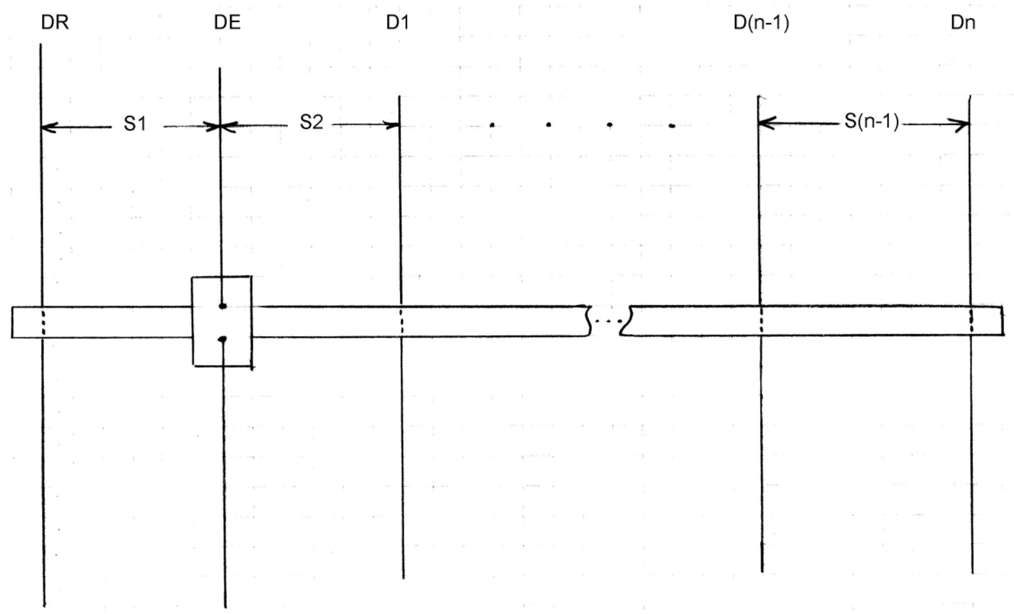
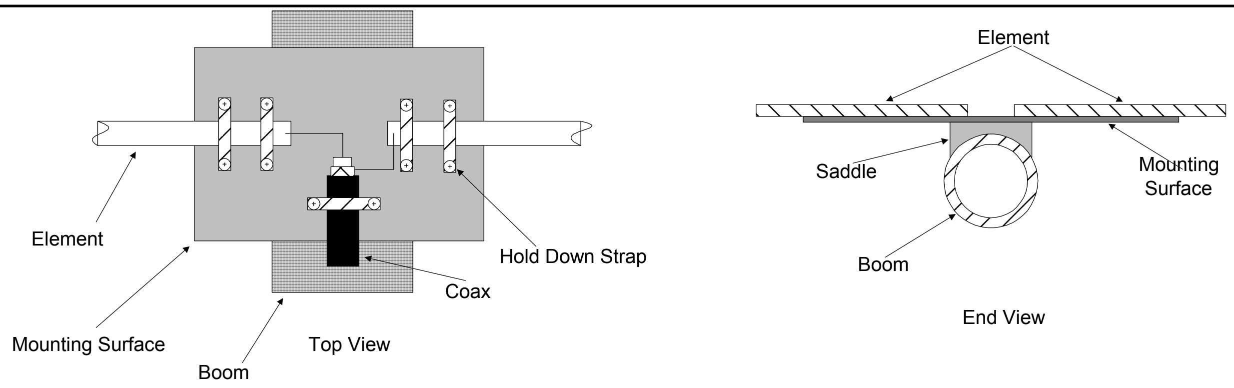
Direct Fed VHF Yagi Designs

The designs presented here are intended to be direct fed by 50 ohm coaxial lines. Possible driven element construction configurations are presented. Boom material is assumed to be PVC or other insulated material. Conductive boom material will require element length adjustment. As such these beams are for light duty or portable use although in relatively benign environments, life should be quite good.
Suggested boom material is ¾ to 1½ inch schedule 40 PVC. Designs are presented for 3/16 to 3/8 inch element diameter. Element lengths are presented as ½ element length and must be doubled.

Following nomenclature is used
DR=reflector
DE=driven element
D1= 1st director
D2= 2nd director
D3= 3rd director
Dn= nth director

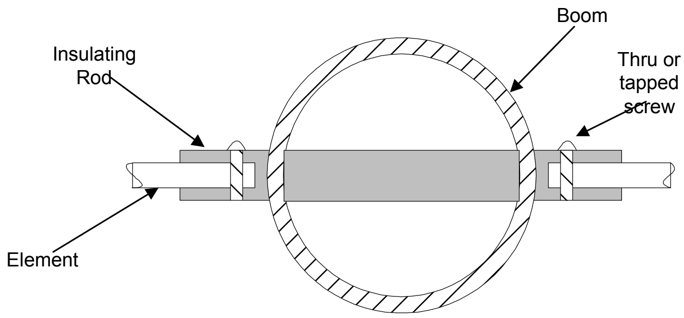
S1=reflector to driven element spacing
S2=driven element to 1st director spacing
S3=1st director to 2nd director spacing
Etc…….





Flat Surface Mounting

Fig 2



Through Boom Mounting

Fig 3

Figure 2 details the feedpoint construction when using a flat mounting plate of insulating material. Small wire clamps hold the half element pieces in place. Attachment of the coax feed can be made to the clamps where screwed down or if the element material is sufficiently large, it can be mounted with screws directly and the coax can be attached at the hold down screws. The element can also tapped and the feedline attached at those points.

Figure 3 shows an alternate method of feeding the split driven element. An insulated rod can be drilled and the element inserted and attached by screws. The insulated rod is inserted through the boom and the feedline is then attached to the element securing screw. The length of shield and center conductor from coax split to the element attachment screws must be subtracted from each side of driven element. This becomes more critical as frequency increases.

Other construction information
My personal preference is to use PVC for the boom material. If it's going to be hand held then additional boom is left to the rear of the reflector. If using PVC, drill pilot holes for the elements in the boom and then using a very sharp final bit drill to size progressively so as to make a clean and tight fit for the element. The element is then inserted (hopefully a tight fit) and centered in the boom. Keepers which look like internal shake washers may be used to hold the element in place if necessary. These are typically available from well stocked hardware stores or hardware suppliers. When using larger element or metal element a metal or machine screw can be inserted through the top or bottom of the boom into the drilled or tapped element.
When using metal boom material, element length adjustments are required and differ whether the element is connected or insulated from the boom. These adjustments are empirical and may be calculated as shown in Appendix A.
Finally, dimensional accuracy is very important, in particular, element lengths. Construction to within 1/32nd inch of design is recommended although at 144 MHz and 220 MHz rounding to 1/16 will provide satisfactory results. Where possible, spacing has been rounded to ¼ or 1/8 inch If possible, construction within these limits will improve actual to predicted performance. While I have used this procedure to design and build numerous yagis from 50 through 1300 MHz not all of these designs have been constructed.

Performance Data
The design process is basically as follows:

1 Optimize the spacing and element lengths based on importance assigned to maximization of gain, a minimum 20 dB front-to-back ratio, and direct feed point impedance of 50 ohms. This is done using either YO (Yagi Optimizer) or AO (Antenna Optimizer) or both of these antenna optimization programs which are unfortunately no longer available. These programs were written by Brian Beezley K6STI for use in a DOS environment.

2. Analysis in EZNEC Plus. Performance agreement between the two steps is of course mandatory.

Gain performance is fundamentally linked to boom length. There are typically several designs that will yield nearly equivalent performance in front-to-back ratio ,feed point impedance and gain but longer beams will show higher gains. Therefore a significant trade off is physical dimensions desired versus gain. Gain can be presented either as free space gain or gain over earth. Gain reference is nearly always expressed in dBi (dB isotropic). Gain over earth will be approximately 6dB larger than free space due to the reflections from ground. It's a matter of personal choice which to use (unless you're doing antenna ads).
In some of the design data to follow there may be two antenna designs presented below for each number of elements covered. One design will be longer and thus have slightly more gain.
Table 1 shows the gain difference between the various antennas in free space and at 3 different antenna heights. Approximate maximum gain lobe angles at each height over earth are also shown.

Elements - Dia	Length inches	Free Space dBi	5 ft - 19° dBi	15 ft - 6° dBi	30 ft - 3° dBi
3 – 0.1875	31.57	7.3	12.2	12.9	13.1
3 – 0.2500	29.40	7.2	12.2	12.9	13.1
3 – 0.3750	23.48	7.0	11.9	12.6	12.8
4 – 0.1875	33.80	7.3	12.3	13.0	13.1
4 – 0.1875	38.70	7.7	12.6	13.3	13.5
4 – 0.2500	33.81	7.4	12.3	13.0	13.2
4 – 0.2500	37.88	7.8	12.7	13.5	13.6
4 – 0.3750	34.09	7.4	12.4	13.1	13.2
4 – 0.3750	36.27	8.2	13.1	13.9	14.1
5 – 0.1875	35.50	7.8	12.7	13.5	13.6
5 – 0.1875	76.42	8.6	13.3	14.2	14.4
5 – 0.2500	35.73	7.9	12.8	13.6	13.7
5 – 0.2500	75.67	8.8	13.5	14.4	14.6
5 – 0.3750	36.72	7.9	12.8	13.6	13.7
5 – 0.3750	76.39	8.8	13.5	14.5	14.7

Table 1

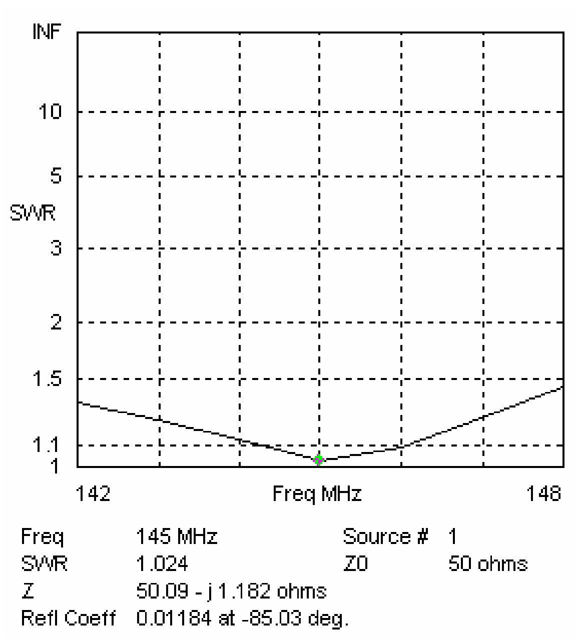
The pages that follow show the ½ element dimensions and element spacing's for each of the yagis shown in the table above. The patterns are free space azimuth plots and the SWR curves are for 142 to 148 mHz with data for 145 mHz.
One question arises and that being why aren't the longer 4 element beams much longer like the 5 element longer yagis. This is so because with fewer elements, there is less freedom to optimize all the variables in question. As the number of elements increases, the constraint space has more options but with the same number of optimization goals. Since gain requires longer beams, the gain can now also be optimized better while the goals of direct 50 ohm feed point and 20 dB front-to-back can be maintained.

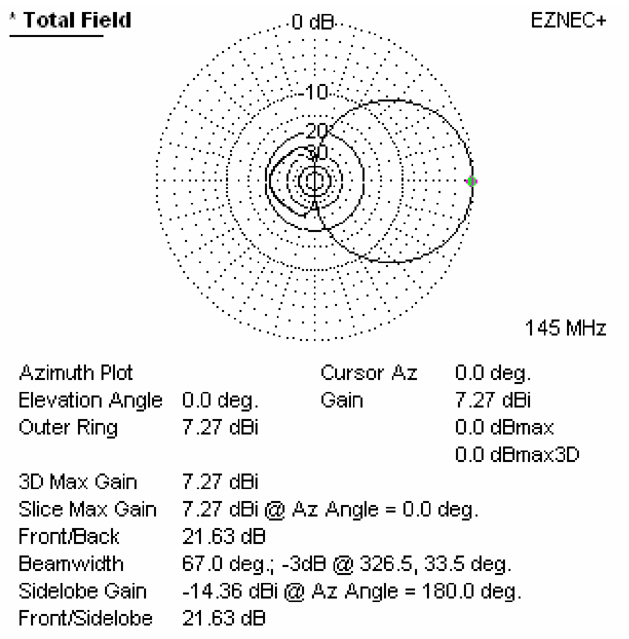
3 Element Designs

***145 MHz 3 element with 0.1875" dia elements*.**

Note: these are ½ element lengths and must be doubled

DR=20.39
DE=19.42
D1=17.51
S1=19.69
S2=31.57

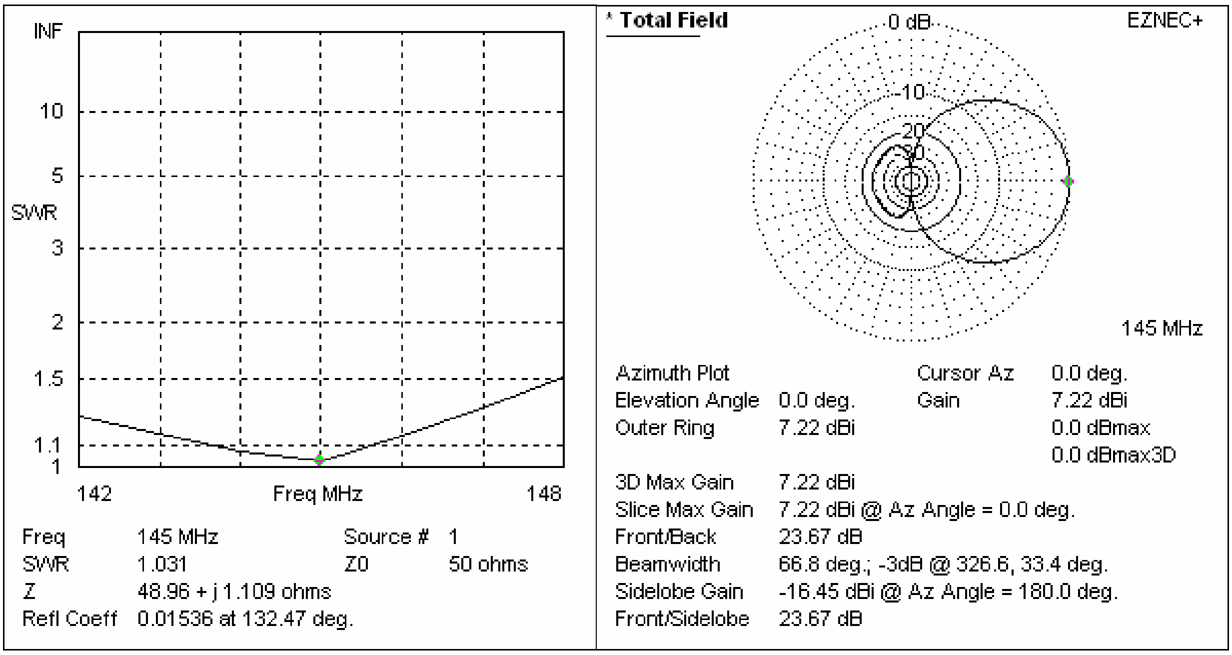




145 MHz 3 element with 0.25" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.64
DE=19.47
D1=17.44
S1=18.17
S2=29.40



145 MHz 3 element with 0.375" dia elements

Note: these are ½ element lengths and must be doubled

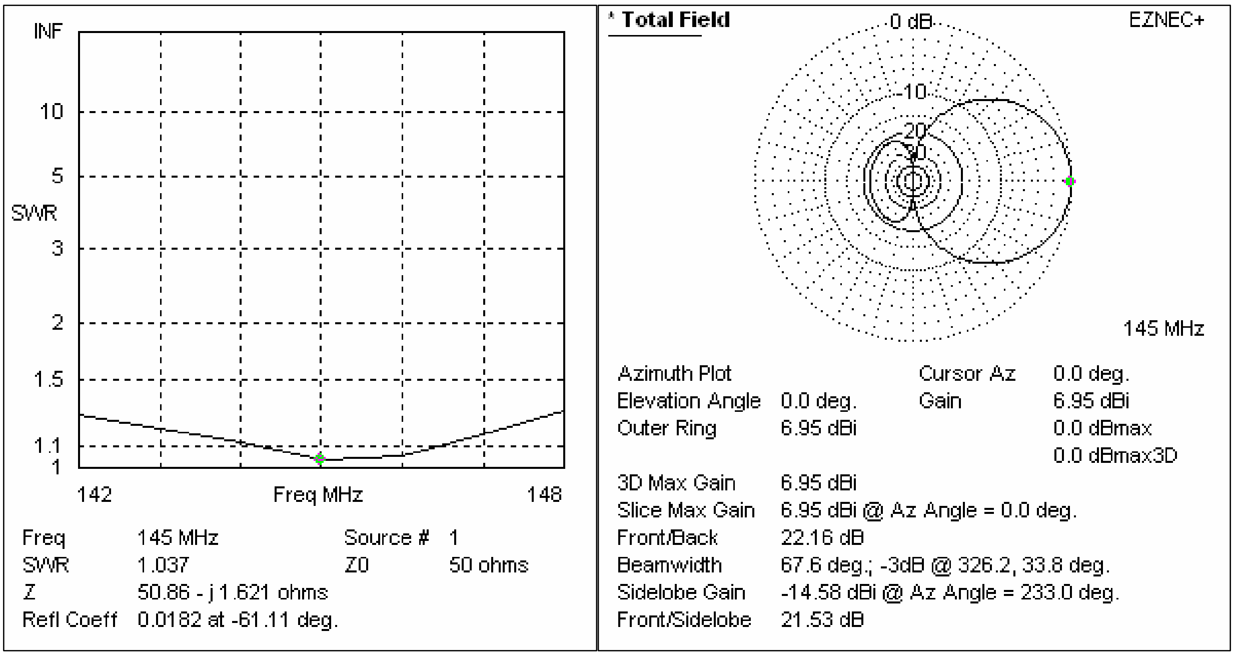
DR=21.12

DE=19.32

D1=17.02

S1=12.96

S2=23.48



145 MHz 4 element with 0.1875" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.69

DE=19.43

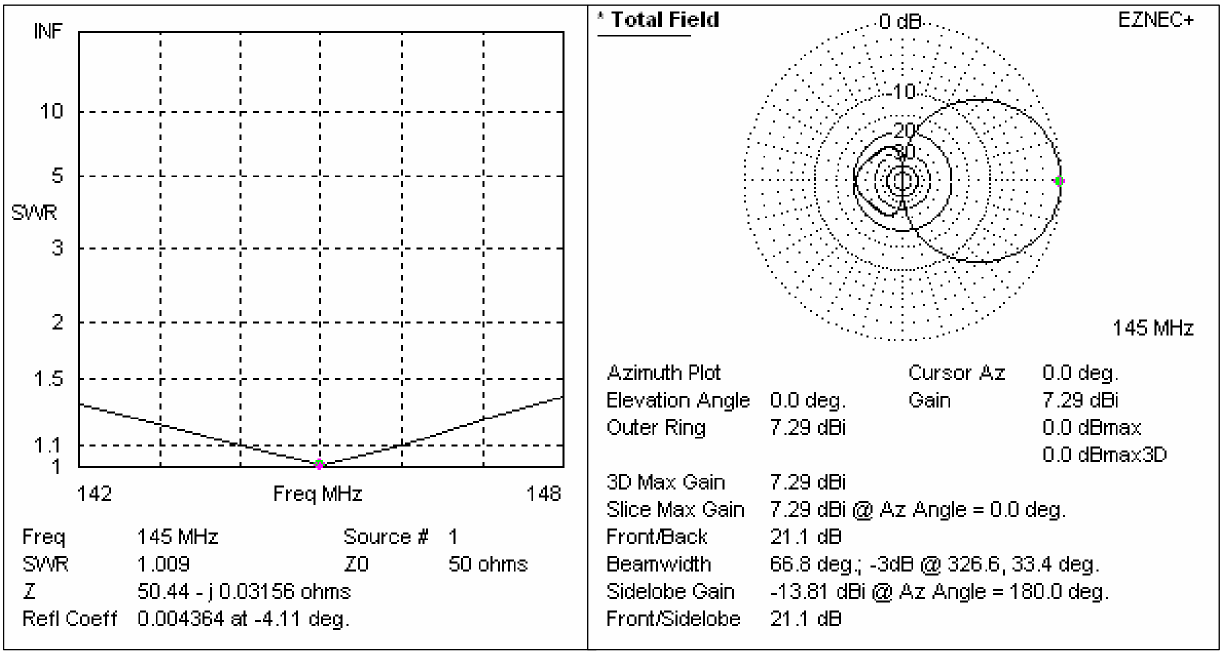
D1=16.91

D2=15.75

S1=17.79

S2=27.02

S3=33.80



145 MHz 4 element longer boom with 0.1875" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.77

DE=19.49

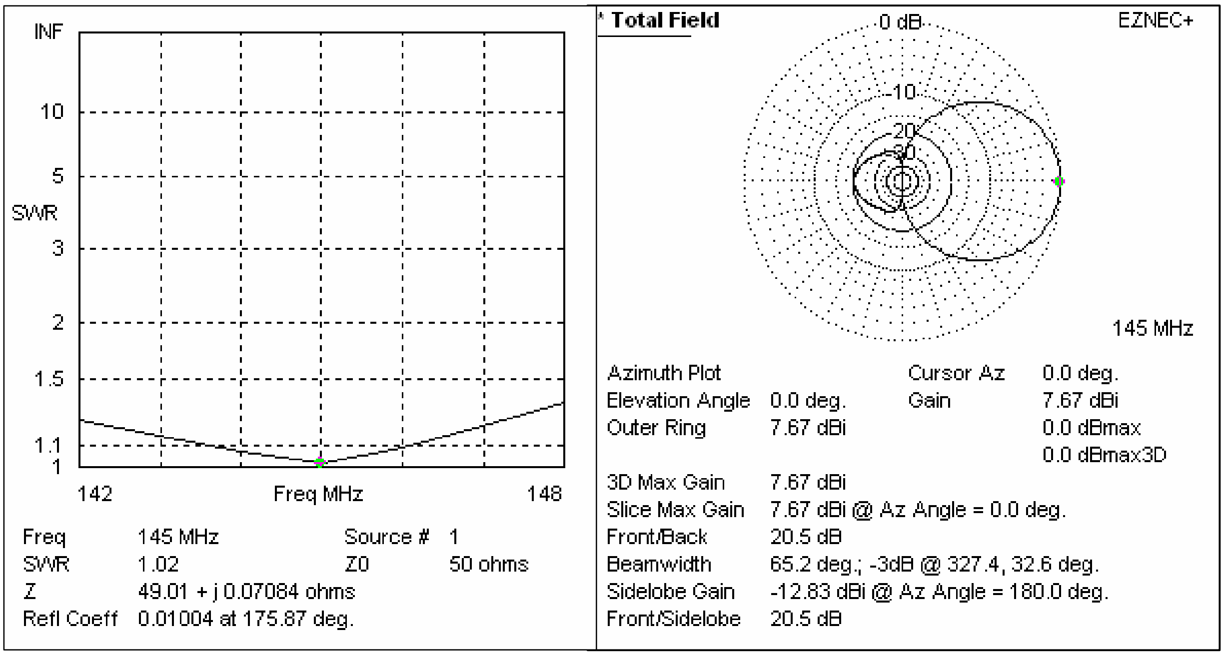
D1=17.78

D2=15.21

S1=14.27

S2=22.93

S3=38.70



145 MHz 4 element with 0.25" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.63

DE=19.33

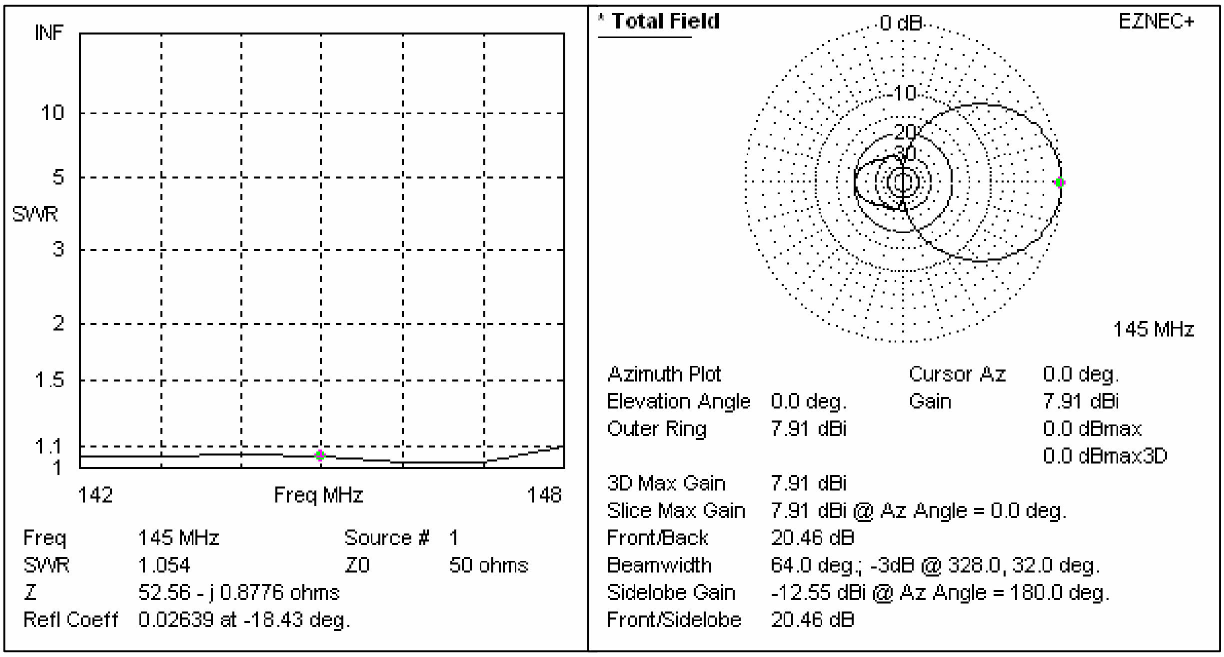
D1=16.73

D2=15.75

S1=16.90

S2=26.29

S3=33.81



145 MHz 4 element longer boom with 0.25" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.72

DE=19.52

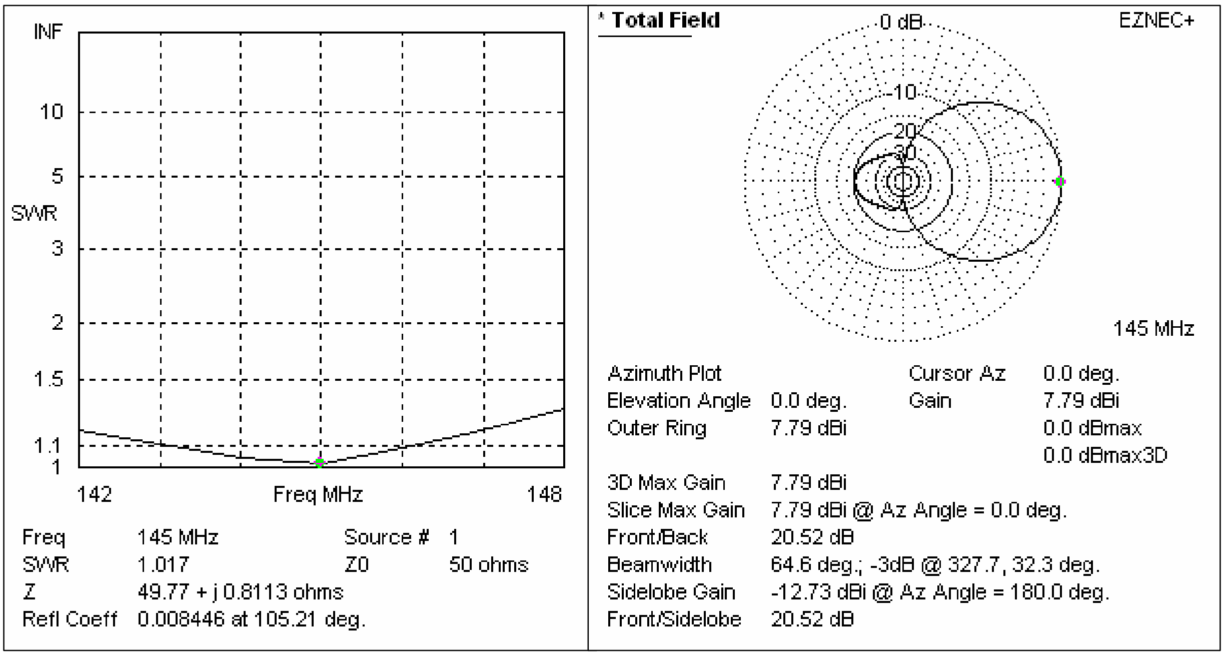
D1=17.76

D2=15.55

S1=14.42

S2=22.12

S3=37.88



145 MHz 4 element with 0.375" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.72

DE=19.27

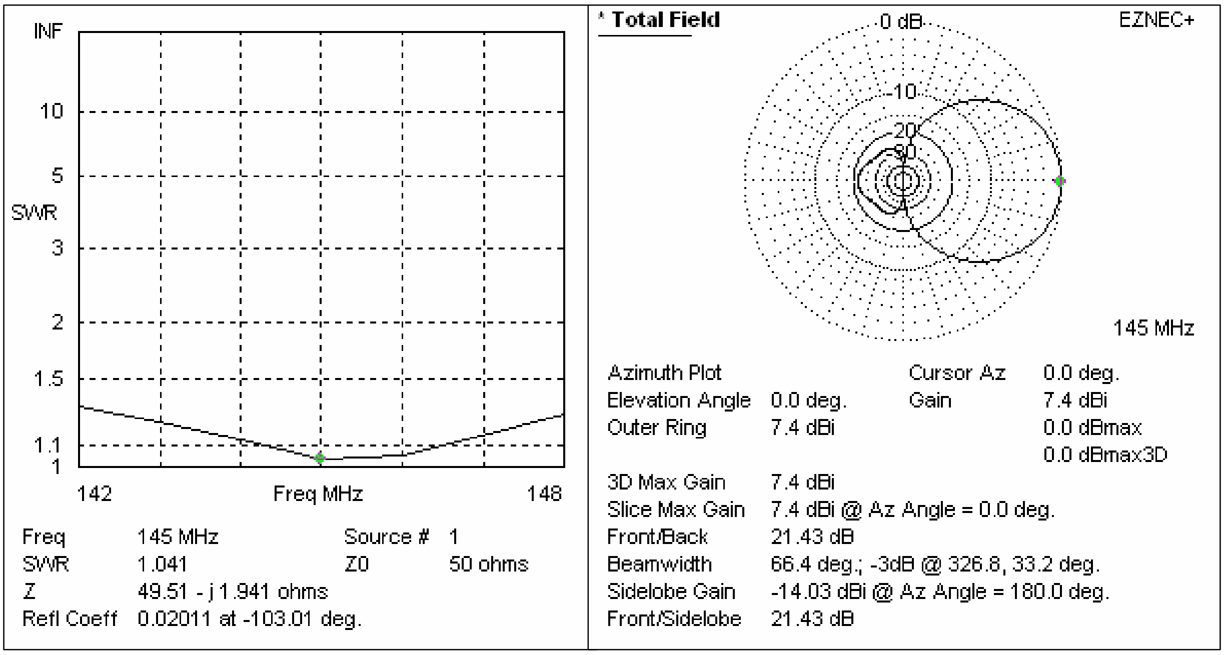
D1=16.60

D2=15.75

S1=17.91

S2=25.24

S3=34.09



145 MHz 4 element longer boom with 0.375" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.43

DE=19.50

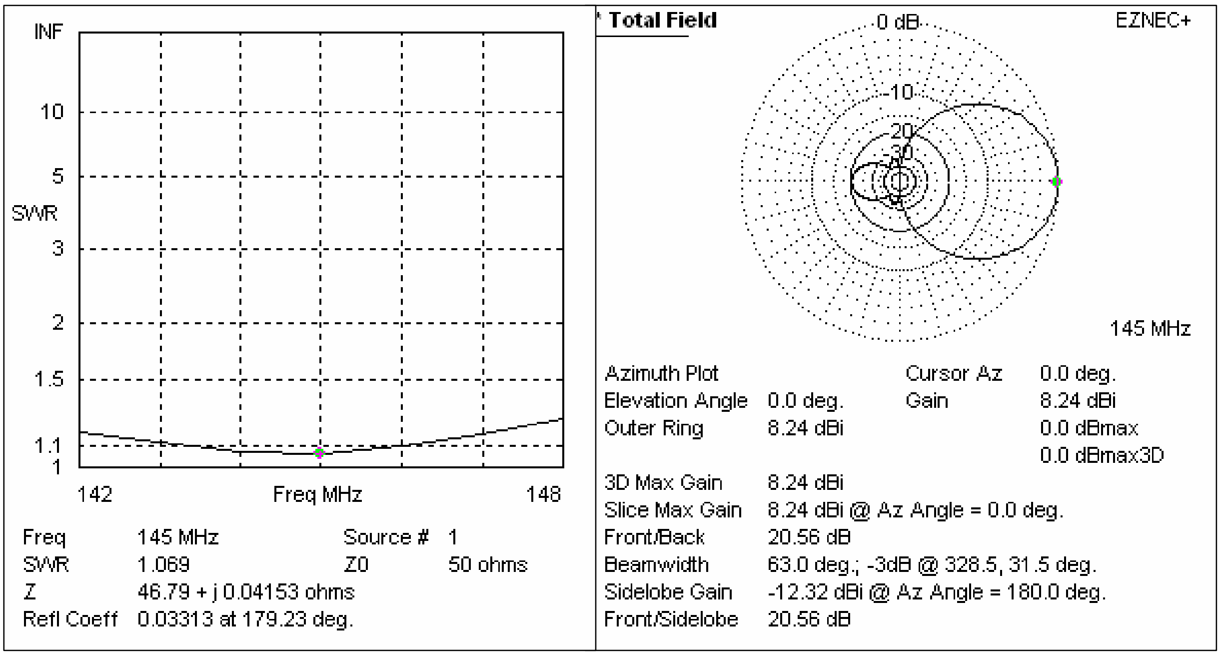
D1=17.92

D2=16.28

S1=14.01

S2=20.39

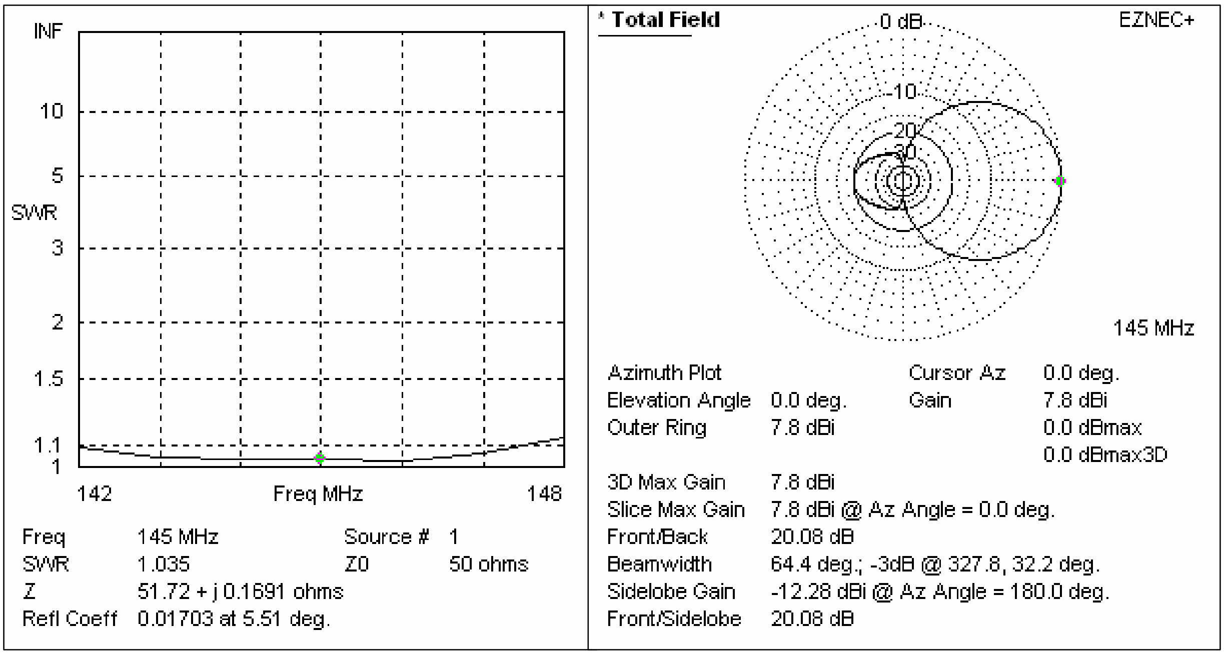
S3=36.37



145 MHz 5 element with 0.1875” dia elements

Note: these are ½ element lengths and must be doubled

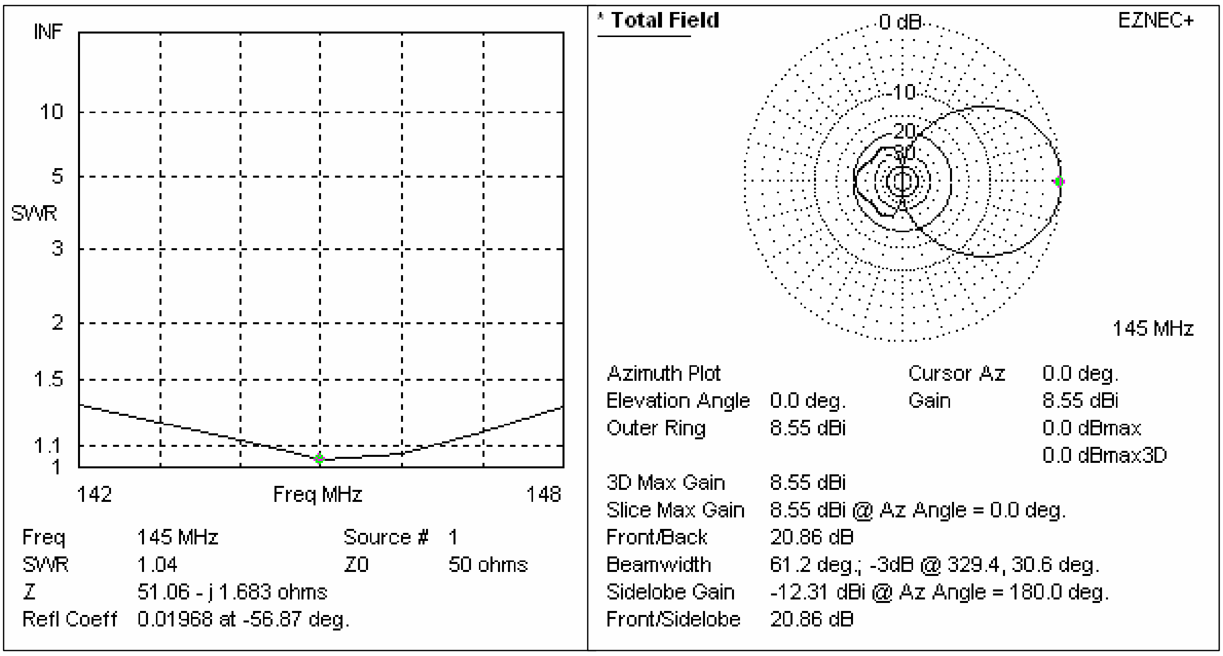
DR=20.77
DE=19.71
D1=18.18
D2=15.33
D3=14.86
S1=10.59
S2=25.94
S3=29.39
S4=35.50



145 MHz 5 element longer boom with 0.1875" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.60
DE=19.31
D1=17.56
D2=15.60
D3=15.11
S1=16.75
S2=28.26
S3=51.74
S4=76.39



145 MHz 5 element with 0.25" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.74

DE=19.72

D1=18.13

D2=15.79

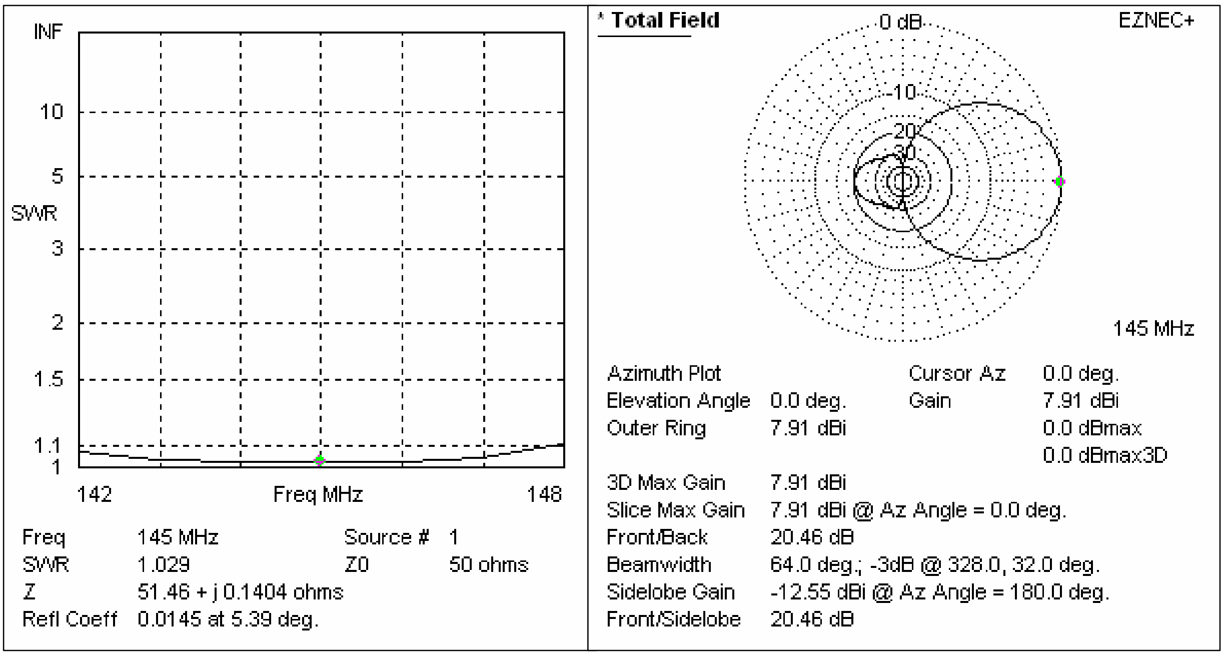
D3=14.75

S1=10.63

S2=15.35

S3=27.85

S4=35.73



145 MHz 5 element longer boom with 0.25" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.42

DE=19.26

D1=17.47

D2=15.60

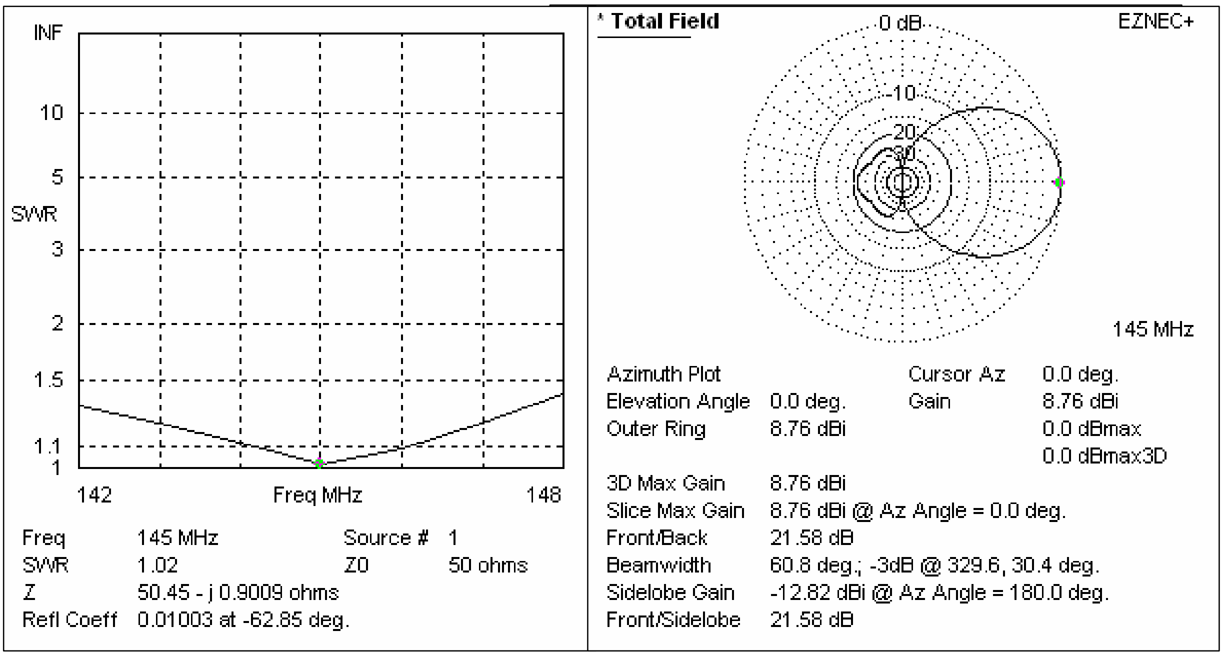
D3=15.09

S1=20.03

S2=32.15

S3=53.56

S4=75.67



145 MHz 5 element with 0.375" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.71

DE=19.55

D1=17.63

D2=15.15

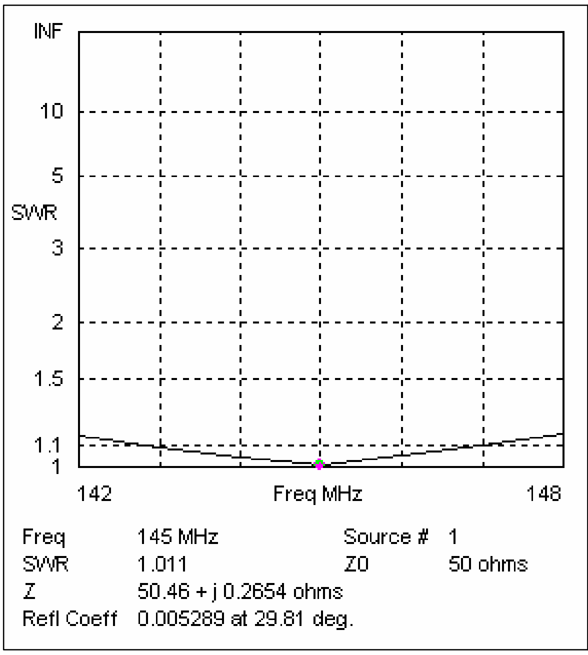
D3=14.66

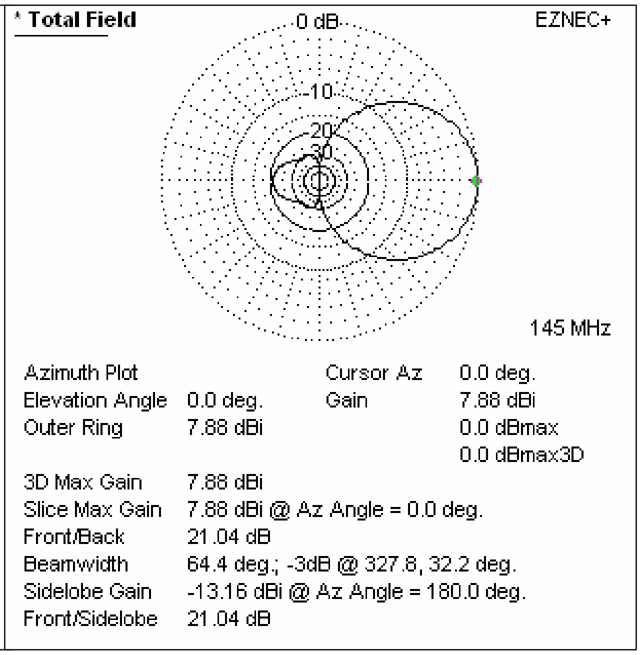
S1=13.85

S2=19.11

S3=29.61

S4=36.72

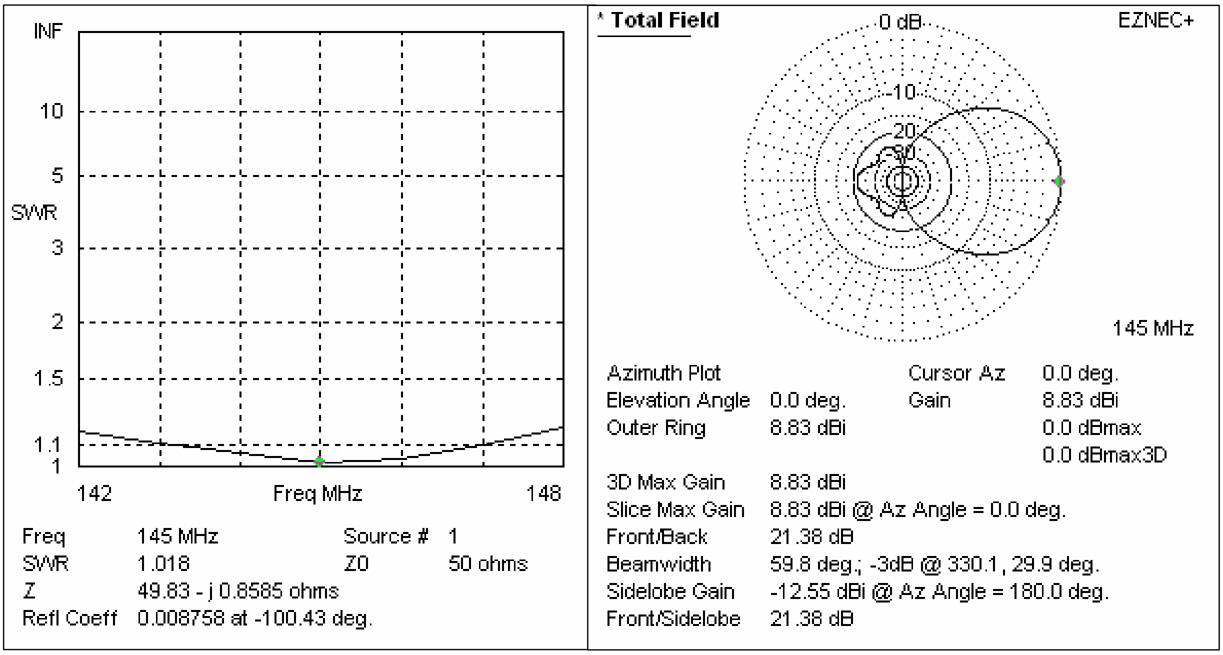




145 MHz 5 element longer boom with 0.375" dia elements

Note: these are ½ element lengths and must be doubled

DR=20.60
DE=19.31
D1=17.56
D2=15.60
D3=15.11
S1=16.75
S2=28.26
S3=51.74
S4=76.39

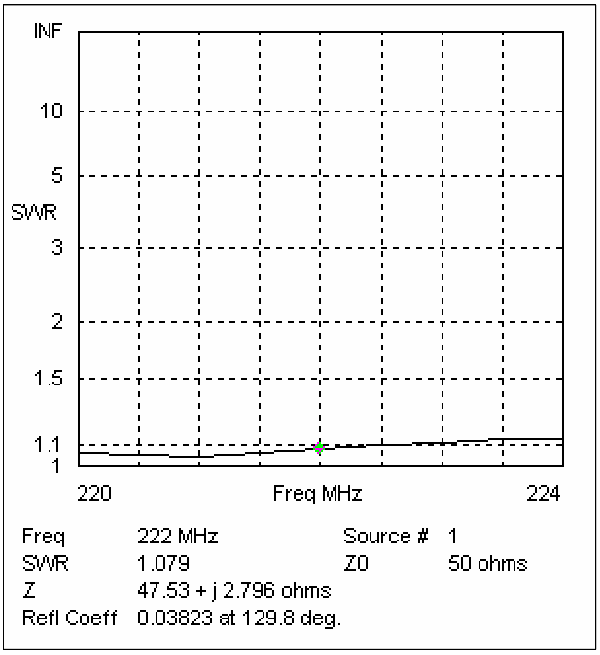


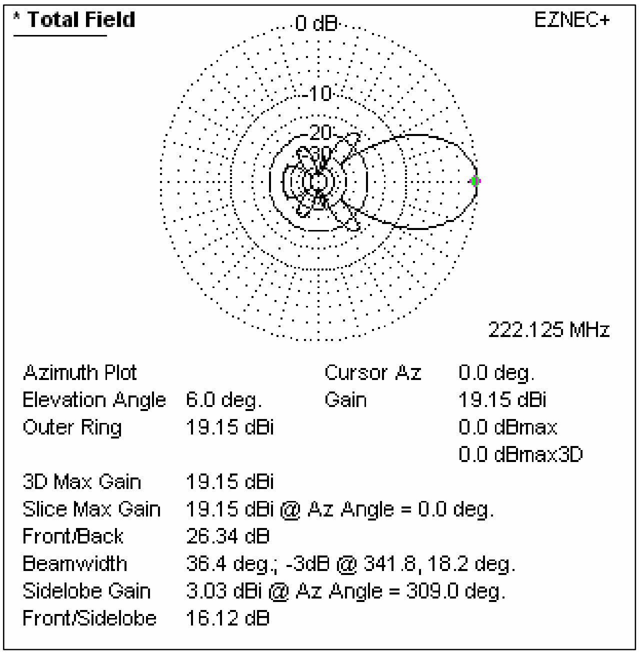
222 MHz 9 Element Amateur

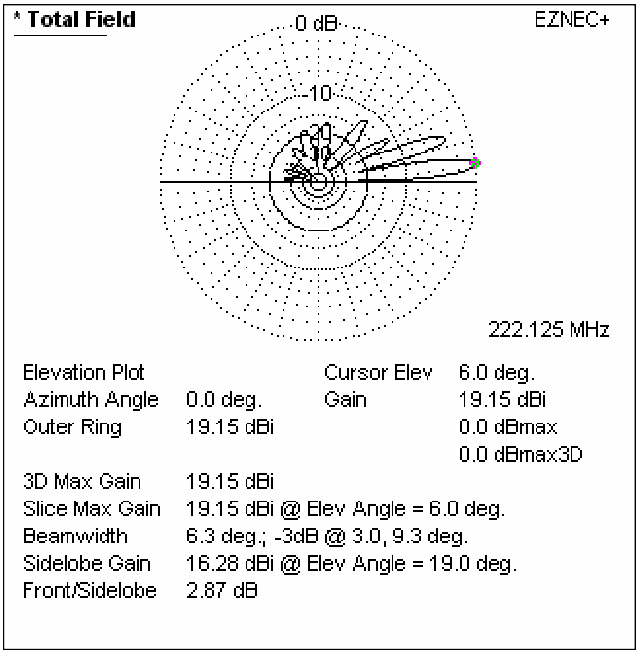
222 MHZ 9 EL 3/16 " elements

These are ½ element lengths and must be doubled

DR = 13.13	S0 = 0
DE = 12.8	S1 = 11.49
D1 = 11.94	S2 = 17.39
D2 = 11.66	S3 = 31.53
D3 = 11.45	S4 = 47.15
D4 = 11.42	S5 = 65.41
D5 = 11.33	S6 = 79.07
D6 = 11.44	S7 = 97.8
D7 = 11.25	S8 = 111.36







2 meter – 70 cm Interlaced 5 element

This beam consists of 2, 5 element beams. One designed for 144 MHz and thte other for 432 MHz. These beams are interlaced and are of moderate gain performance. The designs are for direct 50 ohm feed impedance and may be directly fed with 50 ohm line. The 432 MHz beam driven element is coupled to the 144 MHz driven element by close spacing. Only one feedline and one driving point is required.

2m-70cm Interlaced 5 EL 3/16" diameter

These are ½ element lengths and must be doubled

DR = 20.75	0.0
DE = 19.76	S1 = 10.7
D1 = 18.17	S2 = 15.8
D2 = 15.33	S3 = 29.1
D3 = 14.86	S5 = 34.9
DR2 = 6.75	S20 = 5.3
DE2 = 6.26	S21 = 12.4
D12 = 6.03	S22 = 18.17
D22 = 6.26	S23 = 29.8
D32 = 5.74	S24 = 39.6

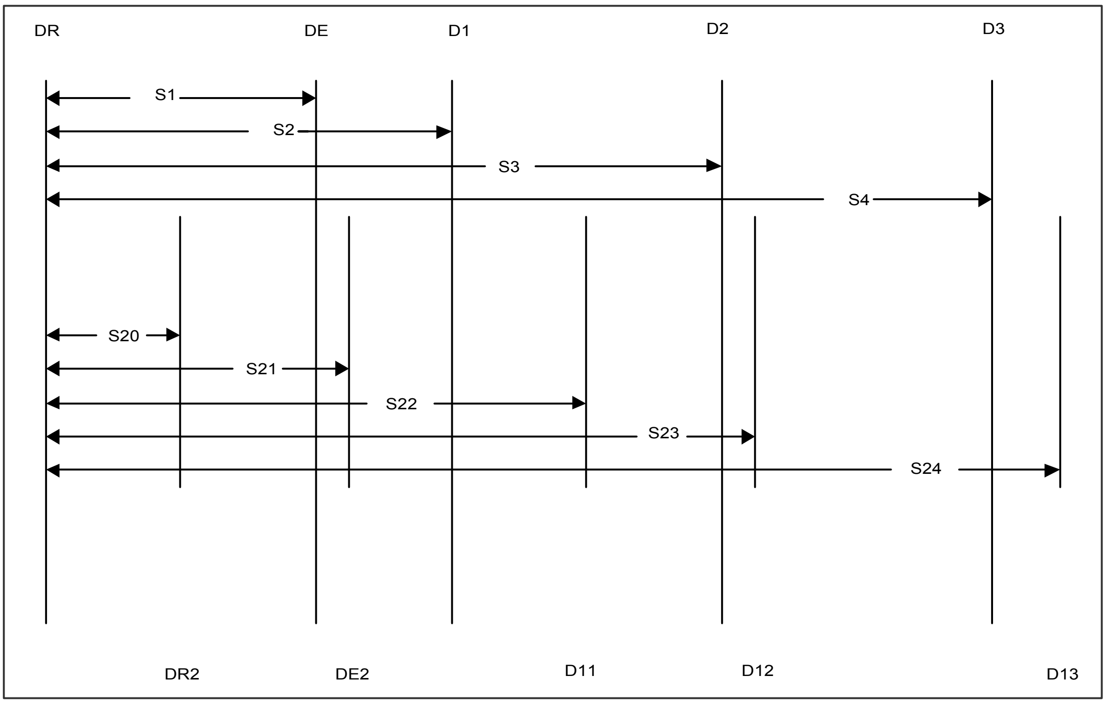
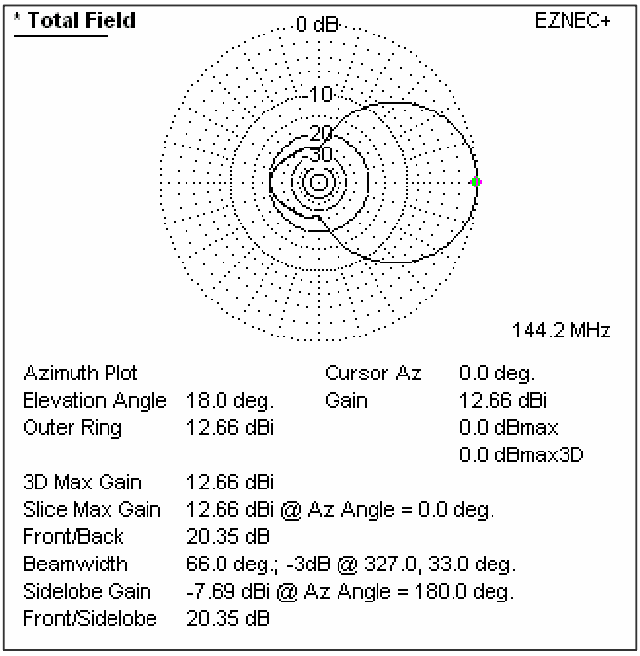
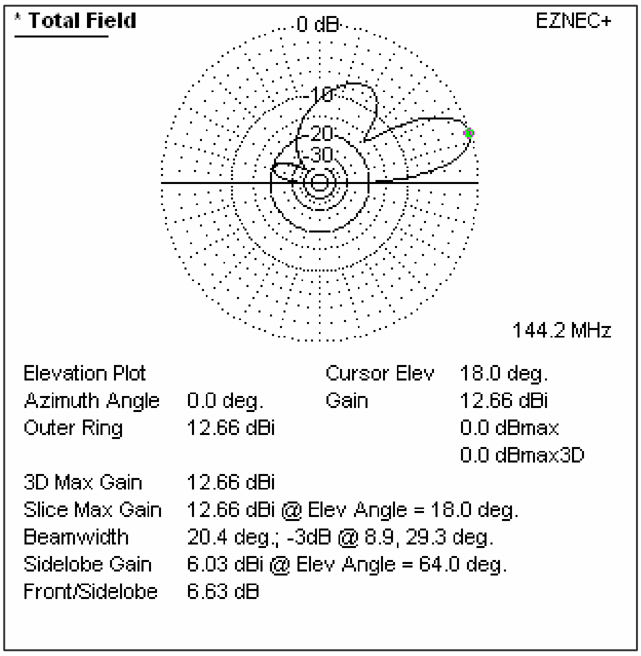
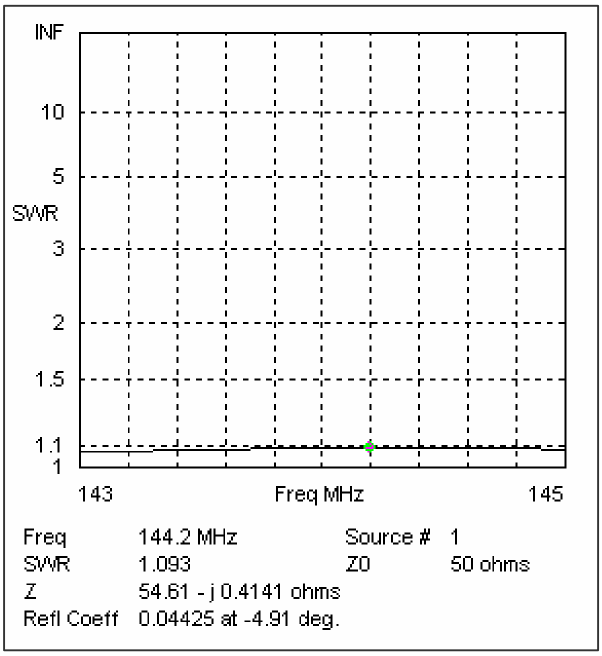


Fig 4

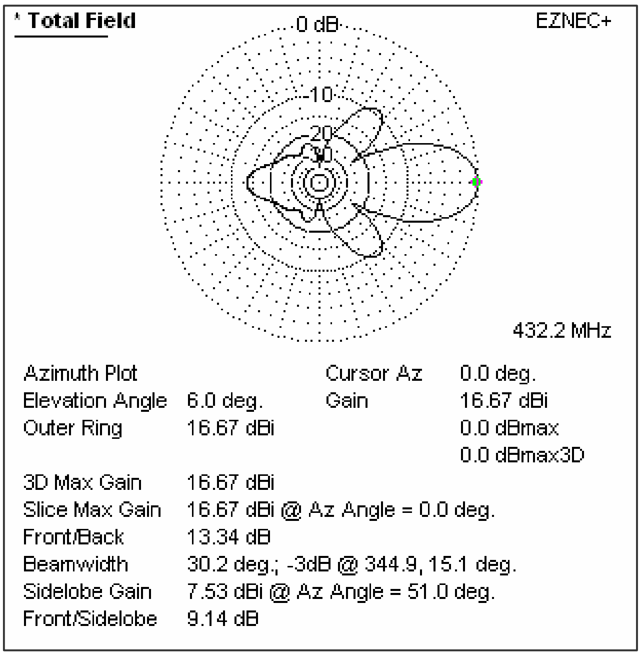
144 MHz Performance

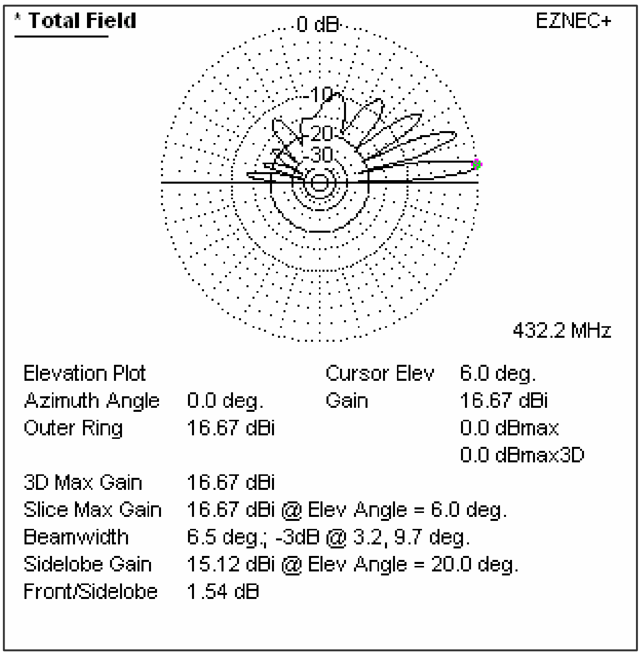


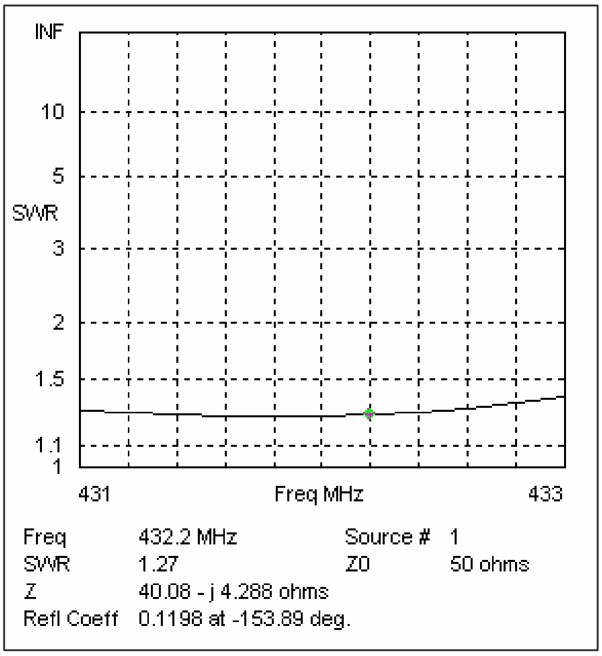




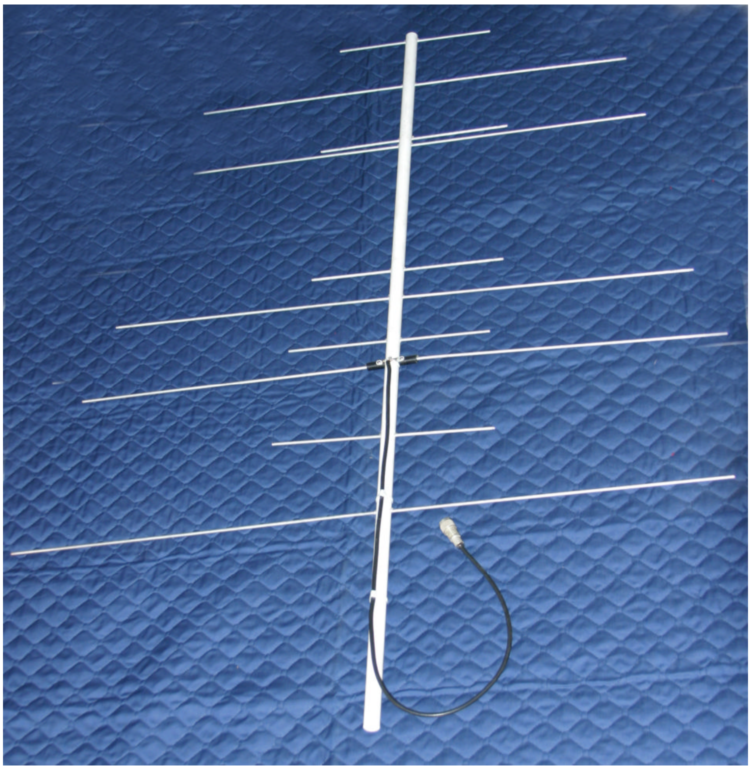
432 MHz Performance

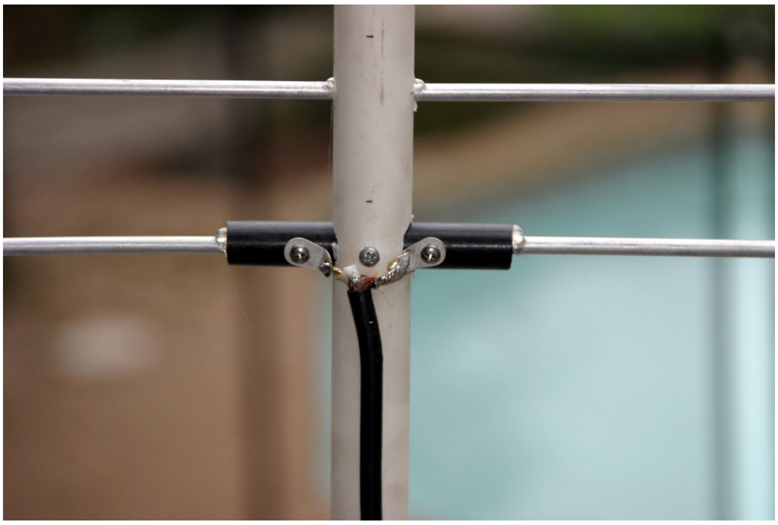




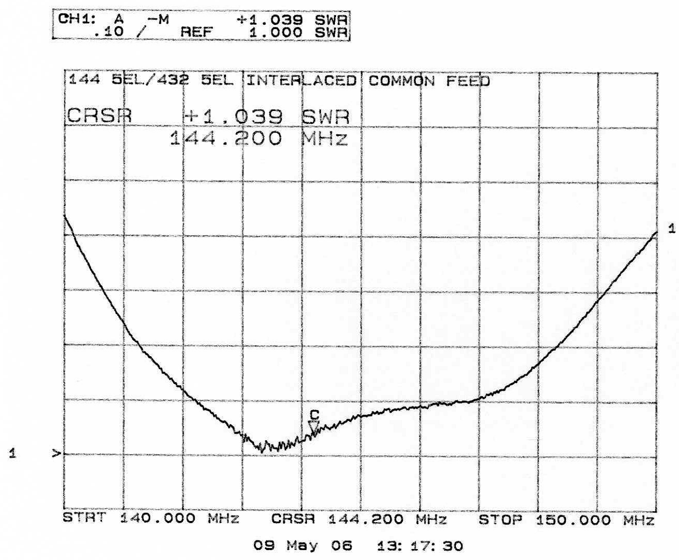


The following photographs and plots show the construction and performance measurements of the antenna described above. Assembly was with 1 inch PVC and .1875" aluminum rod. The feedpoint insulator is 0.5" delrin

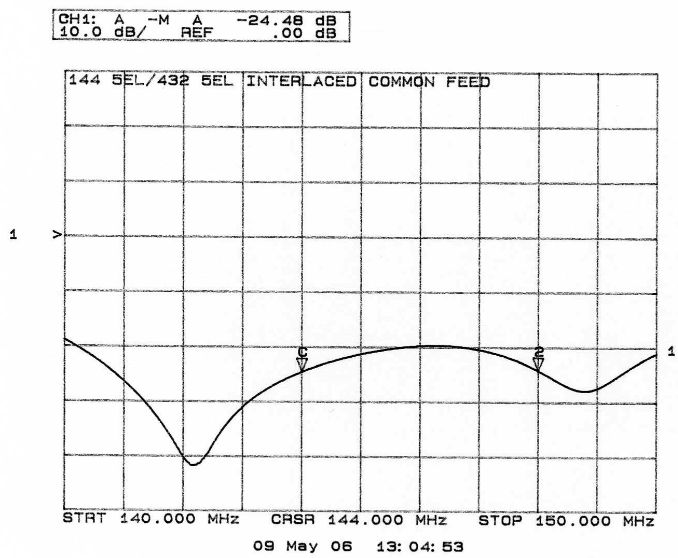




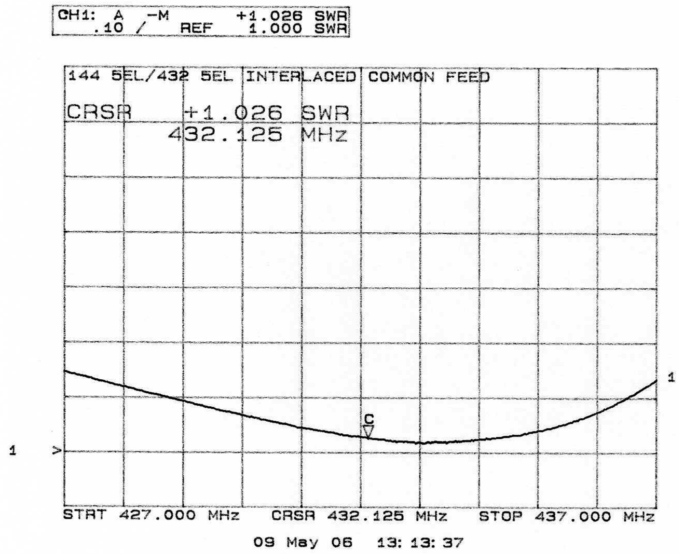
The antenna VSWR and return loss were measured on an HP network analyzer at both 144 MHz and 432 MHz. The cursor frequency in each case is shown on the plots. On the 144 MHz return loss plot, the upper cursor is at 148 MHz showing approximate band limits on 2 meters.



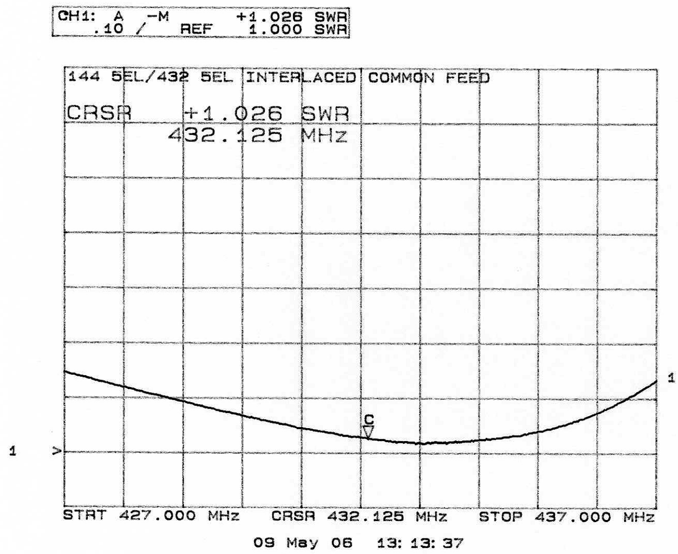
144 MHz VSWR



144 MHz Return Loss



432 MHz VSWR



432 MHz Return Loss

222 MHz 5 element / 432MHz 6 element Interlaced

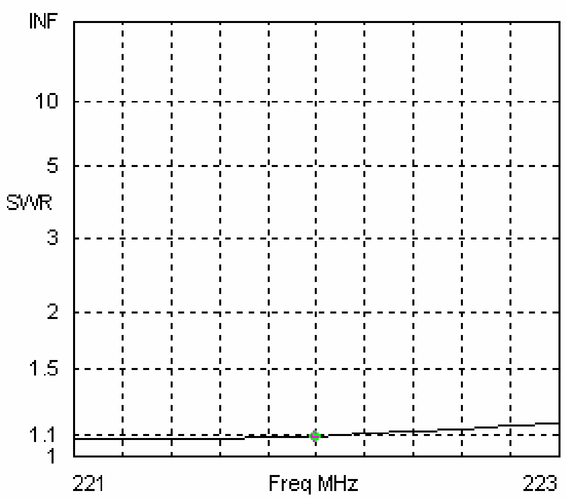
222 MHz 5 Element – 432 MHz 6 Element Design

This antenna is another interlaced design and is intended for 222/432 MHz operation. Element and spacing data is shown below with element and spacing identification similar to Fig 4 above with the addition of another element on 432 MHz.

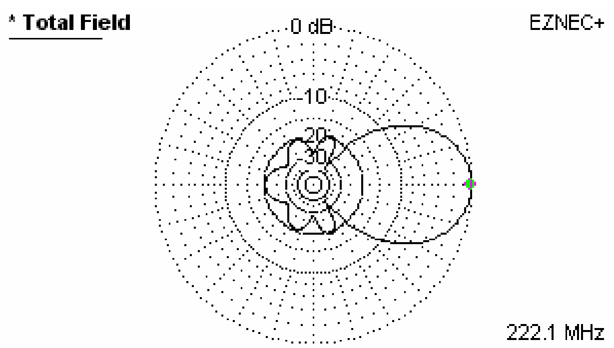
These are ½ element lengths and must be doubled

DR = 13.31	S0 = 0
DE = 12.55	S1 = 13.23
D1 = 11.51	S2 = 24.32
D2 = 12.02	S3 = 39.84
D3 = 11.34	S4 = 51.57
DR2 = 6.88	S20 = 6.00
DE2 = 6.44	S21 = 13.90
D12 = 5.87	S22 = 19.21
D22 = 6.06	S23 = 26.56
D32 = 5.87	S24 = 35.85
D33 = 5.54	S25 = 42.79

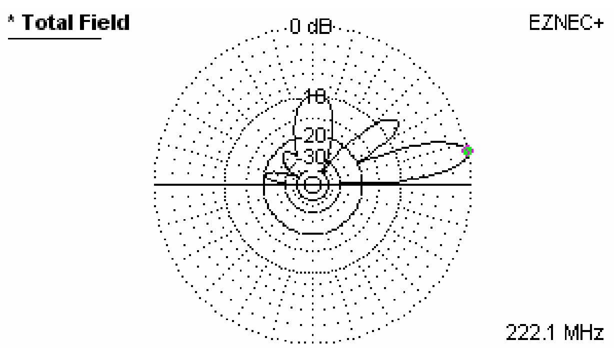
222 MHz Performance @ 5 ft height



Freq	222 MHz	Source #	1
SWR	1.098	Z0	50 ohms
Z	45.74 + j 1.43 ohms		
Refl Coeff	0.04691 at 160.59 deg.		

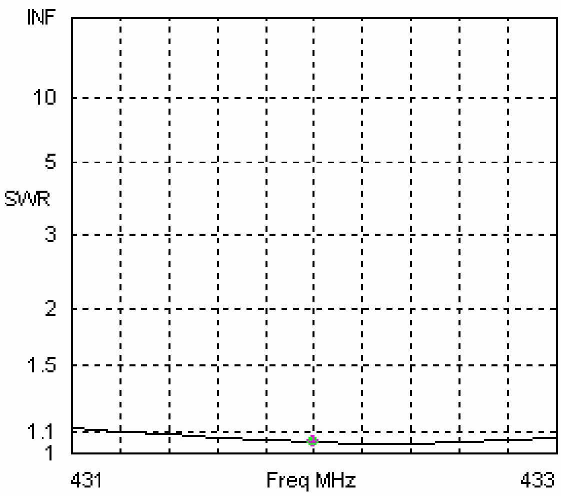


Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	12.0 deg.	Gain	15.35 dBi
Outer Ring	15.35 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	15.35 dBi		
Slice Max Gain	15.35 dBi @ Az Angle = 0.0 deg.		
Front/Back	20.44 dB		
Beamwidth	47.2 deg.; -3dB @ 336.4, 23.6 deg.		
Sidelobe Gain	-3.77 dBi @ Az Angle = 290.0 deg.		
Front/Sidelobe	19.12 dB		

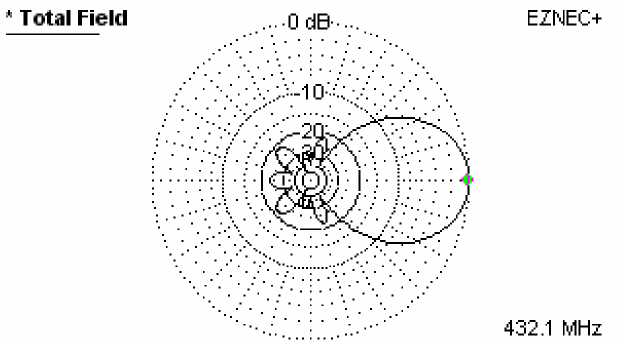


Elevation Plot		Cursor Elev	12.0 deg.
Azimuth Angle	0.0 deg.	Gain	15.35 dBi
Outer Ring	15.35 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	15.35 dBi		
Slice Max Gain	15.35 dBi @ Elev Angle = 12.0 deg.		
Beamwidth	12.6 deg.; -3dB @ 5.8, 18.4 deg.		
Sidelobe Gain	8.4 dBi @ Elev Angle = 37.0 deg.		
Front/Sidelobe	6.95 dB		

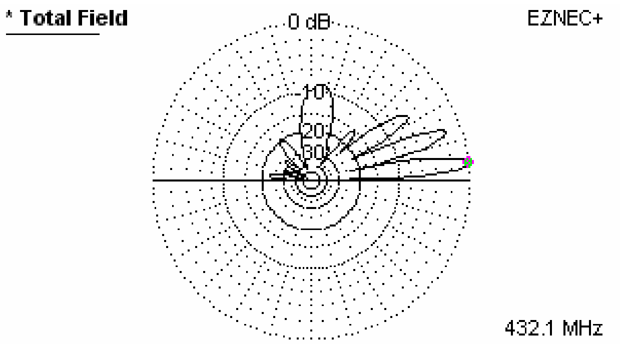
432 MHz Performance @ 5 ft



Freq	432 MHz	Source #	1
SWR	1.053	Z0	50 ohms
Z	47.57 - j 0.5958 ohms		
Refl Coeff	0.02562 at -165.86 deg.		

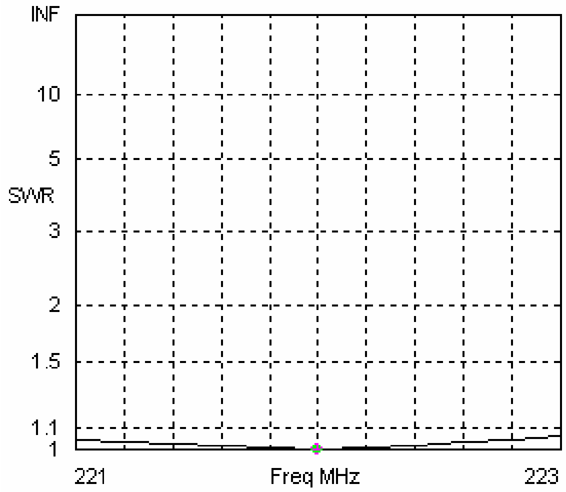


Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	6.0 deg.	Gain	16.07 dBi
Outer Ring	16.07 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	16.07 dBi		
Slice Max Gain	16.07 dBi @ Az Angle = 0.0 deg.		
Front/Back	23.16 dB		
Beamwidth	49.6 deg.; -3dB @ 335.2, 24.8 deg.		
Sidelobe Gain	-5.4 dBi @ Az Angle = 224.0 deg.		
Front/Sidelobe	21.48 dB		

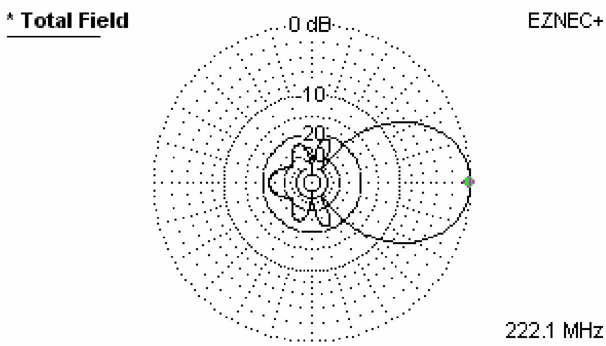


Elevation Plot		Cursor Elev	6.0 deg.
Azimuth Angle	0.0 deg.	Gain	16.07 dBi
Outer Ring	16.07 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	16.07 dBi		
Slice Max Gain	16.07 dBi @ Elev Angle = 6.0 deg.		
Beamwidth	6.4 deg.; -3dB @ 3.2, 9.6 deg.		
Sidelobe Gain	14.3 dBi @ Elev Angle = 20.0 deg.		
Front/Sidelobe	1.78 dB		

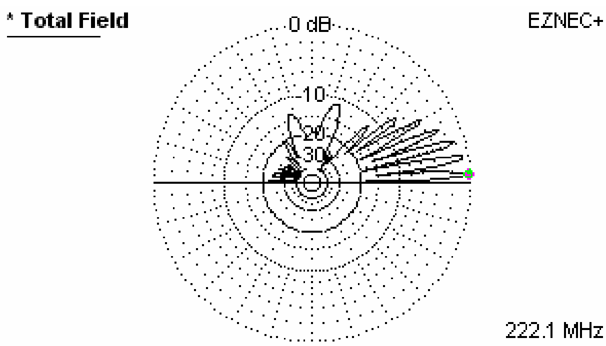
222 MHz Performance @20 ft height



Freq	222 MHz	Source #	1
SWR	1.002	Z0	50 ohms
Z	49.94 - j 0.0837 ohms		
Refl Coeff	0.001037 at -126.07 deg.		

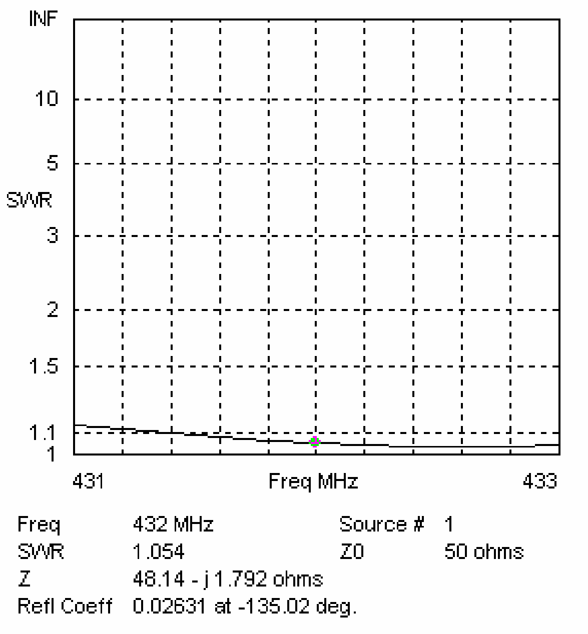


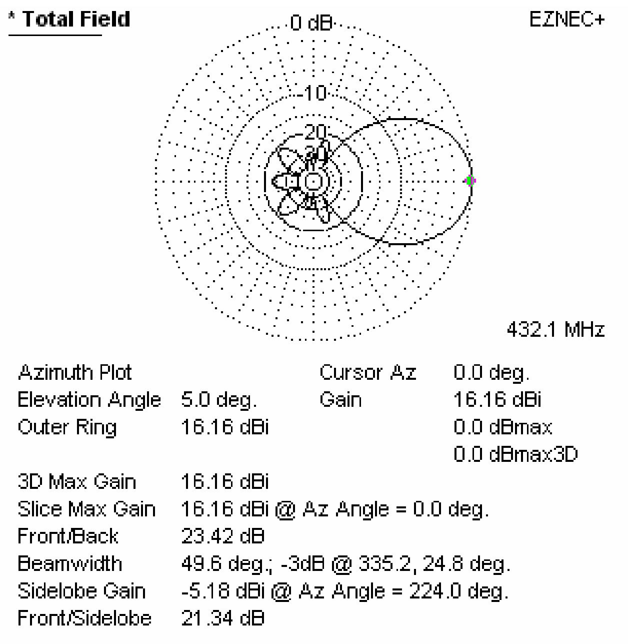
Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	3.0 deg.	Gain	16.24 dBi
Outer Ring	16.24 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	16.24 dBi		
Slice Max Gain	16.24 dBi @ Az Angle = 0.0 deg.		
Front/Back	22.66 dB		
Beamwidth	48.0 deg.; -3dB @ 336.0, 24.0 deg.		
Sidelobe Gain	-4.92 dBi @ Az Angle = 290.0 deg.		
Front/Sidelobe	21.16 dB		

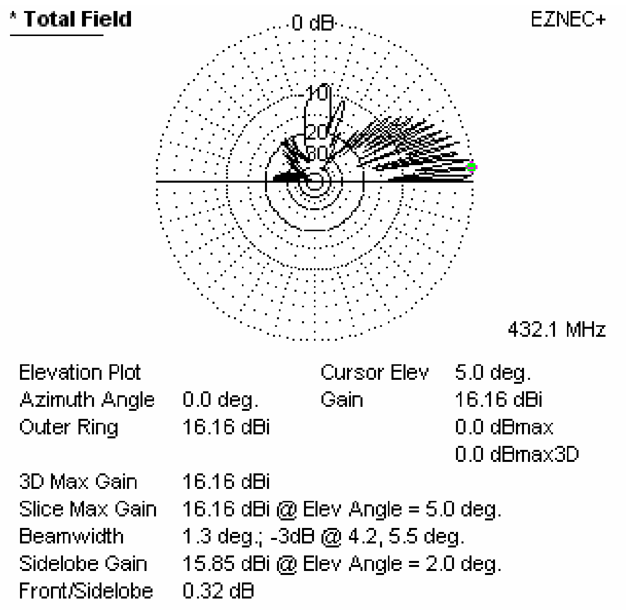


Elevation Plot		Cursor Elev	3.0 deg.
Azimuth Angle	0.0 deg.	Gain	16.24 dBi
Outer Ring	16.24 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	16.24 dBi		
Slice Max Gain	16.24 dBi @ Elev Angle = 3.0 deg.		
Beamwidth	2.9 deg.; -3dB @ 1.7, 4.6 deg.		
Sidelobe Gain	15.5 dBi @ Elev Angle = 10.0 deg.		
Front/Sidelobe	0.74 dB		

432 MHz Performance @ 20 ft







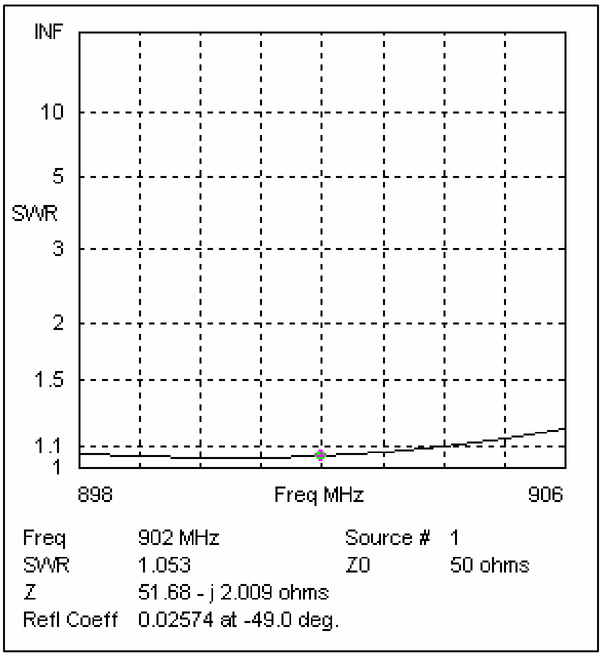
902 MHz Yagis

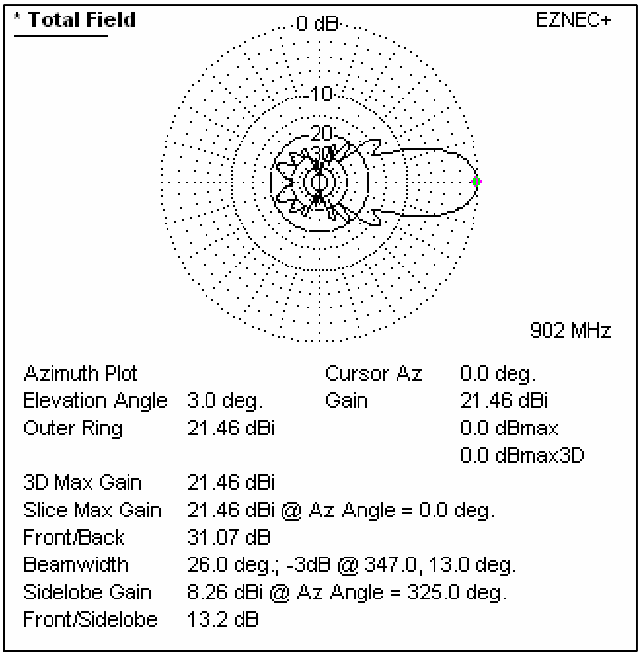
As we move higher in frequency, feeding a conventional yagi design becomes more difficult. The tolerances are tight and small errors will make the beam almost unusable. An alternate method of feeding the beam which provides adjustment latitude but still is less complicated than T- match, Gamma or Omega matches may be achieved by using a full wave loop as the driven element. These antennas are generally known as a Quagi. Easy feedpoint adjustment is possible provided that VSWR measuring equipment is available. The loop can be mounted in place of the split driven element by using dielectric rod to support the loop in place. In some instances the loop can just replace the driven element at the same spacing. Whether this is true or not is dependent upon the element diameter and the original design. In the example shown, a 14 element yagi with 0.125 inch diameter elements, the loop was just placed where the normal yagi driven element would have been. I attempted to build this antenna with standard split element using a dielectric rod through the boom with elements inserted in the ends as shown in Fig 3 but I was never able to get satisfactory feedpoint impedance due to the physical split of the coax. The coax center conductor and shield lead lengths were just too long.
The loop on the other hand was quickly and easily matched. Various connectors can be used but the connection to the shield or shell of the connector must be right at the shell. Soldering the loop directly to the shell by placing through a mounting hole is recommended. While difficult to see in the following photographs, the wire end is touching the nut so that the lug is not adding to the loop length. Calculated and measured data for this antenna is also shown.

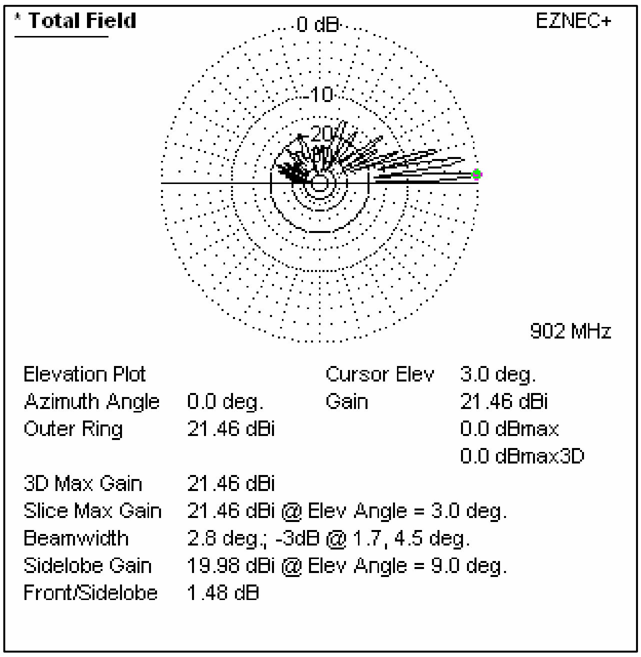
14 Element 902 Mhz Yagi

LR = 3.1875	0.0
DE = 3	S1 = 3.25
D1 = 2.8125	S2 = 5.75
D2 = 2.78125	S3 = 9.25
D3 = 2.71875	S4 = 14.25
D4 = 2.65625	S5 = 19.25
D5 = 2.65625	S6 = 24.25
D6 = 2.65625	S7 = 29.5
D7 = 2.625	S8 = 33.25
D8 = 2.5	S9 = 37.25
D9 = 2.59375	S10 = 41.5
D10 = 2.5	S11 = 45
D11 = 2.65625	S12 = 48.75
D12 = 2.65625	S13 = 52.25

Again these are ½ element lengths and have been rounded to the nearest 1/32 inch.
Predicted performance is shown below


INF
10
5
SWR
3
2
1.5
1.1
1
898
Freq MHz
906
Freq 902 MHz
Source # 1
SWR 1.053
Z0 50 ohms
Z 51.68 - j 2.009 ohms
Refl Coeff 0.02574 at -49.0 deg.

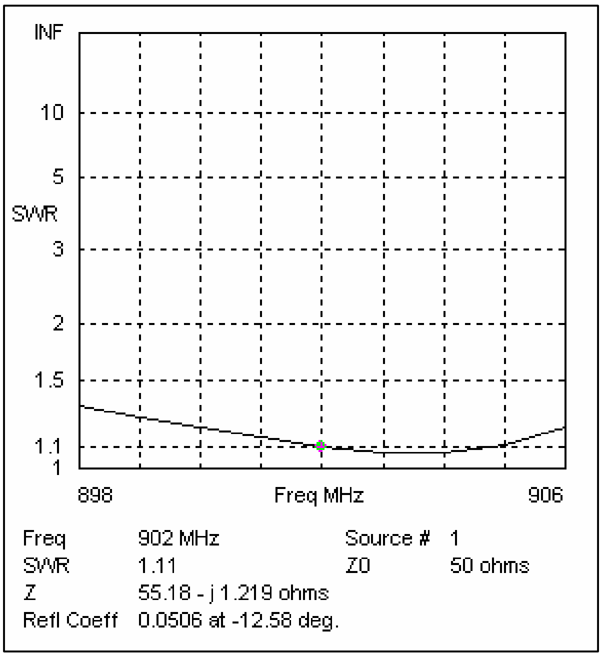

* Total Field
0 dB
EZNEC+
10
20
30
902 MHz
Azimuth Plot
Cursor Az 0.0 deg.
Elevation Angle 3.0 deg.
Gain 21.46 dBi
Outer Ring 21.46 dBi
0.0 dBmax
0.0 dBmax3D
3D Max Gain 21.46 dBi
Slice Max Gain 21.46 dBi @ Az Angle = 0.0 deg.
Front/Back 31.07 dB
Beamwidth 26.0 deg.; -3dB @ 347.0, 13.0 deg.
Sidelobe Gain 8.26 dBi @ Az Angle = 325.0 deg.
Front/Sidelobe 13.2 dB

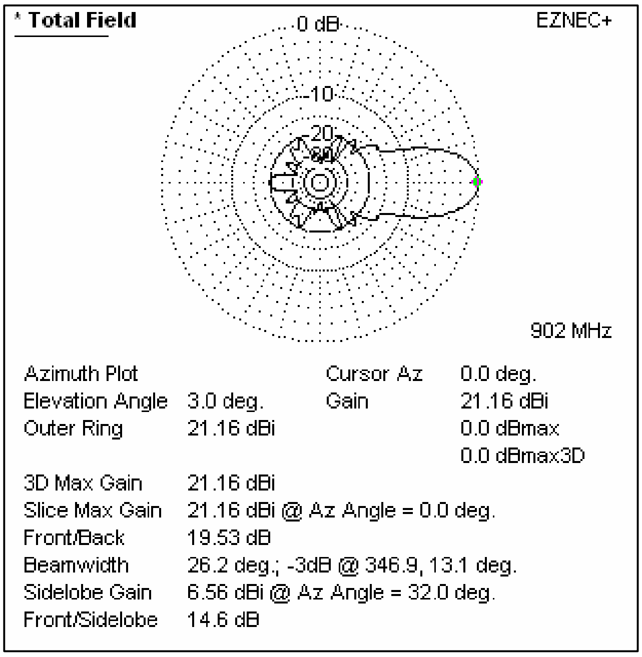

* Total Field
0 dB
EZNEC+
10
20
902 MHz
Elevation Plot
Cursor Elev 3.0 deg.
Azimuth Angle 0.0 deg.
Gain 21.46 dBi
Outer Ring 21.46 dBi
0.0 dBmax
0.0 dBmax3D
3D Max Gain 21.46 dBi
Slice Max Gain 21.46 dBi @ Elev Angle = 3.0 deg.
Beamwidth 2.8 deg.; -3dB @ 1.7, 4.5 deg.
Sidelobe Gain 19.98 dBi @ Elev Angle = 9.0 deg.
Front/Sidelobe 1.48 dB

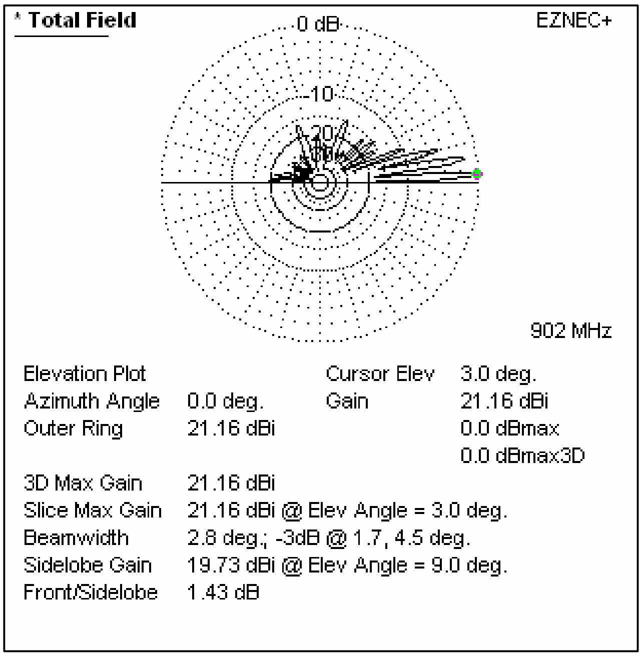
When the loop is inserted in place of the split dipole, it should have the following **total wire length** of #10 copper wire. (obtain from piece of #10 Romex)

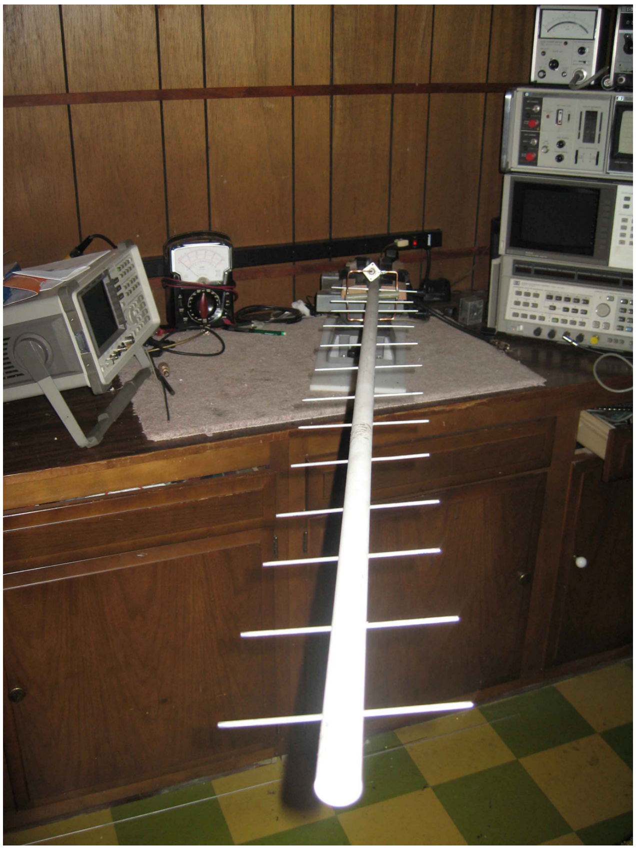
DE = 14.25 "

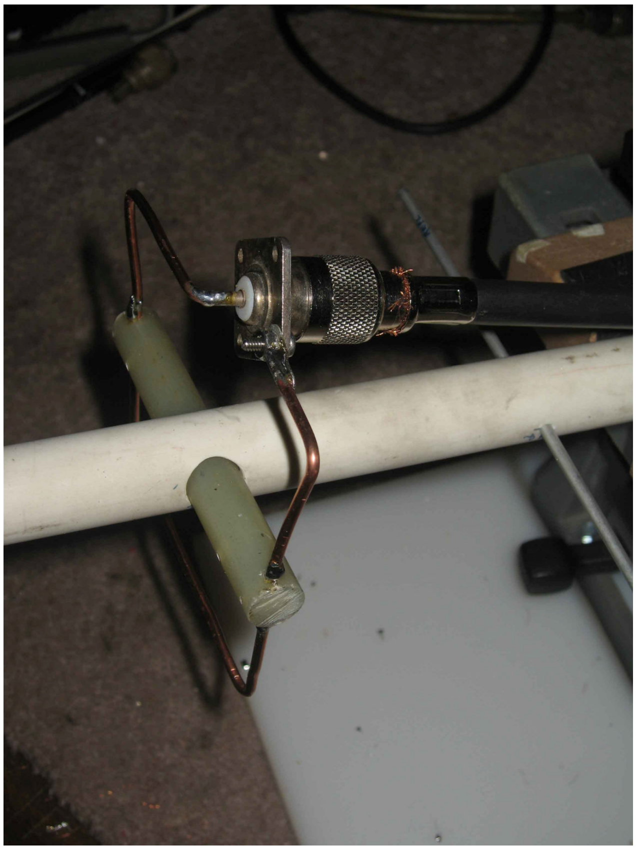
This would be the starting length and will probably have to be shortened somewhat due to construction practice and the size of the connector. The following is the predicted performance. Comparison will show about 0.3db loss in forward gain and somewhat less clean elevation pattern. This remains a very acceptable design.

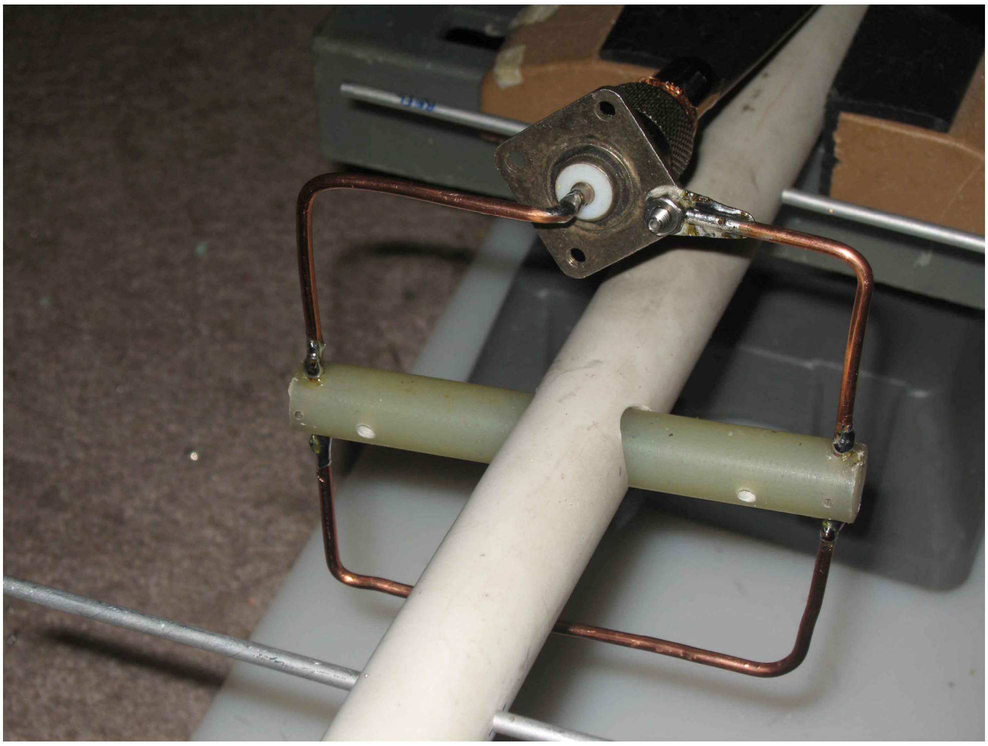








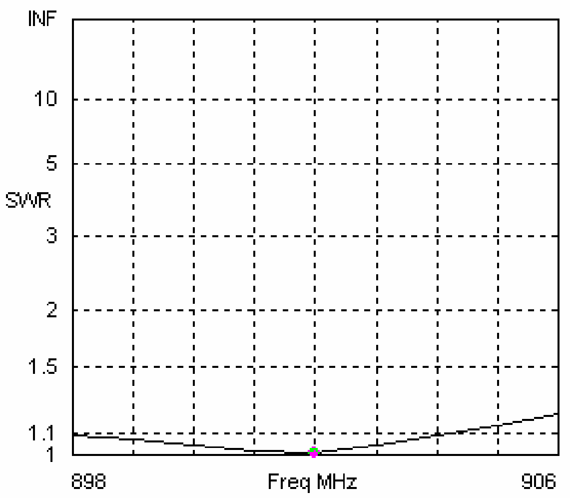




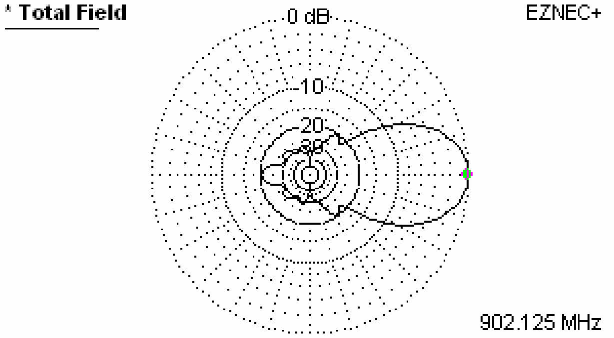
902 MHz 7 Element

This is a 902 MHz 7 element yagi designed for the weak signal area of 902 MHz band. The element diameter is 0.125 inches (1/8"). Performance data is for a height of 5 feet.

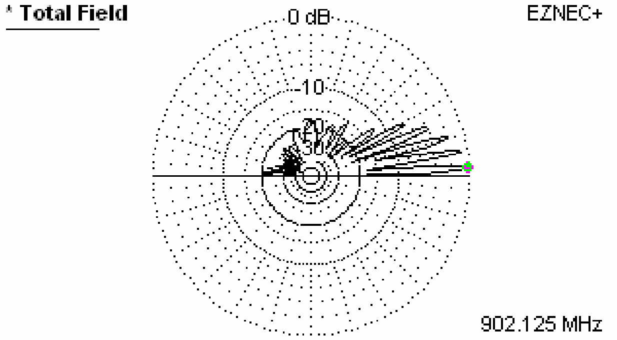
LR = 3.22	0.00
DE = 3.04	S1 = 2.75
D1 = 2.88	S2 = 4.5
D2 = 2.84	S3 = 7.5
D3 = 2.65	S3 = 7.5
D4 = 2.75	S5 = 17.25
D5 = 2.65	S6 = 21



Freq	902 MHz	Source #	1
SWR	1.011	Z0	50 ohms
Z	50.24 - j 0.5194 ohms		
Refl Coeff	0.005694 at -65.22 deg.		



Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	3.0 deg.	Gain	18.66 dBi
Outer Ring	18.66 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	18.66 dBi		
Slice Max Gain	18.66 dBi @ Az Angle = 0.0 deg.		
Front/Back	20.56 dB		
Beamwidth	39.2 deg.; -3dB @ 340.4, 19.6 deg.		
Sidelobe Gain	-1.71 dBi @ Az Angle = 305.0 deg.		
Front/Sidelobe	20.37 dB		

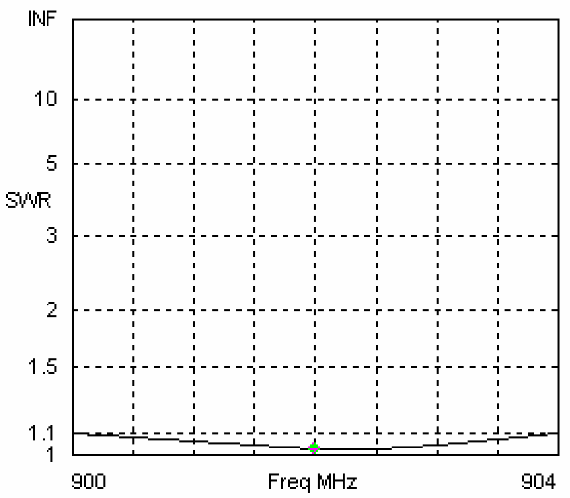


Elevation Plot		Cursor Elev	3.0 deg.
Azimuth Angle	0.0 deg.	Gain	18.66 dBi
Outer Ring	18.66 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	18.66 dBi		
Slice Max Gain	18.66 dBi @ Elev Angle = 3.0 deg.		
Beamwidth	2.8 deg.; -3dB @ 1.7, 4.5 deg.		
Sidelobe Gain	17.85 dBi @ Elev Angle = 9.0 deg.		
Front/Sidelobe	0.81 dB		

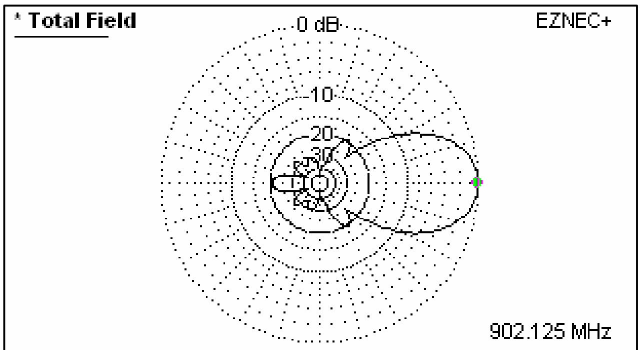
902 MHz 7 Element Yagi

This is a 902 MHz 7 element yagi designed for the weak signal area of 902 MHz band. The element diameter is 0.1875 inches (3/16”). Performance data for height of 5 feet.

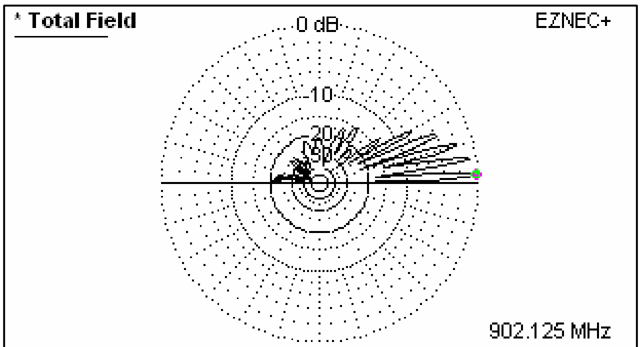
LR = 3.14	0.00
DE = 3.03	S1 = 2.75
D1 = 2.79	S2 = 4
D2 = 2.71	S3 = 7.5
D3 = 2.66	S4 = 11.5
D4 = 2.61	S5 = 17.25
D5 = 2.64	S6 = 21



Freq	902 MHz	Source #	1
SWR	1.025	Z0	50 ohms
Z	49.08 - j 0.8065 ohms		
Refl Coeff	0.01234 at -138.25 deg.		



Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	3.0 deg.	Gain	19.1 dBi
Outer Ring	19.1 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	19.1 dBi		
Slice Max Gain	19.1 dBi @ Az Angle = 0.0 deg.		
Front/Back	20.59 dB		
Beamwidth	39.0 deg.; -3dB @ 340.5, 19.5 deg.		
Sidelobe Gain	-0.38 dBi @ Az Angle = 56.0 deg.		
Front/Sidelobe	19.48 dB		

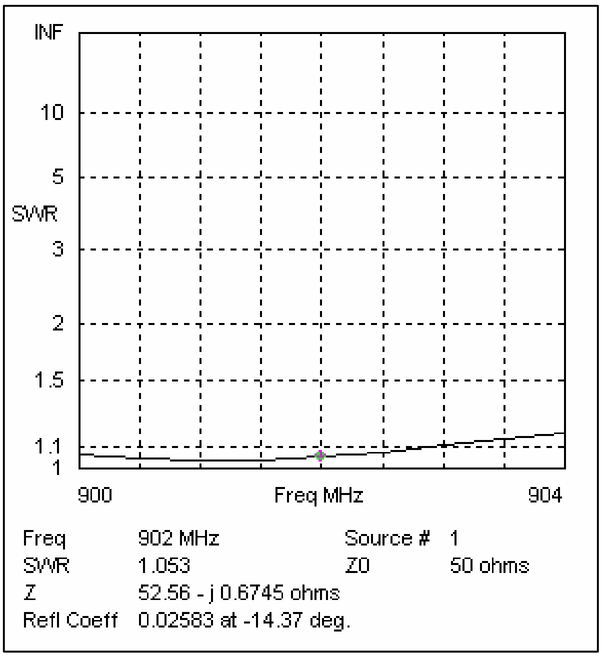


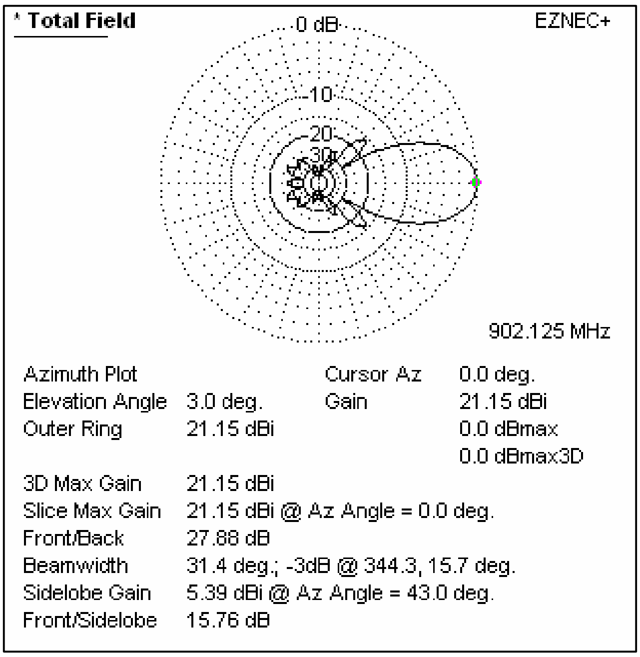
Elevation Plot		Cursor Elev	3.0 deg.
Azimuth Angle	0.0 deg.	Gain	19.1 dBi
Outer Ring	19.1 dBi		0.0 dBmax
			0.0 dBmax3D
3D Max Gain	19.1 dBi		
Slice Max Gain	19.1 dBi @ Elev Angle = 3.0 deg.		
Beamwidth	2.8 deg.; -3dB @ 1.7, 4.5 deg.		
Sidelobe Gain	18.28 dBi @ Elev Angle = 9.0 deg.		
Front/Sidelobe	0.82 dB		

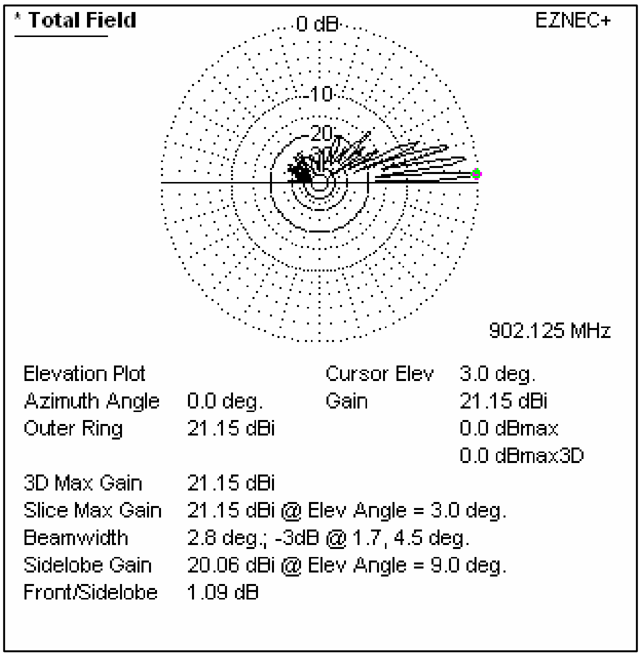
902 MHz 10 Element Yagi

This is a 902 MHz 10 element yagi designed for the weak signal area of 902 MHz band. The element diameter is 0.125 inches (1/8"). Performance data for height of 5 feet.

LR = 3.09	0.00
DE = 3.01	S1 = 3.25
D1 = 2.84	S2 = 4.75
D2 = 2.76	S3 = 8.25
D3 = 2.67	S4 = 13
D4 = 2.63	S5 = 18.25
D5 = 2.61	S6 = 24
D6 = 2.61	S7 = 29.5
D7 = 2.62	S8 = 35
D8 = 2.6	S9=39.5





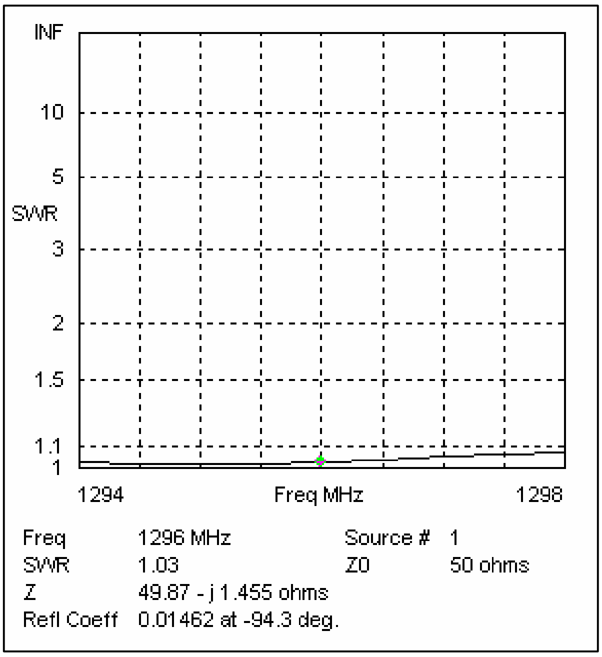


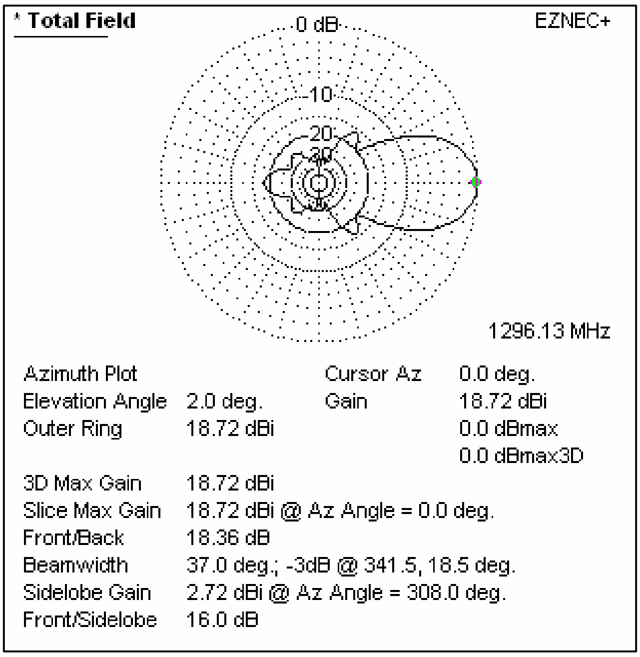
1296 MHz Yagis

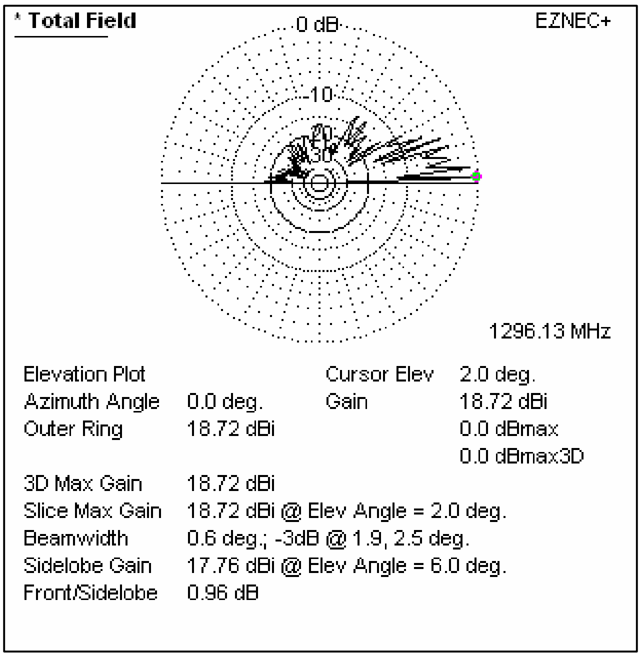
1296 MHz 7 Element Yagi

This is a 1296 MHz 7 element yagi designed for the weak signal area of 1296 MHz band. The element diameter is 0.125 inches (1/8”). Performance data for height of 5 feet.

DR=2.26	0.0000
DE=2.10	S1=2.25
D1=1.92	S2=3.875
D2=1.91	S3=6.375
D3=1.81	S4=9.75
D4=1.88	S5=13.12
D5=1.82	S6=15.75



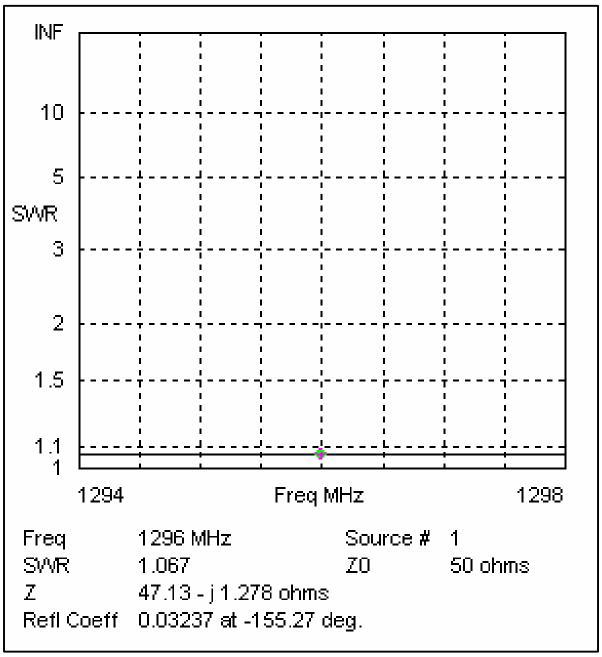


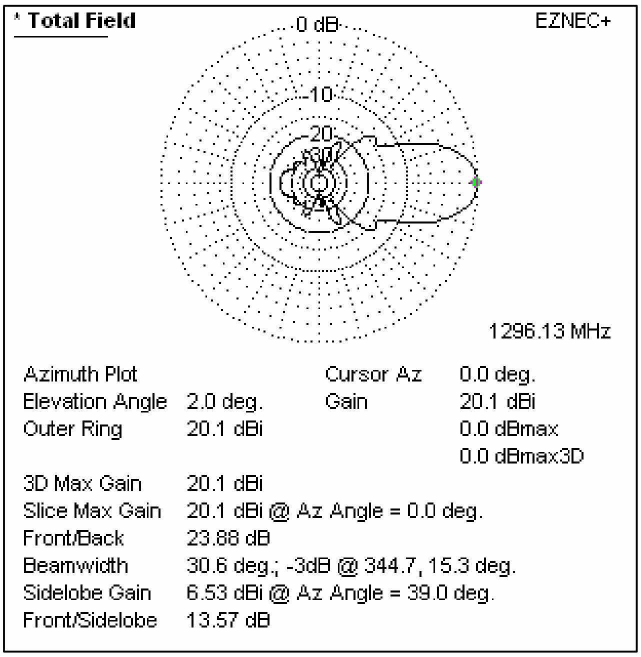


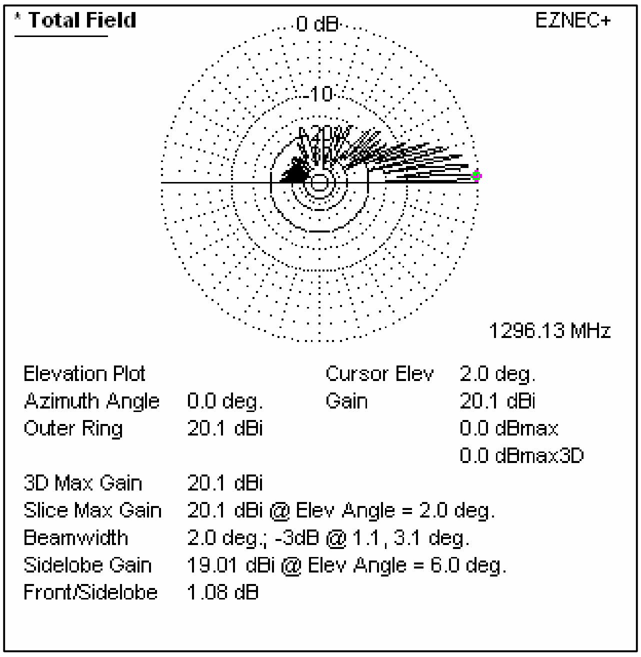
1296 MHz 10 Element Yagi

This is a 1296 MHz 10 element yagi designed for the weak signal area of 1296 MHz band. The element diameter is 0.125 inches (1/8”). Performance data for height of 5 feet.

DR=2.26	0.00
DE=2.10	S1=2.37
D1=1.92	S2=3.875
D2=1.93	S3=6.375
D3=1.87	S4=9.25
D4=1.87	S5=12.5
D5=1.84	S6=15.75
D6=1.79	S7=19.25
D7=1.85	S8=22.875
D8=1.77	S9=25.50







Appendix A

Element Corrections for Metallic Booms

If the element is passed through a metallic boom, some correction must be made. For elements that are **not** insulated from the boom the following equation may be used to calculate the necessary adjustment. This equation has been empirically derived by DL6WU and G3SEK by curve fitting measurements made on VHF and UHF beams.

$$C = 12.597B - 114.5B^2$$

Where C = is the ½ element correction factor as a fraction of the boom diameter B in wavelengths.
B = boom diameter in wavelengths (λ)
$\lambda = 300000/F_{MHz}$ millimeters
1 inch = 25.4 mm

For example: Using a 1 inch boom at 144 MHz B = 25.4 / (300000/144) = 25.4 / 2080 = .012
Yields:

$$C = 12.5975 \times .012 - 114.5 \times (.012)^2$$
$$C = .135 \text{ or } 13.5\%$$

And since the boom is 25.4 mm (1 inch) in diameter then the ½ element correction is 25.4 x .135 or 3.4mm. Elements that are not split like the driven element must by lengthened by 6.8mm.

Finally, if the elements are through a metallic boom but are **insulated** from the boom then the correction factor is ½ of the amount calculated above.