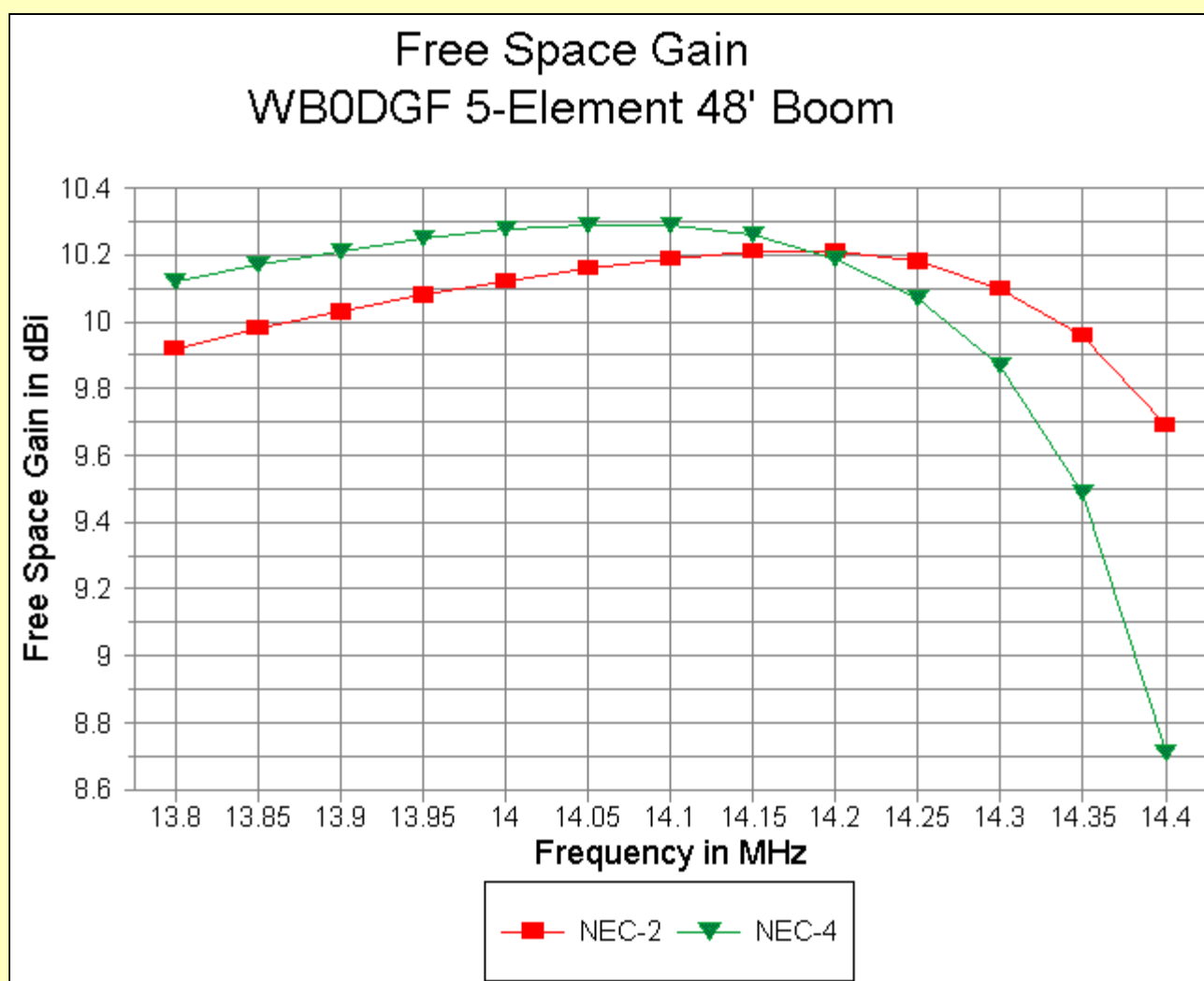
Beware of misreading the steep SWR curves: first read the axis values. Only then can you compare the numbers with those appearing in the other beam graphs.

The WB0DGF 5-element, 48' boom model

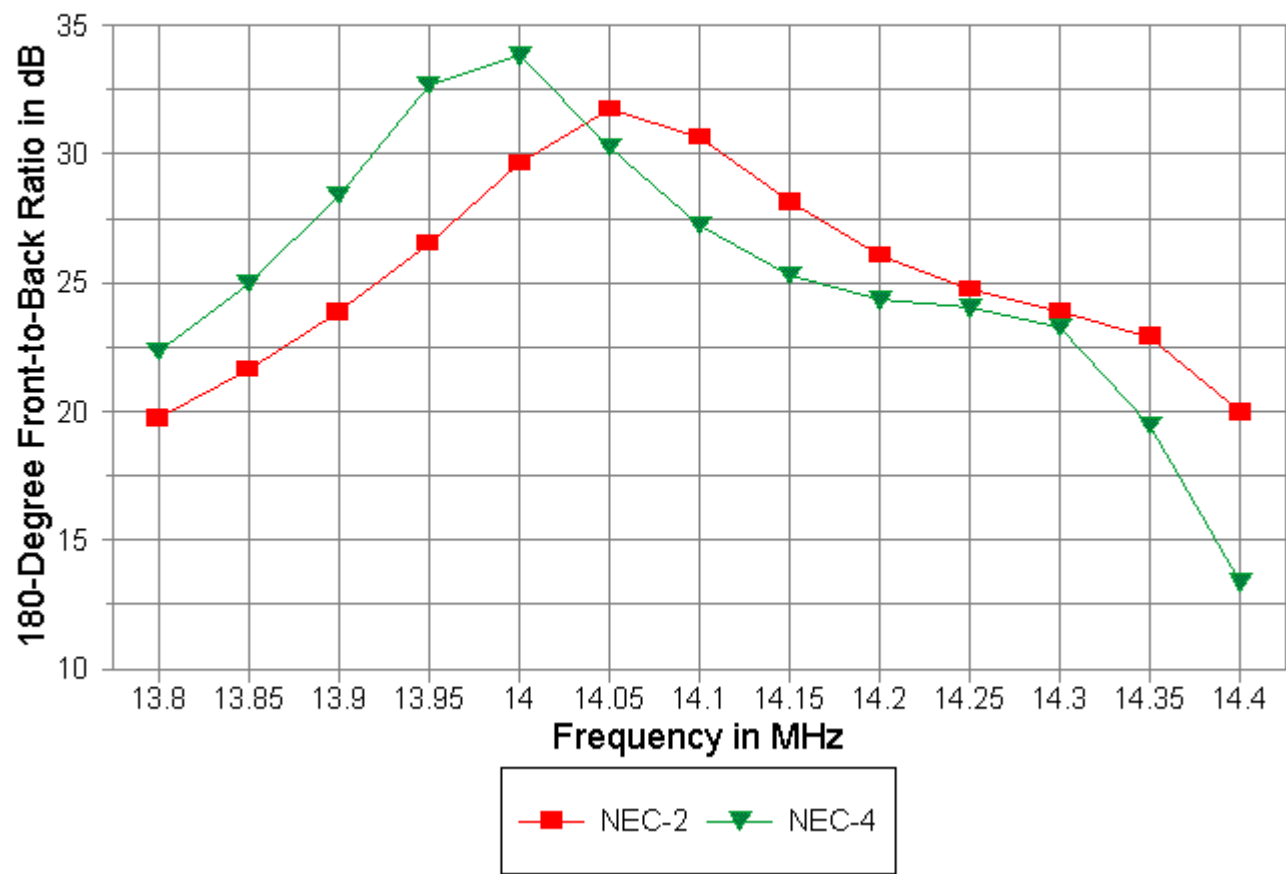


The WB0DGF design, provides an interesting contrast to both the K6STI and the NW3Z designs with respect to modeled properties. It contains center "bulge" sections that limit segment length to 8". However, these occur on only the parasitical elements. Moreover, the design uses a wider reflector spacing than some of the other designs. The result is a far less extreme overestimation of gain, but a significant shift in the NEC-4 curves lower in frequency than the NEC-2 curves. These phenomena are clear on all four of the graphs.

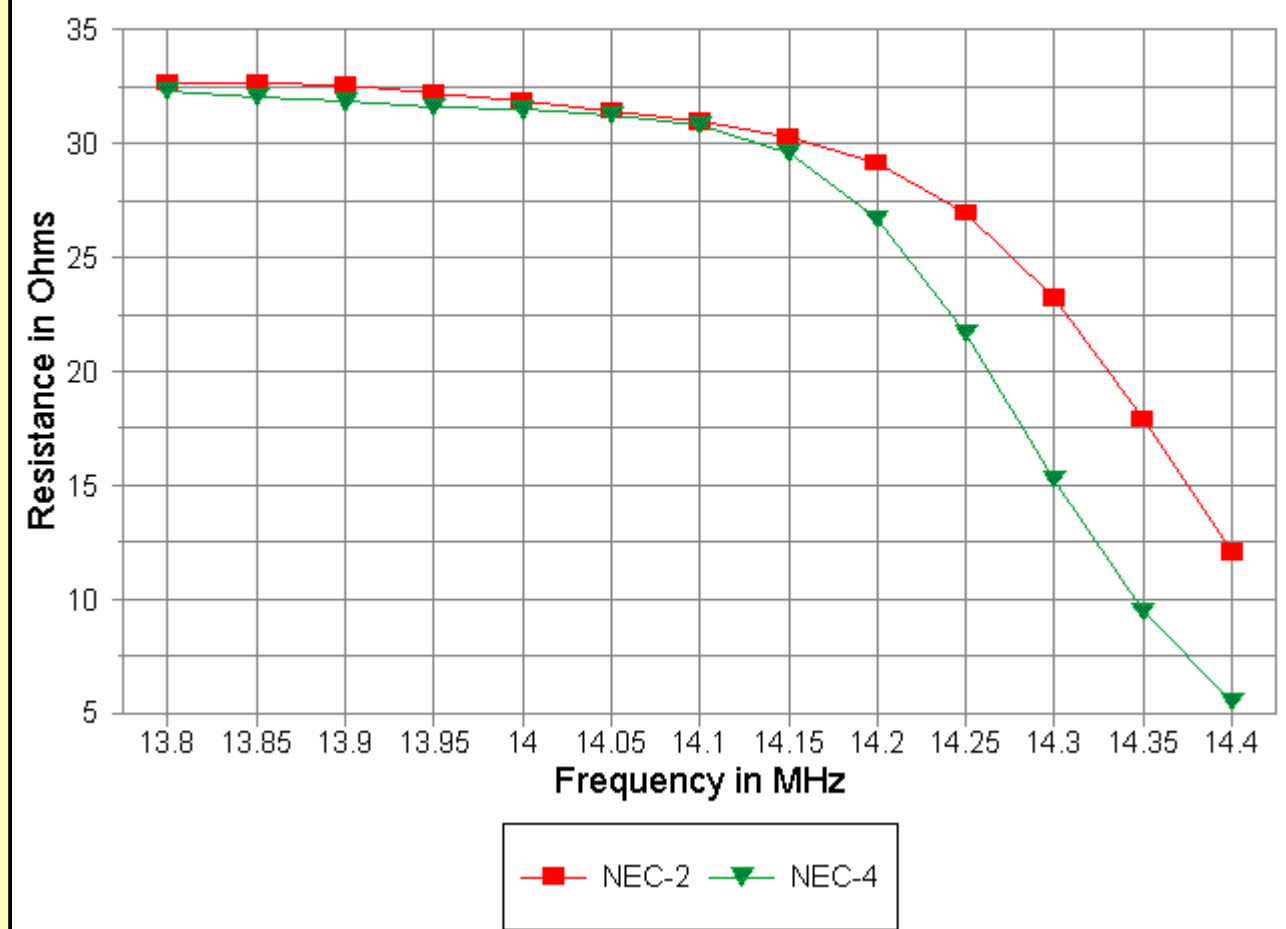
Since this antenna design was set up for potential use with a beta match system, no SWR curve is shown.

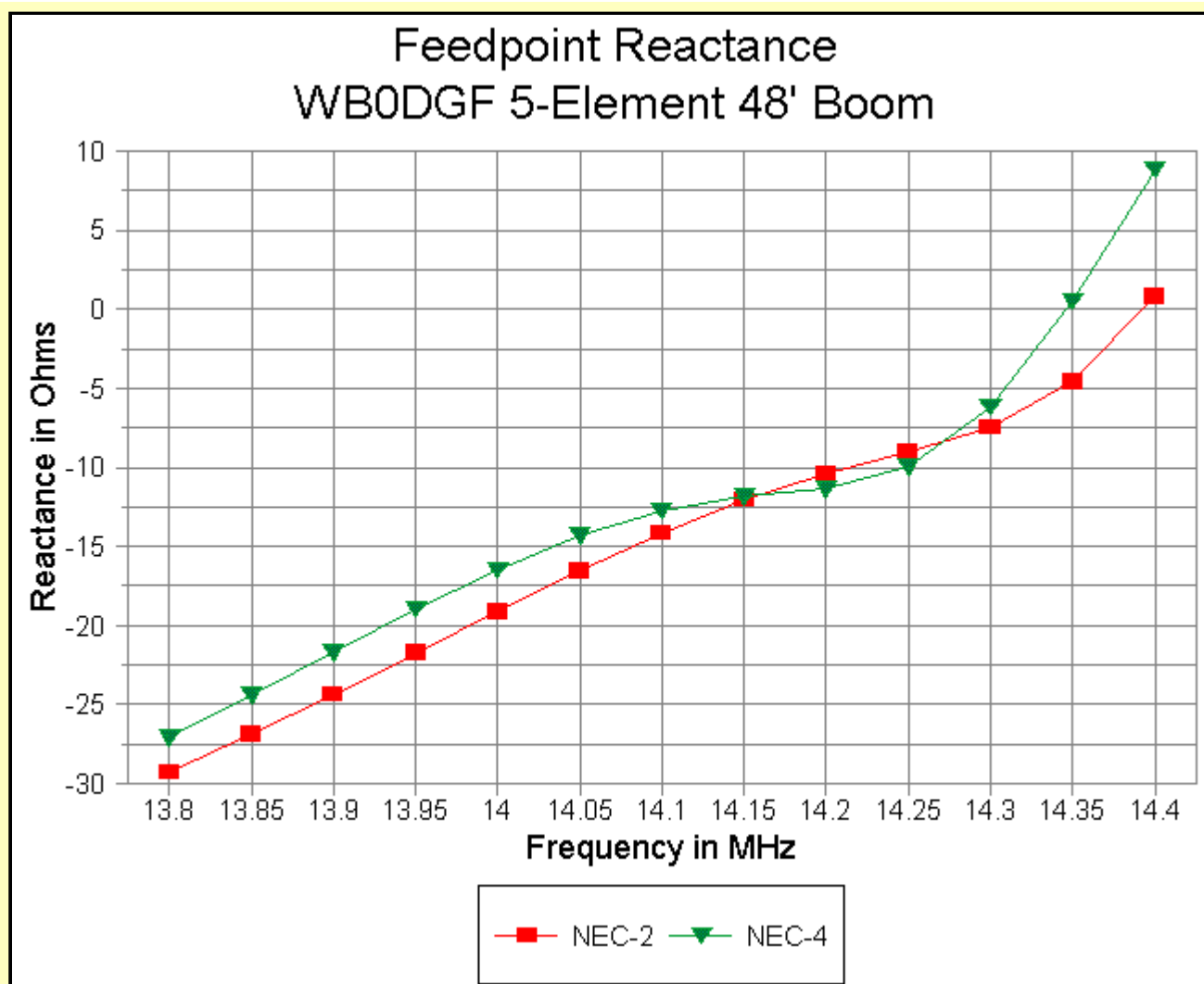


180-Degree Front-to-Back Ratio
WB0DGF 5-Element 48' Boom



Feedpoint Resistance
WB0DGF 5-Element 48' Boom





Conclusions

Because of the open questions left along the way, no evaluative assessment is warranted by this exercise alone. However, two reminders are in order.

1. The beams do reveal something of the broader aspects of large Yagi behavior in the means we use to design specific feedpoint impedances while retaining the highest levels of gain and front-to-back performance. Study of the spacing sketch alone (made more precise by the EZNEC Pro file descriptions appended to this note) may give some insight into future Yagi design directions. Yagi design innovations are far from exhausted.

2. Modeling comparisons are not to be undertaken lightly or hastily. Analyzing the foundations of received models as well as those inherent in one's own creations is a necessary step if models are to be compared against some set of design or analysis goals. It would have been very easy to see two of the designs above as simply inadequate to cover the entirety of 20 meters by looking solely at NEC-4 curves, when what is more likely at work is a frequency offset. Add to this the limitations of each core used to model the structures unambiguously, and the simple conjunction of models would become a disservice to understanding the antennas involved.

Within these handicaps, the comparison of some of the best of extant long-boom 20-meter Yagi design provides an interesting and potentially productive exercise. It can assist us in understanding both antenna design and antenna modeling just a little bit better.

EZNEC Wire Tables for the 5 Yagis

EZNEC/4 ver. 2.0

5L45' W6NGZ CQ 10-96 p 22

07-19-1998 07:44:08

Frequency = 14.175 MHz.

Wire Loss: Aluminum -- Resistivity = 4E-08 ohm-m, Rel. Perm. = 1

----- WIRES -----

Wire Conn. --- End 1 (x,y,z : in) Conn. --- End 2 (x,y,z : in) Dia(in) Segs

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1   -215.60, 0.000, 0.000 W2E1 -156.00, 0.000, 0.000 6.25E-01 5
2   W1E2 -156.00, 0.000, 0.000 W3E1 -120.00, 0.000, 0.000 7.50E-01 3
3   W2E2 -120.00, 0.000, 0.000 W4E1 -72.000, 0.000, 0.000 8.75E-01 4
4   W3E2 -72.000, 0.000, 0.000 W5E1 72.000, 0.000, 0.000 1.00E+00 13
5   W4E2 72.000, 0.000, 0.000 W6E1 120.000, 0.000, 0.000 8.75E-01 4
6   W5E2 120.000, 0.000, 0.000 W7E1 156.000, 0.000, 0.000 7.50E-01 3
7   W6E2 156.000, 0.000, 0.000 215.605, 0.000, 0.000 6.25E-01 5
8   -205.95, 79.800, 0.000 W9E1 -156.00, 79.800, 0.000 6.25E-01 4
9   W8E2 -156.00, 79.800, 0.000 W10E1 -120.00, 79.800, 0.000 7.50E-01 3
10  W9E2 -120.00, 79.800, 0.000 W11E1 -72.000, 79.800, 0.000 8.75E-01 4
11  W10E2 -72.000, 79.800, 0.000 W12E1 72.000, 79.800, 0.000 1.00E+00 13
12  W11E2 72.000, 79.800, 0.000 W13E1 120.000, 79.800, 0.000 8.75E-01 4
13  W12E2 120.000, 79.800, 0.000 W14E1 156.000, 79.800, 0.000 7.50E-01 3
14  W13E2 156.000, 79.800, 0.000 205.950, 79.800, 0.000 6.25E-01 4
15  -198.21,155.160, 0.000 W16E1 -156.00,155.160, 0.000 6.25E-01 4
16  W15E2 -156.00,155.160, 0.000 W17E1 -120.00,155.160, 0.000 7.50E-01 3
17  W16E2 -120.00,155.160, 0.000 W18E1 -72.000,155.160, 0.000 8.75E-01 4

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18 W17E2 -72.000,155.160, 0.000 W19E1 72.000,155.160, 0.000 1.00E+00 13
19 W18E2 72.000,155.160, 0.000 W20E1 120.000,155.160, 0.000 8.75E-01 4
20 W19E2 120.000,155.160, 0.000 W21E1 156.000,155.160, 0.000 7.50E-01 3
21 W20E2 156.000,155.160, 0.000 198.209,155.160, 0.000 6.25E-01 4
22 -196.55,337.920, 0.000 W23E1 -156.00,337.920, 0.000 6.25E-01 3
23 W22E2 -156.00,337.920, 0.000 W24E1 -120.00,337.920, 0.000 7.50E-01 3
24 W23E2 -120.00,337.920, 0.000 W25E1 -72.000,337.920, 0.000 8.75E-01 4
25 W24E2 -72.000,337.920, 0.000 W26E1 72.000,337.920, 0.000 1.00E+00 13
26 W25E2 72.000,337.920, 0.000 W27E1 120.000,337.920, 0.000 8.75E-01 4
27 W26E2 120.000,337.920, 0.000 W28E1 156.000,337.920, 0.000 7.50E-01 3
28 W27E2 156.000,337.920, 0.000 196.548,337.920, 0.000 6.25E-01 3
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30 W29E2 -156.00,530.400, 0.000 W31E1 -120.00,530.400, 0.000 7.50E-01 3
31 W30E2 -120.00,530.400, 0.000 W32E1 -72.000,530.400, 0.000 8.75E-01 4
32 W31E2 -72.000,530.400, 0.000 W33E1 72.000,530.400, 0.000 1.00E+00 13
33 W32E2 72.000,530.400, 0.000 W34E1 120.000,530.400, 0.000 8.75E-01 3
34 W33E2 120.000,530.400, 0.000 W35E1 156.000,530.400, 0.000 7.50E-01 3
35 W34E2 156.000,530.400, 0.000 189.900,530.400, 0.000 6.25E-01 4

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----- SOURCES -----

Source	Wire Seg.	Wire #/Pct Actual (Specified)	From End 1	Ampl.(V, A)	Phase(Deg.)	Type
1	7	11 / 50.00 (11 / 50.00)	1.000	0.000	I	

No loads specified

No transmission lines specified

Ground type is Free Space

EZNEC/4 ver. 2.0

5L48' K6STI YA 07-19-1998 07:44:45

Frequency = 14.175 MHz.

Wire Loss: Aluminum -- Resistivity = 4E-08 ohm-m, Rel. Perm. = 1

----- WIRES -----

Wire Conn.	--- End 1 (x,y,z : in)	Conn.	--- End 2 (x,y,z : in)	Dia(in)	Segs
1	-216.50, 0.000, 0.000	W2E1	-138.00, 0.000, 0.000	5.00E-01	10
2	W1E2 -138.00, 0.000, 0.000	W3E1	-96.000, 0.000, 0.000	6.25E-01	6
3	W2E2 -96.000, 0.000, 0.000	W4E1	-48.000, 0.000, 0.000	7.50E-01	6
4	W3E2 -48.000, 0.000, 0.000	W5E1	-4.000, 0.000, 0.000	8.75E-01	5
5	W4E2 -4.000, 0.000, 0.000	W6E1	4.000, 0.000, 0.000	3.42E+00	1
6	W5E2 4.000, 0.000, 0.000	W7E1	48.000, 0.000, 0.000	8.75E-01	5
7	W6E2 48.000, 0.000, 0.000	W8E1	96.000, 0.000, 0.000	7.50E-01	6
8	W7E2 96.000, 0.000, 0.000	W9E1	138.000, 0.000, 0.000	6.25E-01	6
9	W8E2 138.000, 0.000, 0.000		216.500, 0.000, 0.000	5.00E-01	10
10	-203.50, 72.000, 0.000	W11E1	-138.00, 72.000, 0.000	5.00E-01	8
11	W10E2 -138.00, 72.000, 0.000	W12E1	-96.000, 72.000, 0.000	6.25E-01	6
12	W11E2 -96.000, 72.000, 0.000	W13E1	-48.000, 72.000, 0.000	7.50E-01	6
13	W12E2 -48.000, 72.000, 0.000	W14E1	-4.000, 72.000, 0.000	8.75E-01	5
14	W13E2 -4.000, 72.000, 0.000	W15E1	4.000, 72.000, 0.000	3.42E+00	1
15	W14E2 4.000, 72.000, 0.000	W16E1	48.000, 72.000, 0.000	8.75E-01	5
16	W15E2 48.000, 72.000, 0.000	W17E1	96.000, 72.000, 0.000	7.50E-01	6
17	W16E2 96.000, 72.000, 0.000	W18E1	138.000, 72.000, 0.000	6.25E-01	6
18	W17E2 138.000, 72.000, 0.000		203.500, 72.000, 0.000	5.00E-01	8
19	-201.75,160.000, 0.000	W20E1	-138.00,160.000, 0.000	5.00E-01	8
20	W19E2 -138.00,160.000, 0.000	W21E1	-96.000,160.000, 0.000	6.25E-01	6
21	W20E2 -96.000,160.000, 0.000	W22E1	-48.000,160.000, 0.000	7.50E-01	6
22	W21E2 -48.000,160.000, 0.000	W23E1	-4.000,160.000, 0.000	8.75E-01	5
23	W22E2 -4.000,160.000, 0.000	W24E1	4.000,160.000, 0.000	3.42E+00	1
24	W23E2 4.000,160.000, 0.000	W25E1	48.000,160.000, 0.000	8.75E-01	5
25	W24E2 48.000,160.000, 0.000	W26E1	96.000,160.000, 0.000	7.50E-01	6
26	W25E2 96.000,160.000, 0.000	W27E1	138.000,160.000, 0.000	6.25E-01	6
27	W26E2 138.000,160.000, 0.000		201.750,160.000, 0.000	5.00E-01	8
28	-198.88,359.000, 0.000	W29E1	-138.00,359.000, 0.000	5.00E-01	8
29	W28E2 -138.00,359.000, 0.000	W30E1	-96.000,359.000, 0.000	6.25E-01	5
30	W29E2 -96.000,359.000, 0.000	W31E1	-48.000,359.000, 0.000	7.50E-01	6
31	W30E2 -48.000,359.000, 0.000	W32E1	-4.000,359.000, 0.000	8.75E-01	6
32	W31E2 -4.000,359.000, 0.000	W33E1	4.000,359.000, 0.000	3.42E+00	1
33	W32E2 4.000,359.000, 0.000	W34E1	48.000,359.000, 0.000	8.75E-01	6
34	W33E2 48.000,359.000, 0.000	W35E1	96.000,359.000, 0.000	7.50E-01	6
35	W34E2 96.000,359.000, 0.000	W36E1	138.000,359.000, 0.000	6.25E-01	5
36	W35E2 138.000,359.000, 0.000		198.875,359.000, 0.000	5.00E-01	8
37	-191.62,570.000, 0.000	W38E1	-138.00,570.000, 0.000	5.00E-01	7

38 W37E2 -138.00,570.000, 0.000 W39E1 -96.000,570.000, 0.000 6.25E-01 5
 39 W38E2 -96.000,570.000, 0.000 W40E1 -48.000,570.000, 0.000 7.50E-01 6
 40 W39E2 -48.000,570.000, 0.000 W41E1 -4.000,570.000, 0.000 8.75E-01 6
 41 W40E2 -4.000,570.000, 0.000 W42E1 4.000,570.000, 0.000 3.42E+00 1
 42 W41E2 4.000,570.000, 0.000 W43E1 48.000,570.000, 0.000 8.75E-01 6
 43 W42E2 48.000,570.000, 0.000 W44E1 96.000,570.000, 0.000 7.50E-01 6
 44 W43E2 96.000,570.000, 0.000 W45E1 138.000,570.000, 0.000 6.25E-01 5
 45 W44E2 138.000,570.000, 0.000 191.625,570.000, 0.000 5.00E-01 7

----- SOURCES -----

Source	Wire	Wire #/Pct From End 1	Ampl.(V, A)	Phase(Deg.)	Type
Seg.	Actual	(Specified)			
1	1	14 / 50.00 (14 / 50.00)	1.000 0.000	V	

No loads specified

No transmission lines specified

Ground type is Free Space

EZNEC/4 ver. 2.0

5L48' W3LPL WWW 07-19-1998 07:45:37

Frequency = 14.175 MHz.

Wire Loss: Aluminum -- Resistivity = 4E-08 ohm-m, Rel. Perm. = 1

----- WIRES -----

Wire Conn. --- End 1 (x,y,z : in) Conn. --- End 2 (x,y,z : in) Dia(in) Segs

1 -217.00, 0.000, 0.000 W2E1 -150.00, 0.000, 0.000 7.50E-01 8
 2 W1E2 -150.00, 0.000, 0.000 W3E1 -117.00, 0.000, 0.000 8.75E-01 4
 3 W2E2 -117.00, 0.000, 0.000 W4E1 -84.000, 0.000, 0.000 1.00E+00 4
 4 W3E2 -84.000, 0.000, 0.000 W5E1 -33.750, 0.000, 0.000 1.12E+00 6
 5 W4E2 -33.750, 0.000, 0.000 W6E1 33.750, 0.000, 0.000 1.25E+00 9
 6 W5E2 33.750, 0.000, 0.000 W7E1 84.000, 0.000, 0.000 1.12E+00 6
 7 W6E2 84.000, 0.000, 0.000 W8E1 117.000, 0.000, 0.000 1.00E+00 4
 8 W7E2 117.000, 0.000, 0.000 W9E1 150.000, 0.000, 0.000 8.75E-01 4
 9 W8E2 150.000, 0.000, 0.000 217.000, 0.000, 0.000 7.50E-01 8
 10 -212.00, 86.000, 0.000 W11E1 -150.00, 86.000, 0.000 7.50E-01 8
 11 W10E2 -150.00, 86.000, 0.000 W12E1 -117.00, 86.000, 0.000 8.75E-01 4
 12 W11E2 -117.00, 86.000, 0.000 W13E1 -84.000, 86.000, 0.000 1.00E+00 4
 13 W12E2 -84.000, 86.000, 0.000 W14E1 -33.750, 86.000, 0.000 1.12E+00 6
 14 W13E2 -33.750, 86.000, 0.000 W15E1 33.750, 86.000, 0.000 1.25E+00 9
 15 W14E2 33.750, 86.000, 0.000 W16E1 84.000, 86.000, 0.000 1.12E+00 6
 16 W15E2 84.000, 86.000, 0.000 W17E1 117.000, 86.000, 0.000 1.00E+00 4
 17 W16E2 117.000, 86.000, 0.000 W18E1 150.000, 86.000, 0.000 8.75E-01 4
 18 W17E2 150.000, 86.000, 0.000 212.000, 86.000, 0.000 7.50E-01 8
 19 -199.38,171.000, 0.000 W20E1 -135.88,171.000, 0.000 7.50E-01 8
 20 W19E2 -135.88,171.000, 0.000 W21E1 -102.88,171.000, 0.000 8.75E-01 4
 21 W20E2 -102.88,171.000, 0.000 W22E1 -69.875,171.000, 0.000 1.00E+00 4
 22 W21E2 -69.875,171.000, 0.000 W23E1 -22.000,171.000, 0.000 1.12E+00 6
 23 W22E2 -22.000,171.000, 0.000 W24E1 22.000,171.000, 0.000 1.25E+00 5
 24 W23E2 22.000,171.000, 0.000 W25E1 69.875,171.000, 0.000 1.12E+00 6
 25 W24E2 69.875,171.000, 0.000 W26E1 102.875,171.000, 0.000 1.00E+00 4
 26 W25E2 102.875,171.000, 0.000 W27E1 135.875,171.000, 0.000 8.75E-01 4
 27 W26E2 135.875,171.000, 0.000 199.380,171.000, 0.000 7.50E-01 8
 28 -196.25,349.000, 0.000 W29E1 -119.25,349.000, 0.000 7.50E-01 10
 29 W28E2 -119.25,349.000, 0.000 W30E1 -86.250,349.000, 0.000 8.75E-01 4
 30 W29E2 -86.250,349.000, 0.000 W31E1 -53.250,349.000, 0.000 1.00E+00 4
 31 W30E2 -53.250,349.000, 0.000 W32E1 -22.000,349.000, 0.000 1.12E+00 4
 32 W31E2 -22.000,349.000, 0.000 W33E1 22.000,349.000, 0.000 1.25E+00 5
 33 W32E2 22.000,349.000, 0.000 W34E1 53.250,349.000, 0.000 1.12E+00 4
 34 W33E2 53.250,349.000, 0.000 W35E1 86.250,349.000, 0.000 1.00E+00 4
 35 W34E2 86.250,349.000, 0.000 W36E1 119.250,349.000, 0.000 8.75E-01 4
 36 W35E2 119.250,349.000, 0.000 196.250,349.000, 0.000 7.50E-01 10
 37 -183.75,570.000, 0.000 W38E1 -131.75,570.000, 0.000 7.50E-01 7
 38 W37E2 -131.75,570.000, 0.000 W39E1 -98.750,570.000, 0.000 8.75E-01 4
 39 W38E2 -98.750,570.000, 0.000 W40E1 -65.750,570.000, 0.000 1.00E+00 4
 40 W39E2 -65.750,570.000, 0.000 W41E1 -22.000,570.000, 0.000 1.12E+00 5
 41 W40E2 -22.000,570.000, 0.000 W42E1 22.000,570.000, 0.000 1.25E+00 5
 42 W41E2 22.000,570.000, 0.000 W43E1 65.750,570.000, 0.000 1.12E+00 5
 43 W42E2 65.750,570.000, 0.000 W44E1 98.750,570.000, 0.000 1.00E+00 4
 44 W43E2 98.750,570.000, 0.000 W45E1 131.750,570.000, 0.000 8.75E-01 4
 45 W44E2 131.750,570.000, 0.000 183.750,570.000, 0.000 7.50E-01 7

----- SOURCES -----

Source Wire Wire #/Pct From End 1 Ampl.(V, A) Phase(Deg.) Type
Seg. Actual (Specified)

1 5 14 / 50.00 (14 / 50.00) 1.000 0.000 V

No loads specified

No transmission lines specified

Ground type is Free Space

EZNEC/4 ver. 2.0

K4SB 5-element, 55' boom 07-19-1998 07:46:17

Frequency = 14.175 MHz.

Wire Loss: Aluminum -- Resistivity = 4E-08 ohm-m, Rel. Perm. = 1

----- WIRES -----

Wire Conn. --- End 1 (x,y,z : in) Conn. --- End 2 (x,y,z : in) Dia(in) Segs

1 -217.00, 0.000, 0.000 W2E1 -152.00, 0.000, 0.000 5.00E-01 7
2 W1E2 -152.00, 0.000, 0.000 W3E1 -116.00, 0.000, 0.000 6.25E-01 4
3 W2E2 -116.00, 0.000, 0.000 W4E1 -72.000, 0.000, 0.000 7.50E-01 4
4 W3E2 -72.000, 0.000, 0.000 W5E1 -48.000, 0.000, 0.000 8.75E-01 2
5 W4E2 -48.000, 0.000, 0.000 W6E1 48.000, 0.000, 0.000 1.00E+00 9
6 W5E2 48.000, 0.000, 0.000 W7E1 72.000, 0.000, 0.000 8.75E-01 2
7 W6E2 72.000, 0.000, 0.000 W8E1 116.000, 0.000, 0.000 7.50E-01 4
8 W7E2 116.000, 0.000, 0.000 W9E1 152.000, 0.000, 0.000 6.25E-01 4
9 W8E2 152.000, 0.000, 0.000 217.000, 0.000, 0.000 5.00E-01 7
10 -207.50,182.504, 0.000 W11E1 -152.00,182.504, 0.000 5.00E-01 6
11 W10E2 -152.00,182.504, 0.000 W12E1 -116.00,182.504, 0.000 6.25E-01 4
12 W11E2 -116.00,182.504, 0.000 W13E1 -72.000,182.504, 0.000 7.50E-01 4
13 W12E2 -72.000,182.504, 0.000 W14E1 -48.000,182.504, 0.000 8.75E-01 2
14 W13E2 -48.000,182.504, 0.000 W15E1 48.000,182.504, 0.000 1.00E+00 9
15 W14E2 48.000,182.504, 0.000 W16E1 72.000,182.504, 0.000 8.75E-01 2
16 W15E2 72.000,182.504, 0.000 W17E1 116.000,182.504, 0.000 7.50E-01 4
17 W16E2 116.000,182.504, 0.000 W18E1 152.000,182.504, 0.000 6.25E-01 4
18 W17E2 152.000,182.504, 0.000 207.500,182.504, 0.000 5.00E-01 6
19 -195.53,269.544, 0.000 W20E1 -152.00,269.544, 0.000 5.00E-01 4
20 W19E2 -152.00,269.544, 0.000 W21E1 -116.00,269.544, 0.000 6.25E-01 4
21 W20E2 -116.00,269.544, 0.000 W22E1 -72.000,269.544, 0.000 7.50E-01 4
22 W21E2 -72.000,269.544, 0.000 W23E1 -48.000,269.544, 0.000 8.75E-01 2
23 W22E2 -48.000,269.544, 0.000 W24E1 48.000,269.544, 0.000 1.00E+00 9
24 W23E2 48.000,269.544, 0.000 W25E1 72.000,269.544, 0.000 8.75E-01 2
25 W24E2 72.000,269.544, 0.000 W26E1 116.000,269.544, 0.000 7.50E-01 4
26 W25E2 116.000,269.544, 0.000 W27E1 152.000,269.544, 0.000 6.25E-01 4
27 W26E2 152.000,269.544, 0.000 195.530,269.544, 0.000 5.00E-01 4
28 -192.48,448.494, 0.000 W29E1 -152.00,448.494, 0.000 5.00E-01 4
29 W28E2 -152.00,448.494, 0.000 W30E1 -116.00,448.494, 0.000 6.25E-01 4
30 W29E2 -116.00,448.494, 0.000 W31E1 -72.000,448.494, 0.000 7.50E-01 4
31 W30E2 -72.000,448.494, 0.000 W32E1 -48.000,448.494, 0.000 8.75E-01 2
32 W31E2 -48.000,448.494, 0.000 W33E1 48.000,448.494, 0.000 1.00E+00 9
33 W32E2 48.000,448.494, 0.000 W34E1 72.000,448.494, 0.000 8.75E-01 2
34 W33E2 72.000,448.494, 0.000 W35E1 116.000,448.494, 0.000 7.50E-01 4
35 W34E2 116.000,448.494, 0.000 W36E1 152.000,448.494, 0.000 6.25E-01 4
36 W35E2 152.000,448.494, 0.000 192.480,448.494, 0.000 5.00E-01 4
37 -189.42,656.474, 0.000 W38E1 -152.00,656.474, 0.000 5.00E-01 4
38 W37E2 -152.00,656.474, 0.000 W39E1 -116.00,656.474, 0.000 6.25E-01 4
39 W38E2 -116.00,656.474, 0.000 W40E1 -72.000,656.474, 0.000 7.50E-01 4
40 W39E2 -72.000,656.474, 0.000 W41E1 -48.000,656.474, 0.000 8.75E-01 2
41 W40E2 -48.000,656.474, 0.000 W42E1 48.000,656.474, 0.000 1.00E+00 9
42 W41E2 48.000,656.474, 0.000 W43E1 72.000,656.474, 0.000 8.75E-01 2
43 W42E2 72.000,656.474, 0.000 W44E1 116.000,656.474, 0.000 7.50E-01 4
44 W43E2 116.000,656.474, 0.000 W45E1 152.000,656.474, 0.000 6.25E-01 4
45 W44E2 152.000,656.474, 0.000 189.420,656.474, 0.000 5.00E-01 4

----- SOURCES -----

Source Wire Wire #/Pct From End 1 Ampl.(V, A) Phase(Deg.) Type
Seg. Actual (Specified)

1 5 14 / 50.00 (14 / 50.00) 1.000 0.000 V

No loads specified

No transmission lines specified

Ground type is Free Space

EZNEC/4 ver. 2.0

NW3Z 6 el, 48' boom WWW 07-19-1998 07:47:18

Frequency = 14.175 MHz.

Wire Loss: Aluminum -- Resistivity = 4E-08 ohm-m, Rel. Perm. = 1

----- WIRES -----

Wire Conn. --- End 1 (x,y,z : in) Conn. --- End 2 (x,y,z : in) Dia(in) Segs

1	-217.73, 0.000, 0.000	W2E1	-152.00, 0.000, 0.000	5.00E-01	7
2	W1E2 -152.00, 0.000, 0.000	W3E1	-116.00, 0.000, 0.000	6.25E-01	4
3	W2E2 -116.00, 0.000, 0.000	W4E1	-72.000, 0.000, 0.000	7.50E-01	4
4	W3E2 -72.000, 0.000, 0.000	W5E1	-48.000, 0.000, 0.000	8.75E-01	2
5	W4E2 -48.000, 0.000, 0.000	W6E1	48.000, 0.000, 0.000	1.00E+00	9
6	W5E2 48.000, 0.000, 0.000	W7E1	72.000, 0.000, 0.000	8.75E-01	2
7	W6E2 72.000, 0.000, 0.000	W8E1	116.000, 0.000, 0.000	7.50E-01	4
8	W7E2 116.000, 0.000, 0.000	W9E1	152.000, 0.000, 0.000	6.25E-01	4
9	W8E2 152.000, 0.000, 0.000		217.730, 0.000, 0.000	5.00E-01	7
10	-210.70, 90.000, 0.000	W11E1	-152.00, 90.000, 0.000	5.00E-01	6
11	W10E2 -152.00, 90.000, 0.000	W12E1	-116.00, 90.000, 0.000	6.25E-01	4
12	W11E2 -116.00, 90.000, 0.000	W13E1	-72.000, 90.000, 0.000	7.50E-01	4
13	W12E2 -72.000, 90.000, 0.000	W14E1	-48.000, 90.000, 0.000	8.75E-01	2
14	W13E2 -48.000, 90.000, 0.000	W15E1	48.000, 90.000, 0.000	1.00E+00	9
15	W14E2 48.000, 90.000, 0.000	W16E1	72.000, 90.000, 0.000	8.75E-01	2
16	W15E2 72.000, 90.000, 0.000	W17E1	116.000, 90.000, 0.000	7.50E-01	4
17	W16E2 116.000, 90.000, 0.000	W18E1	152.000, 90.000, 0.000	6.25E-01	4
18	W17E2 152.000, 90.000, 0.000		210.700, 90.000, 0.000	5.00E-01	6
19	-200.80, 139.520, 0.000	W20E1	-152.00, 139.520, 0.000	5.00E-01	5
20	W19E2 -152.00, 139.520, 0.000	W21E1	-116.00, 139.520, 0.000	6.25E-01	4
21	W20E2 -116.00, 139.520, 0.000	W22E1	-72.000, 139.520, 0.000	7.50E-01	4
22	W21E2 -72.000, 139.520, 0.000	W23E1	-48.000, 139.520, 0.000	8.75E-01	2
23	W22E2 -48.000, 139.520, 0.000	W24E1	48.000, 139.520, 0.000	1.00E+00	9
24	W23E2 48.000, 139.520, 0.000	W25E1	72.000, 139.520, 0.000	8.75E-01	2
25	W24E2 72.000, 139.520, 0.000	W26E1	116.000, 139.520, 0.000	7.50E-01	4
26	W25E2 116.000, 139.520, 0.000	W27E1	152.000, 139.520, 0.000	6.25E-01	4
27	W26E2 152.000, 139.520, 0.000		200.800, 139.520, 0.000	5.00E-01	5
28	-194.62, 266.700, 0.000	W29E1	-152.00, 266.700, 0.000	5.00E-01	4
29	W28E2 -152.00, 266.700, 0.000	W30E1	-116.00, 266.700, 0.000	6.25E-01	4
30	W29E2 -116.00, 266.700, 0.000	W31E1	-72.000, 266.700, 0.000	7.50E-01	4
31	W30E2 -72.000, 266.700, 0.000	W32E1	-48.000, 266.700, 0.000	8.75E-01	2
32	W31E2 -48.000, 266.700, 0.000	W33E1	48.000, 266.700, 0.000	1.00E+00	9
33	W32E2 48.000, 266.700, 0.000	W34E1	72.000, 266.700, 0.000	8.75E-01	2
34	W33E2 72.000, 266.700, 0.000	W35E1	116.000, 266.700, 0.000	7.50E-01	4
35	W34E2 116.000, 266.700, 0.000	W36E1	152.000, 266.700, 0.000	6.25E-01	4
36	W35E2 152.000, 266.700, 0.000		194.620, 266.700, 0.000	5.00E-01	4
37	-194.63, 388.440, 0.000	W38E1	-152.00, 388.440, 0.000	5.00E-01	4
38	W37E2 -152.00, 388.440, 0.000	W39E1	-116.00, 388.440, 0.000	6.25E-01	4
39	W38E2 -116.00, 388.440, 0.000	W40E1	-72.000, 388.440, 0.000	7.50E-01	4
40	W39E2 -72.000, 388.440, 0.000	W41E1	-48.000, 388.440, 0.000	8.75E-01	2
41	W40E2 -48.000, 388.440, 0.000	W42E1	48.000, 388.440, 0.000	1.00E+00	9
42	W41E2 48.000, 388.440, 0.000	W43E1	72.000, 388.440, 0.000	8.75E-01	2
43	W42E2 72.000, 388.440, 0.000	W44E1	116.000, 388.440, 0.000	7.50E-01	4
44	W43E2 116.000, 388.440, 0.000	W45E1	152.000, 388.440, 0.000	6.25E-01	4
45	W44E2 152.000, 388.440, 0.000		194.630, 388.440, 0.000	5.00E-01	4
46	-187.39, 570.000, 0.000	W47E1	-152.00, 570.000, 0.000	5.00E-01	4
47	W46E2 -152.00, 570.000, 0.000	W48E1	-116.00, 570.000, 0.000	6.25E-01	4
48	W47E2 -116.00, 570.000, 0.000	W49E1	-72.000, 570.000, 0.000	7.50E-01	4
49	W48E2 -72.000, 570.000, 0.000	W50E1	-48.000, 570.000, 0.000	8.75E-01	2
50	W49E2 -48.000, 570.000, 0.000	W51E1	48.000, 570.000, 0.000	1.00E+00	9
51	W50E2 48.000, 570.000, 0.000	W52E1	72.000, 570.000, 0.000	8.75E-01	2
52	W51E2 72.000, 570.000, 0.000	W53E1	116.000, 570.000, 0.000	7.50E-01	4
53	W52E2 116.000, 570.000, 0.000	W54E1	152.000, 570.000, 0.000	6.25E-01	4
54	W53E2 152.000, 570.000, 0.000		187.390, 570.000, 0.000	5.00E-01	4

----- SOURCES -----

Source	Wire	Wire #/Pct From End 1	Ampl.(V, A)	Phase(Deg.)	Type
	Seg.	Actual (Specified)			
1	5	14 / 50.00 (14 / 50.00)	1.000	0.000	V

No loads specified

No transmission lines specified

Ground type is Free Space

EZNEC/4 ver. 2.0

Hy-Gain 205-XLB, 48' Boom (WB0DGF) 07-19-1998 07:55:56

Frequency = 14.175 MHz.

Wire Loss: Aluminum -- Resistivity = 4E-08 ohm-m, Rel. Perm. = 1

----- WIRES -----

Wire Conn. --- End 1 (x,y,z : in) Conn. --- End 2 (x,y,z : in) Dia(in) Segs

1	-286.00,-223.75, 0.000	W2E1	-286.00,-166.00, 0.000	4.38E-01	7
2	W1E2 -286.00,-166.00, 0.000	W3E1	-286.00,-142.00, 0.000	6.25E-01	3
3	W2E2 -286.00,-142.00, 0.000	W4E1	-286.00,-91.500, 0.000	8.75E-01	6
4	W3E2 -286.00,-91.500, 0.000	W5E1	-286.00,-45.500, 0.000	1.12E+00	6
5	W4E2 -286.00,-45.500, 0.000	W6E1	-286.00, -3.625, 0.000	1.25E+00	5
6	W5E2 -286.00, -3.625, 0.000	W7E1	-286.00, 3.625, 0.000	4.00E+00	1
7	W6E2 -286.00, 3.625, 0.000	W8E1	-286.00, 45.500, 0.000	1.25E+00	5
8	W7E2 -286.00, 45.500, 0.000	W9E1	-286.00, 91.500, 0.000	1.12E+00	6
9	W8E2 -286.00, 91.500, 0.000	W10E1	-286.00,142.000, 0.000	8.75E-01	6
10	W9E2 -286.00,142.000, 0.000	W11E1	-286.00,166.000, 0.000	6.25E-01	3
11	W10E2 -286.00,166.000, 0.000		-286.00,223.750, 0.000	4.38E-01	7
12	-170.00,-209.50, 0.000	W13E1	-170.00,-156.50, 0.000	4.38E-01	7
13	W12E2 -170.00,-156.50, 0.000	W14E1	-170.00,-132.50, 0.000	6.25E-01	3
14	W13E2 -170.00,-132.50, 0.000	W15E1	-170.00,-82.000, 0.000	8.75E-01	6
15	W14E2 -170.00,-82.000, 0.000	W16E1	-170.00,-36.000, 0.000	1.12E+00	6
16	W15E2 -170.00,-36.000, 0.000	W17E1	-170.00,-10.000, 0.000	1.25E+00	3
17	W16E2 -170.00,-10.000, 0.000	W18E1	-170.00, 10.000, 0.000	1.25E+00	3
18	W17E2 -170.00, 10.000, 0.000	W19E1	-170.00, 36.000, 0.000	1.25E+00	3
19	W18E2 -170.00, 36.000, 0.000	W20E1	-170.00, 82.000, 0.000	1.12E+00	6
20	W19E2 -170.00, 82.000, 0.000	W21E1	-170.00,132.500, 0.000	8.75E-01	6
21	W20E2 -170.00,132.500, 0.000	W22E1	-170.00,156.500, 0.000	6.25E-01	3
22	W21E2 -170.00,156.500, 0.000		-170.00,209.500, 0.000	4.38E-01	7
23	-80.000,-206.25, 0.000	W24E1	-80.000,-156.50, 0.000	4.38E-01	6
24	W23E2 -80.000,-156.50, 0.000	W25E1	-80.000,-132.50, 0.000	6.25E-01	3
25	W24E2 -80.000,-132.50, 0.000	W26E1	-80.000,-82.000, 0.000	8.75E-01	6
26	W25E2 -80.000,-82.000, 0.000	W27E1	-80.000,-36.000, 0.000	1.12E+00	6
27	W26E2 -80.000,-36.000, 0.000	W28E1	-80.000, -3.625, 0.000	1.25E+00	4
28	W27E2 -80.000, -3.625, 0.000	W29E1	-80.000, 3.625, 0.000	4.00E+00	1
29	W28E2 -80.000, 3.625, 0.000	W30E1	-80.000, 36.000, 0.000	1.25E+00	4
30	W29E2 -80.000, 36.000, 0.000	W31E1	-80.000, 82.000, 0.000	1.12E+00	6
31	W30E2 -80.000, 82.000, 0.000	W32E1	-80.000,132.500, 0.000	8.75E-01	6
32	W31E2 -80.000,132.500, 0.000	W33E1	-80.000,156.500, 0.000	6.25E-01	3
33	W32E2 -80.000,156.500, 0.000		-80.000,206.250, 0.000	4.38E-01	6
34	86.000,-203.25, 0.000	W35E1	86.000,-156.50, 0.000	4.38E-01	6
35	W34E2 86.000,-156.50, 0.000	W36E1	86.000,-132.50, 0.000	6.25E-01	3
36	W35E2 86.000,-132.50, 0.000	W37E1	86.000,-82.000, 0.000	8.75E-01	6
37	W36E2 86.000,-82.000, 0.000	W38E1	86.000,-36.000, 0.000	1.12E+00	6
38	W37E2 86.000,-36.000, 0.000	W39E1	86.000, -3.625, 0.000	1.25E+00	4
39	W38E2 86.000, -3.625, 0.000	W40E1	86.000, 3.625, 0.000	4.00E+00	1
40	W39E2 86.000, 3.625, 0.000	W41E1	86.000, 36.000, 0.000	1.25E+00	4
41	W40E2 86.000, 36.000, 0.000	W42E1	86.000, 82.000, 0.000	1.12E+00	6
42	W41E2 86.000, 82.000, 0.000	W43E1	86.000,132.500, 0.000	8.75E-01	6
43	W42E2 86.000,132.500, 0.000	W44E1	86.000,156.500, 0.000	6.25E-01	3
44	W43E2 86.000,156.500, 0.000		86.000,203.250, 0.000	4.38E-01	6
45	286.000,-193.12, 0.000	W46E1	286.000,-138.25, 0.000	4.38E-01	7
46	W45E2 286.000,-138.25, 0.000	W47E1	286.000,-114.25, 0.000	6.25E-01	3
47	W46E2 286.000,-114.25, 0.000	W48E1	286.000,-63.750, 0.000	8.75E-01	6
48	W47E2 286.000,-63.750, 0.000	W49E1	286.000,-17.750, 0.000	1.12E+00	6
49	W48E2 286.000,-17.750, 0.000	W50E1	286.000, -3.625, 0.000	1.25E+00	2
50	W49E2 286.000, -3.625, 0.000	W51E1	286.000, 3.625, 0.000	4.00E+00	1
51	W50E2 286.000, 3.625, 0.000	W52E1	286.000, 17.750, 0.000	1.25E+00	2
52	W51E2 286.000, 17.750, 0.000	W53E1	286.000, 63.750, 0.000	1.12E+00	6
53	W52E2 286.000, 63.750, 0.000	W54E1	286.000,114.250, 0.000	8.75E-01	6
54	W53E2 286.000,114.250, 0.000	W55E1	286.000,138.250, 0.000	6.25E-01	3
55	W54E2 286.000,138.250, 0.000		286.000,193.125, 0.000	4.38E-01	7

----- SOURCES -----

Source	Wire Seg.	Wire #/Pct Actual	From End 1 (Specified)	Ampl.(V, A)	Phase(Deg.)	Type
1	2	17 / 50.00	(17 / 50.00)	0.707	0.000	V

No loads specified

No transmission lines specified

Ground type is Free Space

Any transcription errors in the above models are strictly my own fault, and I shall gladly correct any found.



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