YAGI Antennas

And Other "Bubba Stuff"

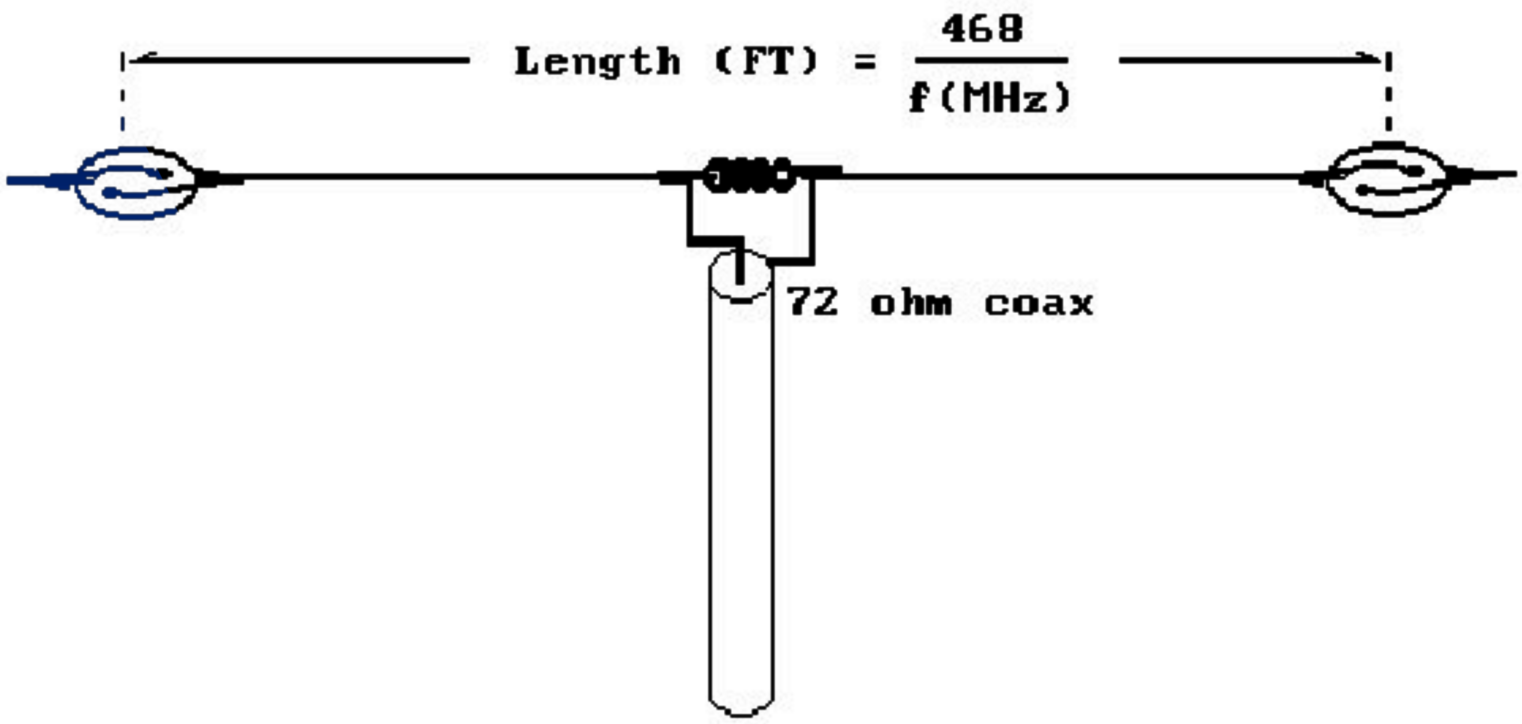
The YAGI Antenna

- What Is A YAGI Antenna ?
- Why Do We Call It A “YAGI” ?

Hidetsugu Yagi, 1886-1976
Shintaro Uda, 1896-1976

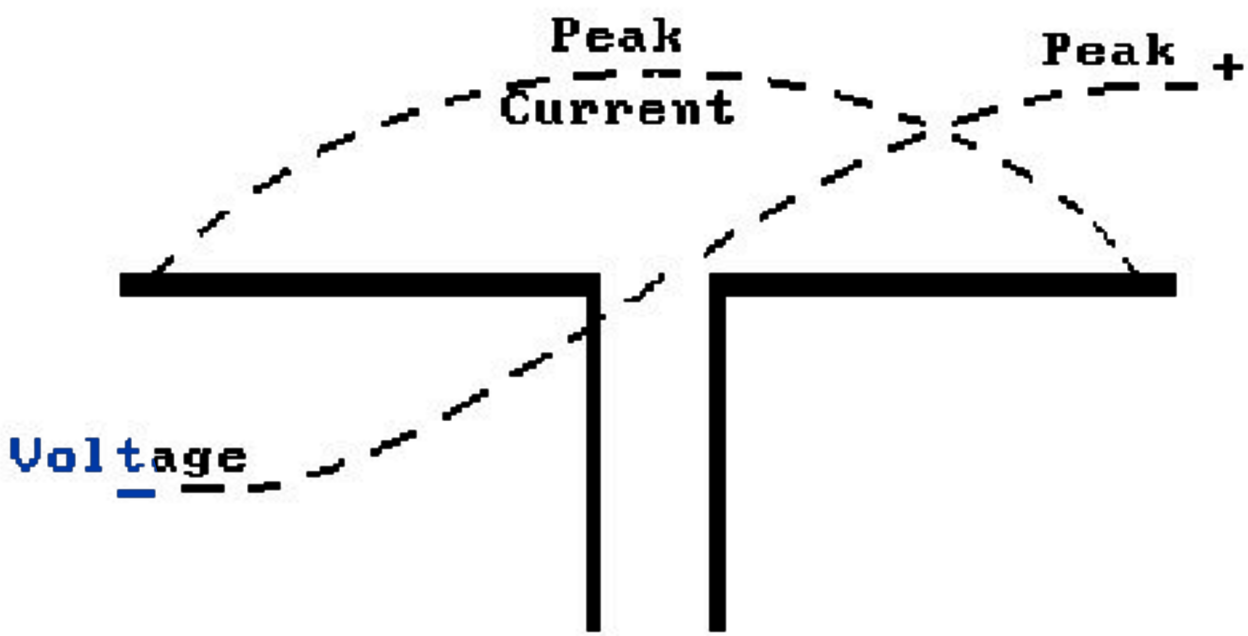
- Investigated methods of improving transmitted signals from shortwave oscillators (68 mhz and 115 mhz). His first publication dealing with “Projector Of The Sharpest Beam Of Electric Waves” was introduced in 1926. His follow up experiments with multiple elements on an antenna led to his “Wave Canal”.

Understanding The Basics



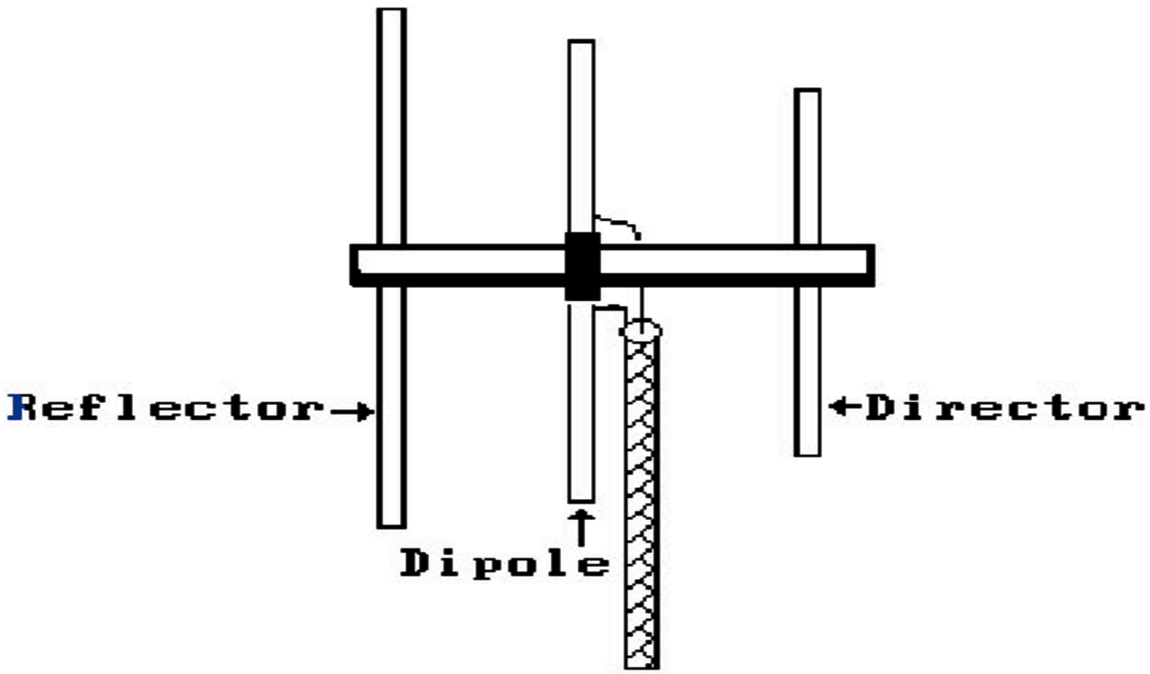
A dipole is a half-wave antenna fed at the center.
The impedance at the center is near 72 ohms.

Understanding The Basics



The basic dipole consists of two charges or elements which receive signals of opposite polarity.

Understanding The Basics

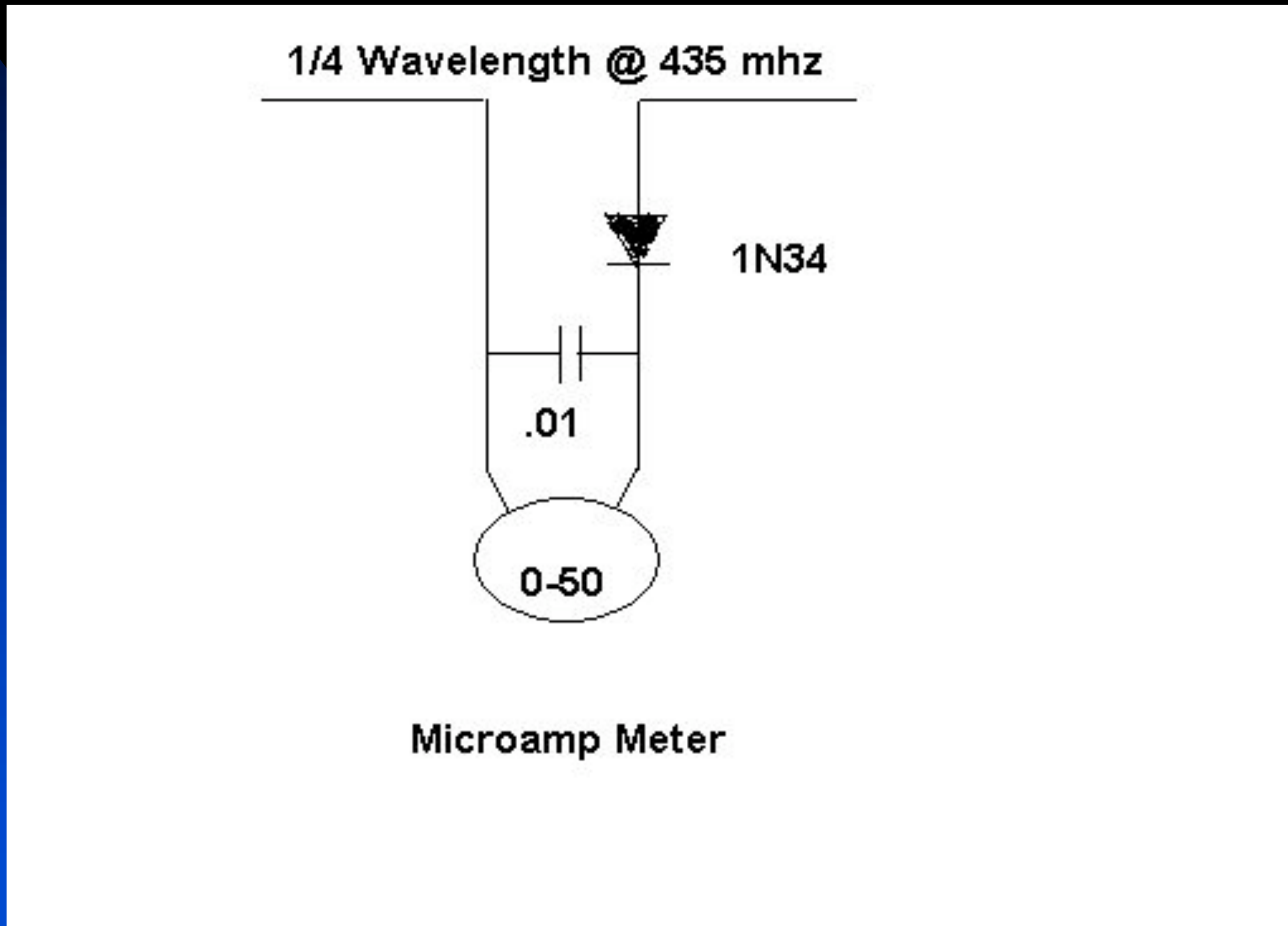


Adding a reflector and a parasitic element (director) to the dipole greatly improves its gain and directivity. Thus, the dipole becomes a "YAGI" antenna.

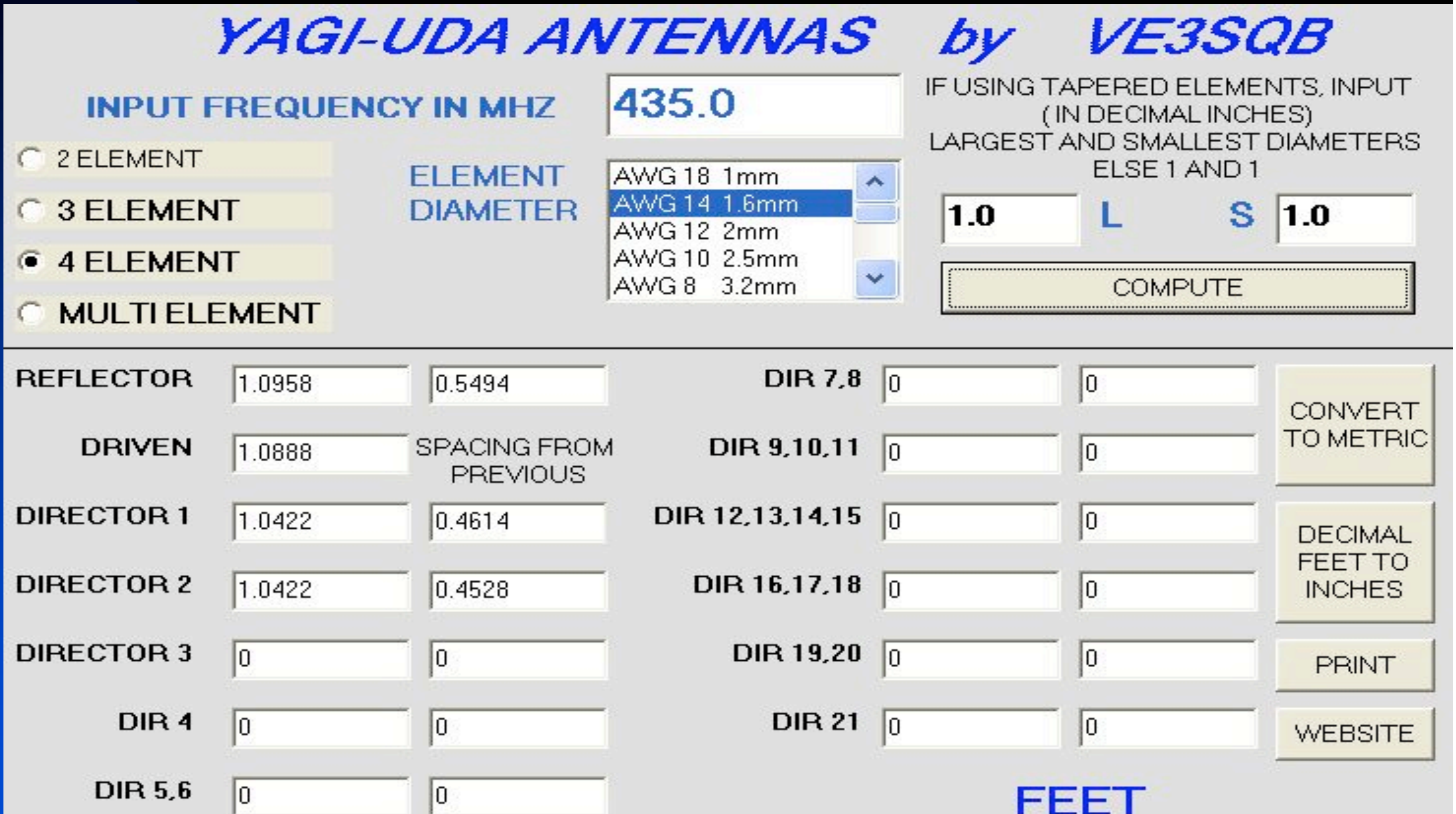
YAGI Performance

- Forward Gain
- Radiation Pattern
- F/B Ratio
- VSWR (match)

Test Receiver Diagram



Modeling Software Examples



Modeling Software Examples

Modeling Software Conversions

Refl. 1.0958 ft = 1-1 5/32 = 6.5748 inches = 6 37/64 inches

Space .5494 ft = 6.5928 inches = 6 19/32 inches

Drvn 1.0888 ft = 1-1 1/16 = 6.5328 inches = 6 17/32 inches

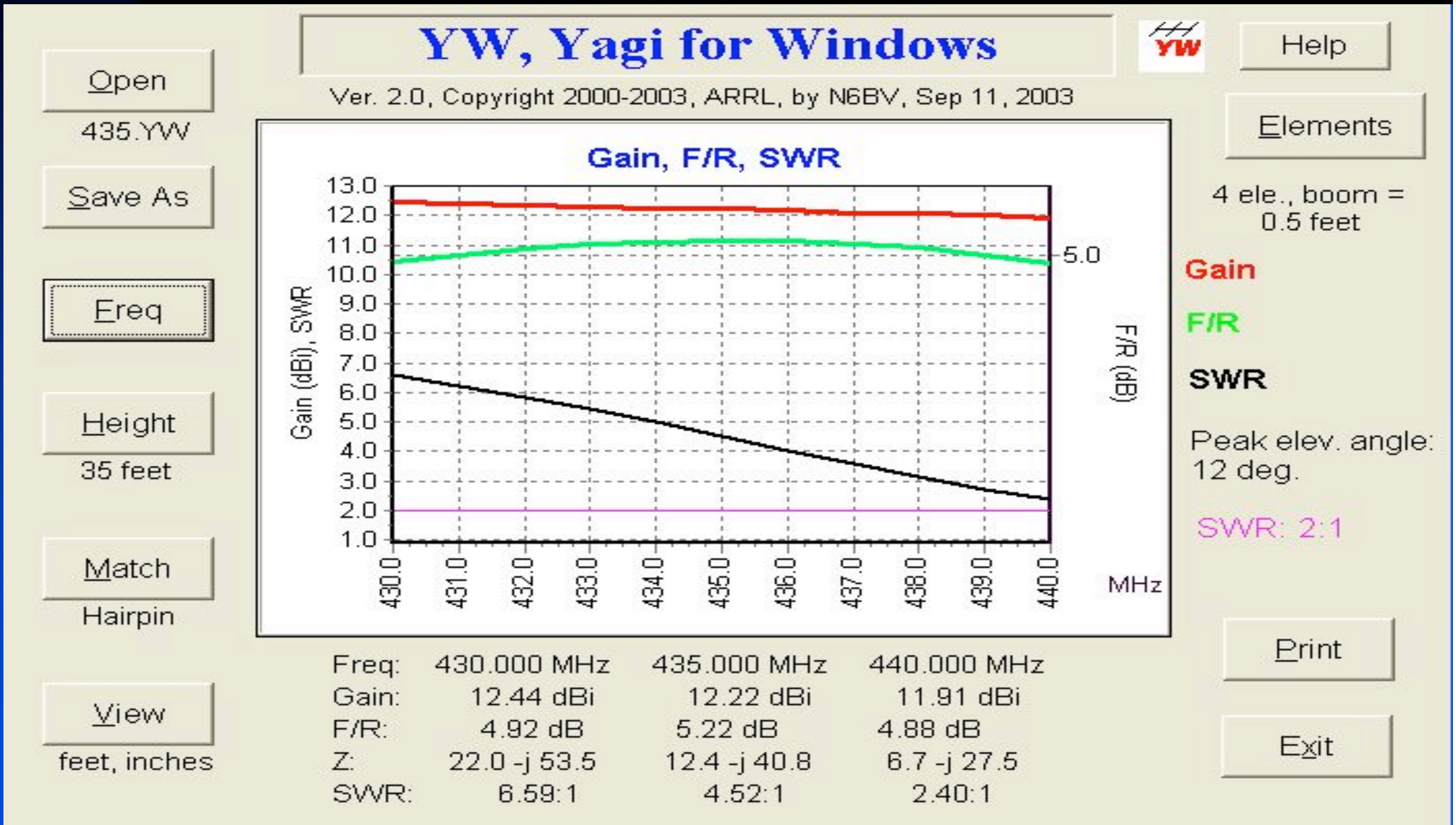
Space .4614 ft = 5.5368 inches = 5 17/32 inches

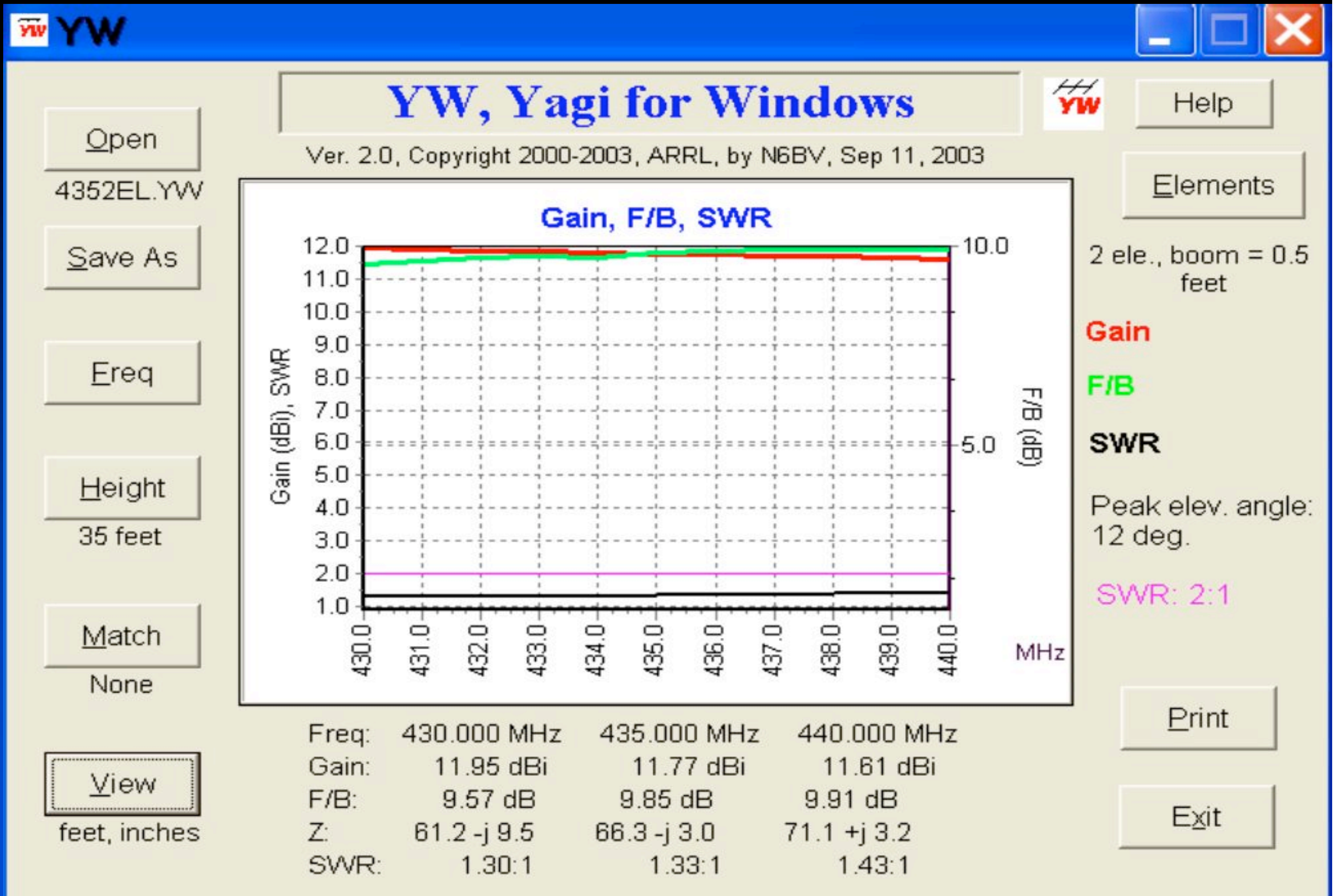
Dir1 1.0422 ft = 1-0 ½ = 6.2532 inches = 6 ¼ inches

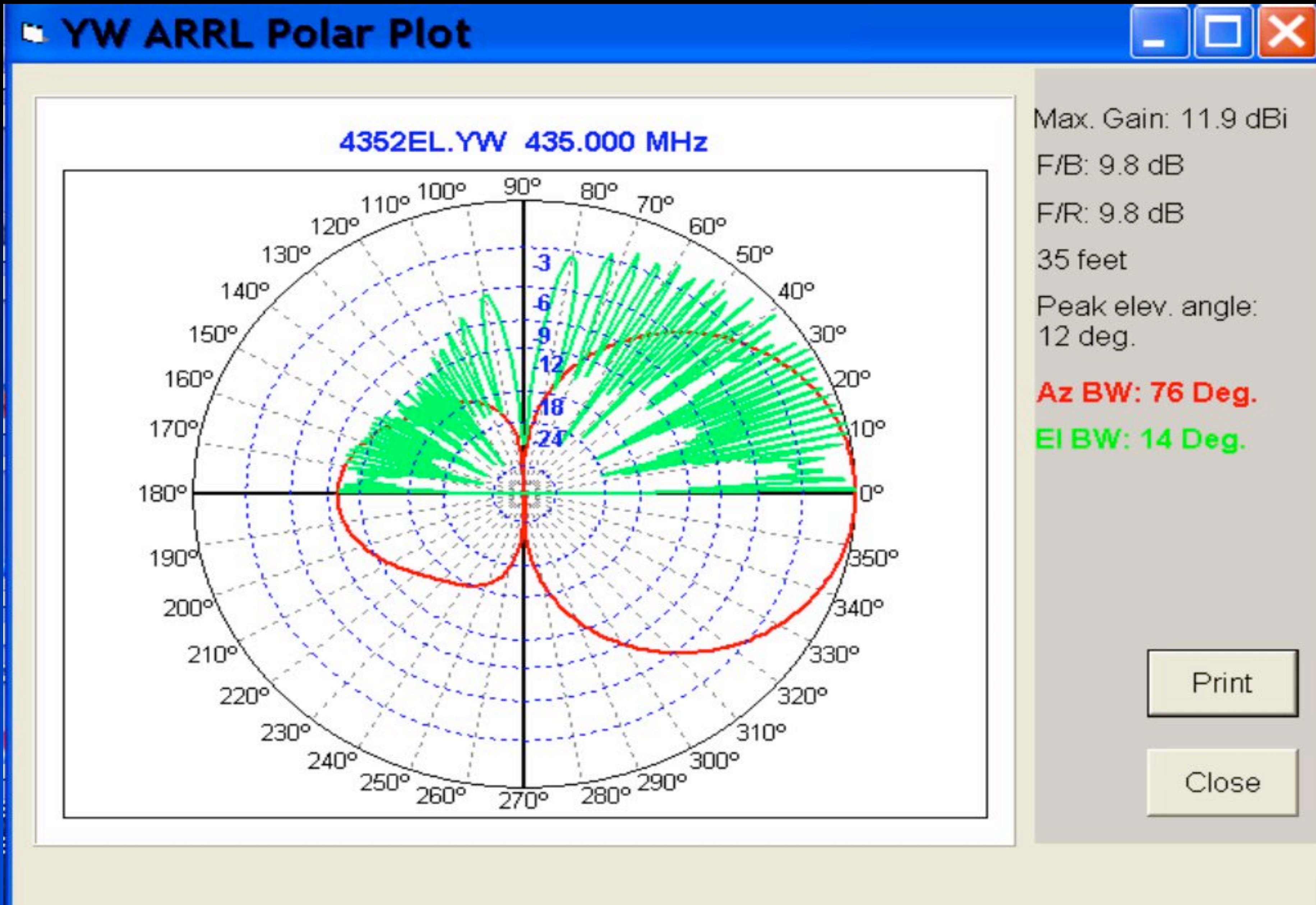
Space .4528 ft = 5.4336 inches = 5 7/16 inches

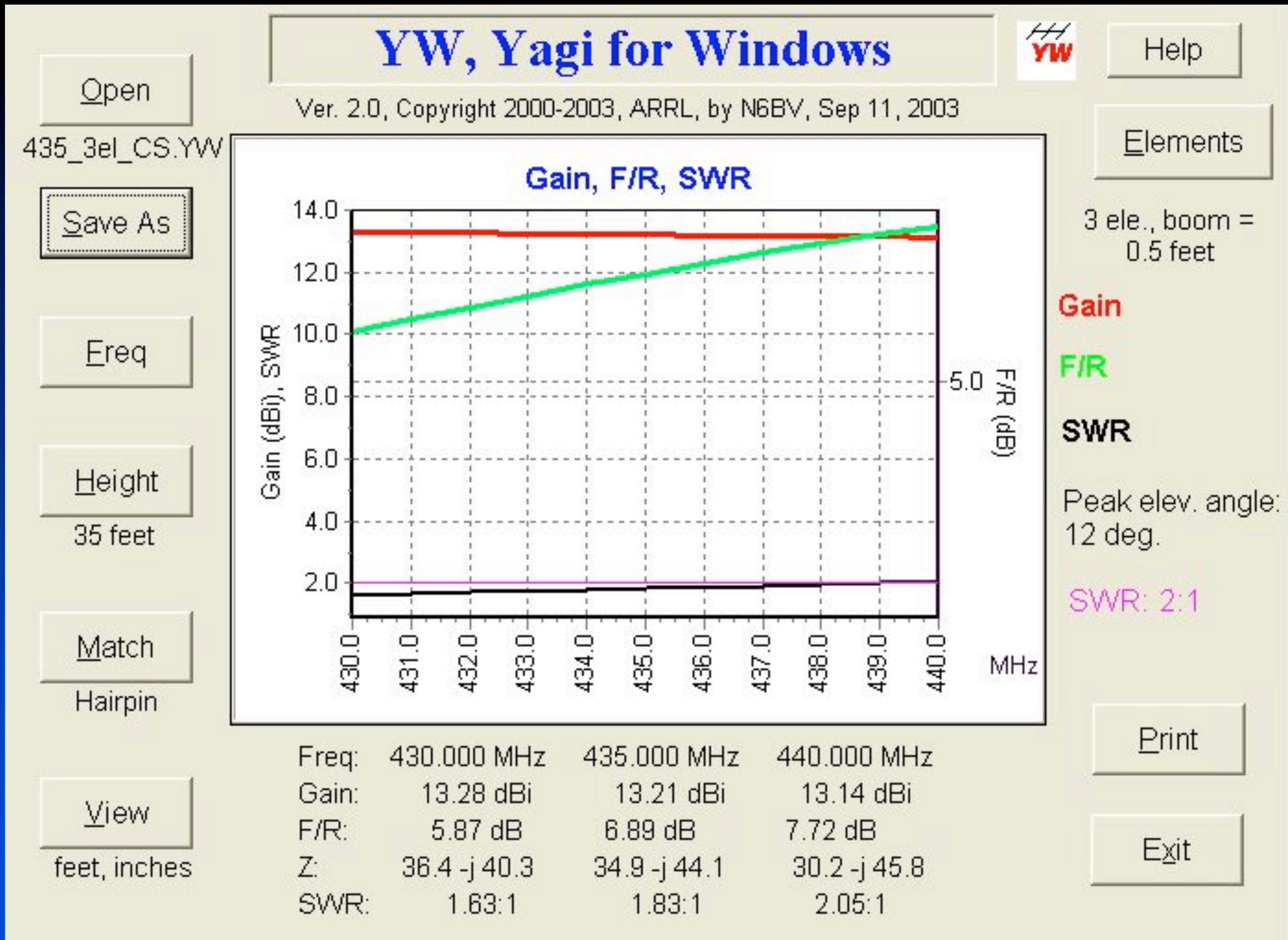
Dir2 1.0422 ft = 1-0 ½ = 6.2532 inches = 6 ¼ inches

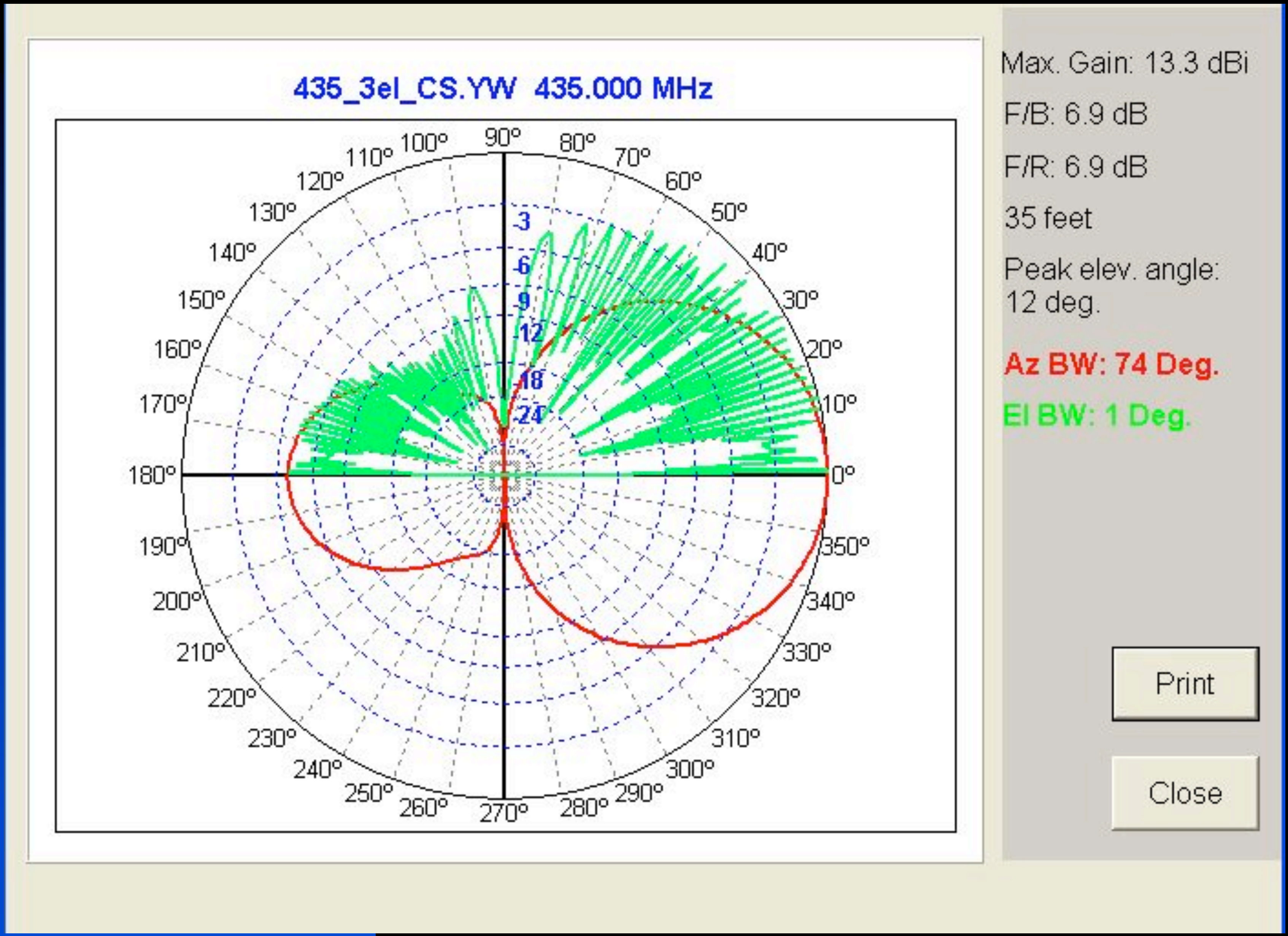
Modeling Software Examples

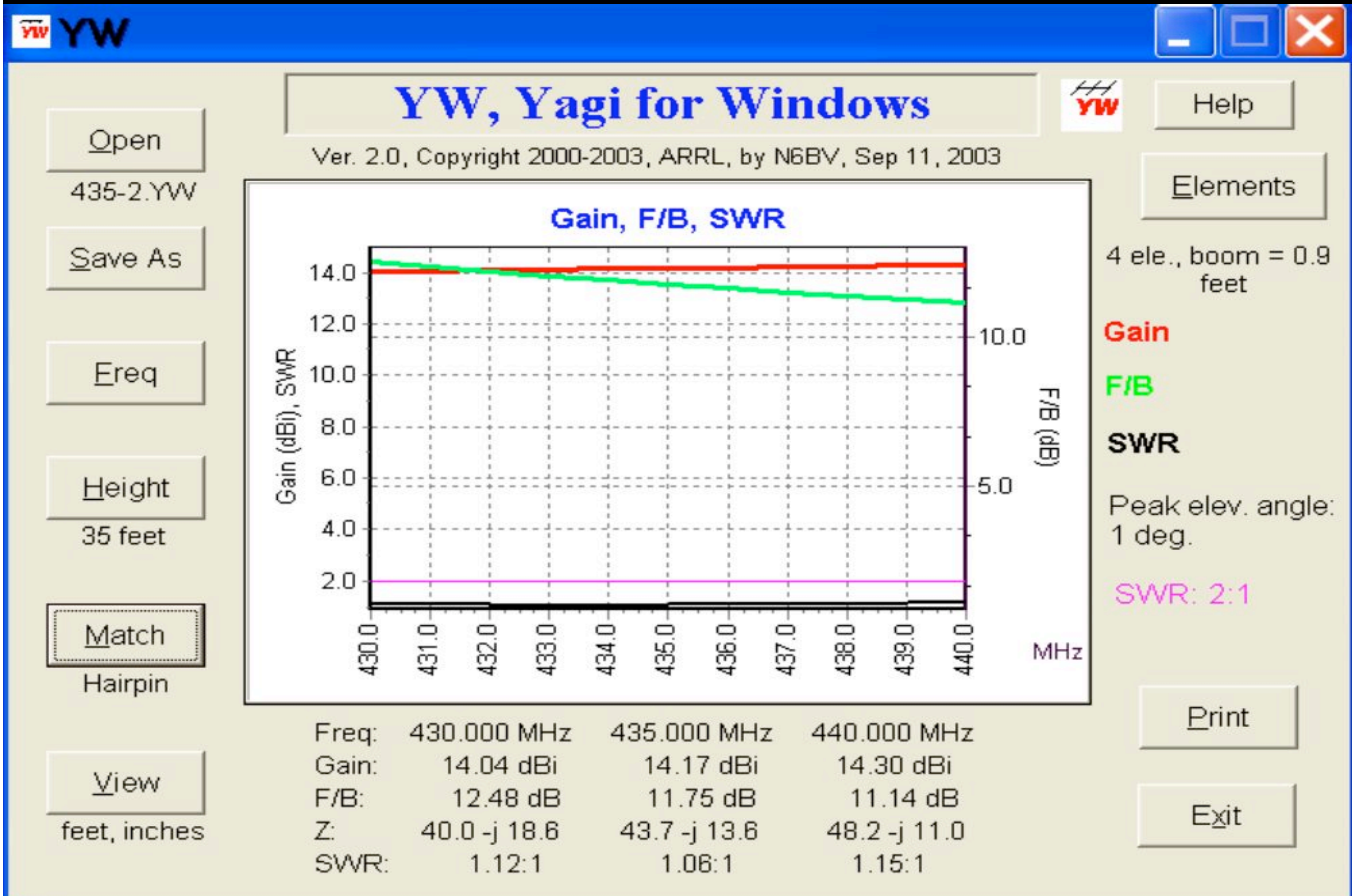


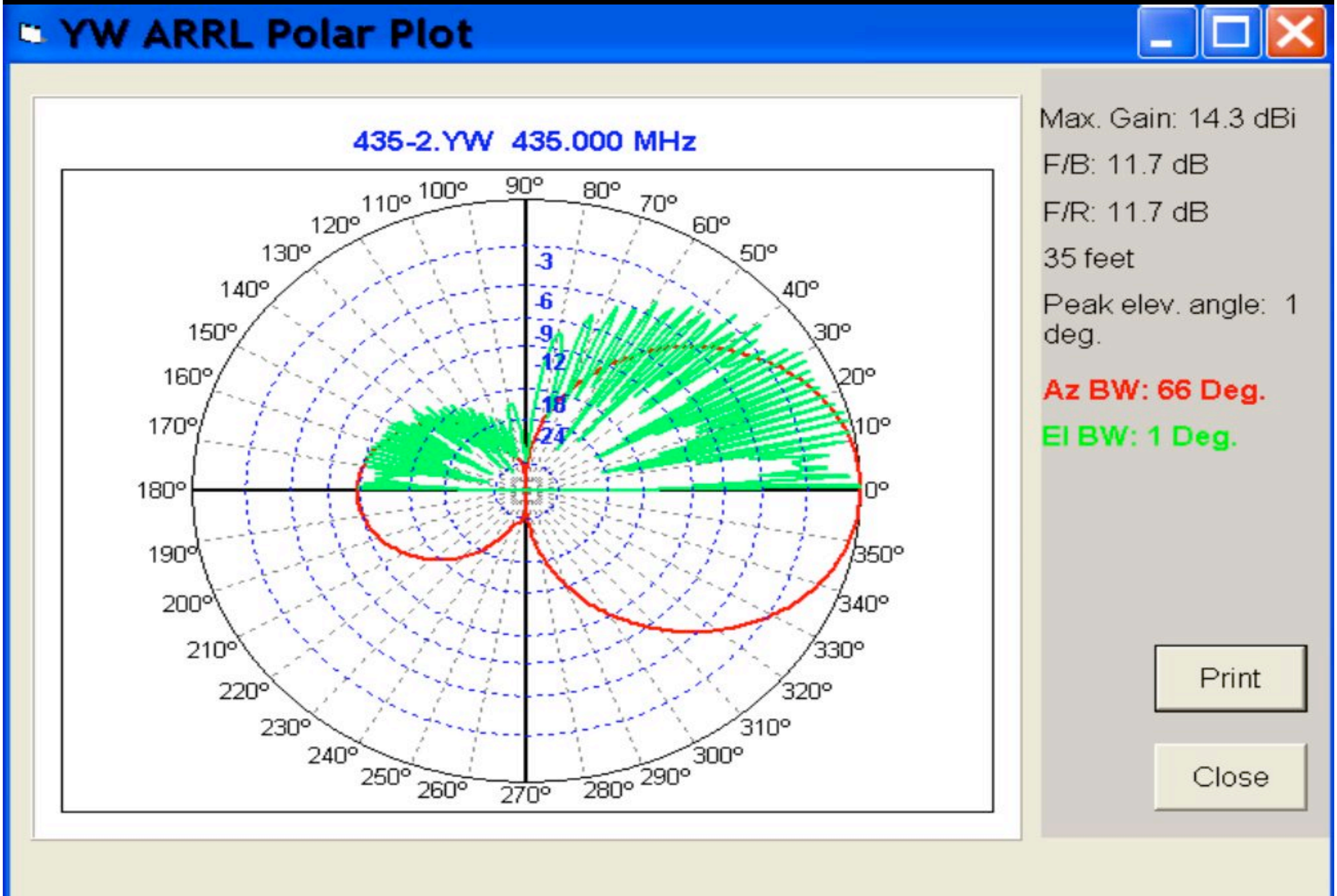

YW
YW, Yagi for Windows
Ver. 2.0, Copyright 2000-2003, ARRL, by N6BV, Sep 11, 2003
Help
Open
4352EL.YW
Save As
Freq
Height
35 feet
Match
None
View
feet, inches
Elements
2 ele., boom = 0.5 feet
Gain
F/B
SWR
Peak elev. angle: 12 deg.
SWR: 2:1
Print
Exit
Gain, F/B, SWR
Gain (dBi), SWR
F/B (dB)
MHz
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
10.0
5.0
430.0
431.0
432.0
433.0
434.0
435.0
436.0
437.0
438.0
439.0
440.0
Freq: 430.000 MHz 435.000 MHz 440.000 MHz
Gain: 11.95 dBi 11.77 dBi 11.61 dBi
F/B: 9.57 dB 9.85 dB 9.91 dB
Z: 61.2 -j 9.5 66.3 -j 3.0 71.1 +j 3.2
SWR: 1.30:1 1.33:1 1.43:1


YW ARRL Polar Plot
4352EL.YW 435.000 MHz
Max. Gain: 11.9 dBi
F/B: 9.8 dB
F/R: 9.8 dB
35 feet
Peak elev. angle: 12 deg.
Az BW: 76 Deg.
El BW: 14 Deg.
Print
Close

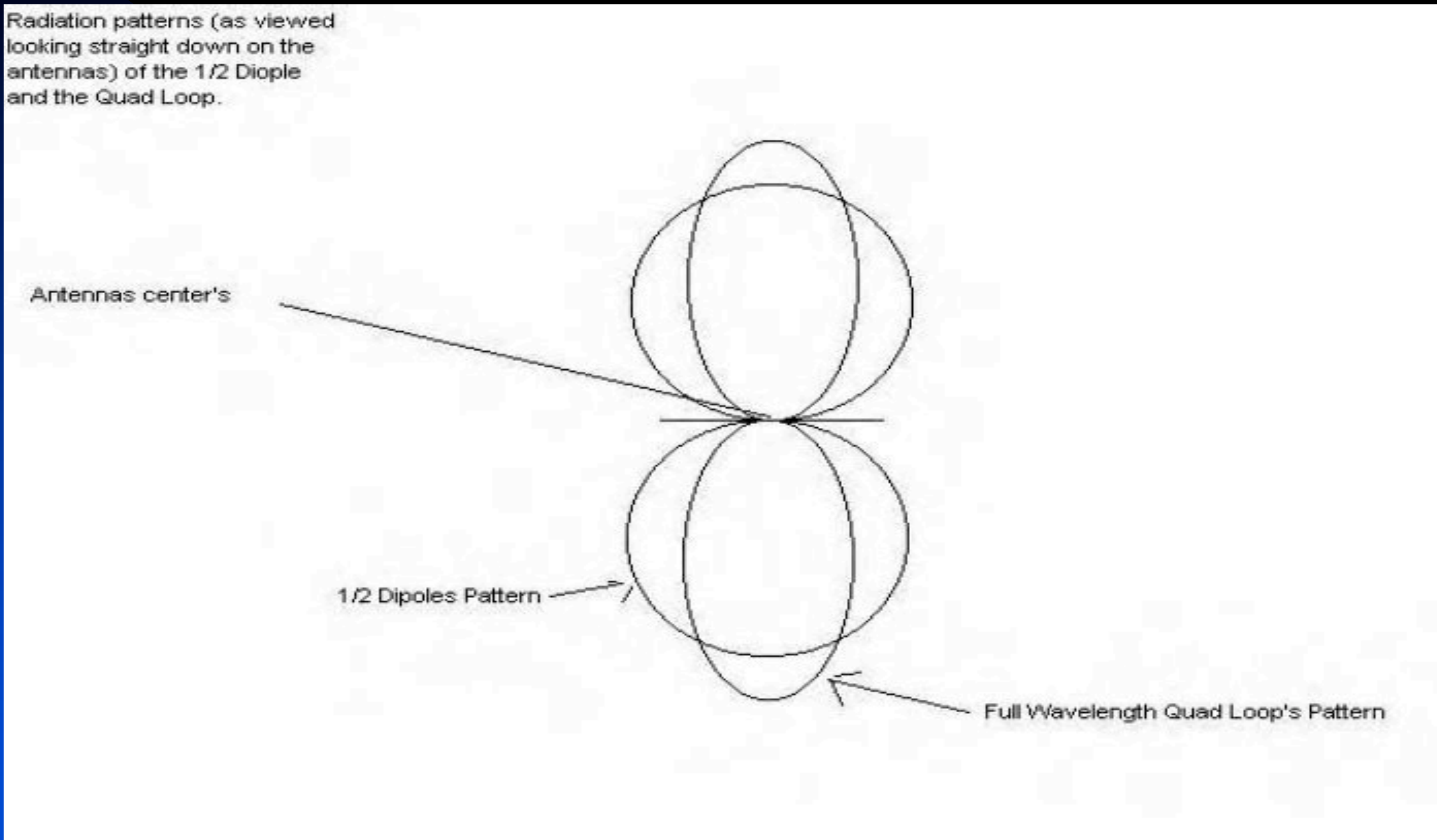

YW, Yagi for Windows
Ver. 2.0, Copyright 2000-2003, ARRL, by N6BV, Sep 11, 2003
Open
435_3el_CS.YW
Save As
Freq
Height
35 feet
Match
Hairpin
View
feet, inches
Help
Elements
3 ele., boom = 0.5 feet
Gain
F/R
SWR
Peak elev. angle: 12 deg.
SWR: 2:1
Print
Exit
Gain, F/R, SWR
Gain (dBi), SWR
14.0
12.0
10.0
8.0
6.0
4.0
2.0
5.0
F/R (dB)
430.0
431.0
432.0
433.0
434.0
435.0
436.0
437.0
438.0
439.0
440.0
MHz
Freq: 430.000 MHz 435.000 MHz 440.000 MHz
Gain: 13.28 dBi 13.21 dBi 13.14 dBi
F/R: 5.87 dB 6.89 dB 7.72 dB
Z: 36.4 -j 40.3 34.9 -j 44.1 30.2 -j 45.8
SWR: 1.63:1 1.83:1 2.05:1


435_3el_CS.YW 435.000 MHz
Max. Gain: 13.3 dBi
F/B: 6.9 dB
F/R: 6.9 dB
35 feet
Peak elev. angle: 12 deg.
Az BW: 74 Deg.
El BW: 1 Deg.
Print
Close


YW
YW, Yagi for Windows
Ver. 2.0, Copyright 2000-2003, ARRL, by N6BV, Sep 11, 2003
Help
Open
435-2.YW
Save As
Freq
Height
35 feet
Match
Hairpin
View
feet, inches
Elements
4 ele., boom = 0.9 feet
Gain
F/B
SWR
Peak elev. angle: 1 deg.
SWR: 2:1
Print
Exit
Gain, F/B, SWR
Gain (dBi), SWR
F/B (dB)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
10.0
5.0
430.0
431.0
432.0
433.0
434.0
435.0
436.0
437.0
438.0
439.0
440.0
MHz
Freq: 430.000 MHz 435.000 MHz 440.000 MHz
Gain: 14.04 dBi 14.17 dBi 14.30 dBi
F/B: 12.48 dB 11.75 dB 11.14 dB
Z: 40.0 -j 18.6 43.7 -j 13.6 48.2 -j 11.0
SWR: 1.12:1 1.06:1 1.15:1


YW ARRL Polar Plot
435-2.YW 435.000 MHz
90°
80°
70°
60°
50°
40°
30°
20°
10°
0°
350°
340°
330°
320°
310°
300°
290°
280°
270°
260°
250°
240°
230°
220°
210°
200°
190°
180°
170°
160°
150°
140°
130°
120°
110°
100°
3
6
9
12
18
24
Max. Gain: 14.3 dBi
F/B: 11.7 dB
F/R: 11.7 dB
35 feet
Peak elev. angle: 1 deg.
Az BW: 66 Deg.
El BW: 1 Deg.
Print
Close

Now Comes The Quad



Quad Advantages vs Yagi

- More gain. Numerous tests over the years have shown the Quad to have 1 to 2 db more gain for antennas on the same length boom with the same amount of elements over the Yagi (2 el Quad = 3 el Yagi)
- Lighter weight. Due to the use of light weight fiberglass spreader arms Quads are typically lighter in weight than Yagi's of similar gain.
- Smaller turning radius. A two element quad with a gain of 8-10 dbi has a turning radius of only 10.1 ft. You won't find a Yagi with that much gain that will turn in so little space.

Quad Advantages vs Yagi

- Better front to back ratio. When a Quad antenna is properly tuned the lobes off the back of the Quad can be brought to a smaller magnitude then is normally found in a Yagi array.
- Better side rejection, less noise = better reception.
- The design of the Quad is such that the top half of the vertical element is 180 degrees out of phase with the bottom half which causes any signal striking the vertical portion of the driven element to be canceled. ***This is also the reason that a Quad is so outstanding at being a low noise antenna for reception.***

Quad Advantages vs Yagi

- The Cubicle Quad has less noise product, because it is more immune to terrestrial noise than other VHF & UHF antennas.
- Lower radiation angle; operates efficiently at a lower elevation. The Yagi half-wave elements are more affected by their proximity to the ground because of the presence of high voltage at the element tips - 'tip to ground capacity' One effect is to lower the arrays frequency as it approaches the ground. The Quad loop on the other hand is essentially a stacked two-element array of very low proximity effect, and this "stacking effect" results in an inherent gain and a lower angle of radiation. This is why the Quad will be efficient at an elevation as low as 35 ft. The low angle of radiation also means less skips to any distant station which results in a stronger signal on the other end where it counts.

Quad Gain

Number of Elements	Gain (Over Dipole)	Front-to-Back Ratio (F/B Ratio)	Comment
2	5 dB	12 dB	Reflector element only
2	7 dB	Zero	Director element only
3	10 dB	15 dB	
4	12 dB	25 dB	

Summary

- Understand The Differences Between Antenna Types – Physical And Performance
- Establish A Standard Reference – dBd vs dBi
- Take Time To Test And Verify
- Antenna Testing – Educational & Rewarding