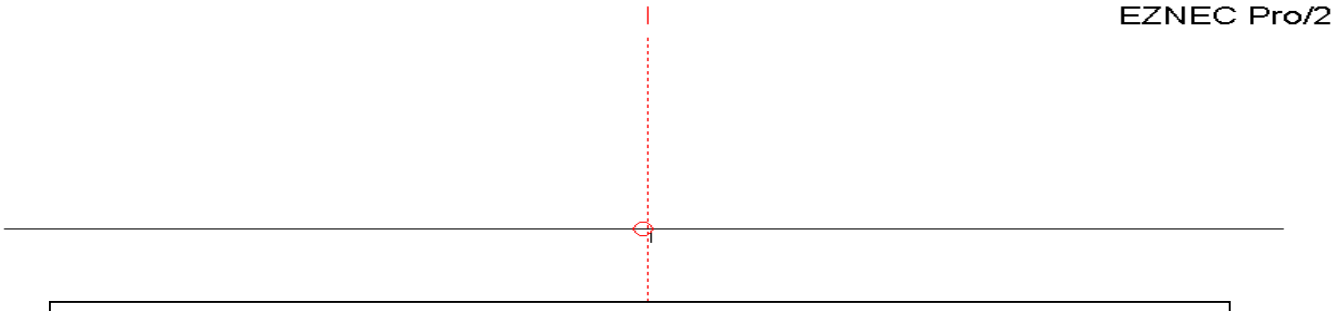
The 40M Extended Double Zepp

By Jim Streible, K4DLI

There were many new and somewhat unfamiliar antennas used at this year's NFARL Field Day. One of these was the one for the CW station. This antenna is basically two 5/8 wave antennas end to end. It can be fed with ladder line from the center insulator to tuner or it can use an impedance transforming length of ladder line to take the impedance to 50 ohms and fed from there to the rig with 50 ohm coax. That would limit it use (without a tuner) to a single band – 40 meters. To make it an efficient antenna system on multiple bands, ladder line to a balanced tuner should be used and this was the configuration at the 2009 NFARL FD. Shown in the paper are the plots and impedance calculations for all bands from 160 thru 6 meters.

This antenna was feed with 450-ohm ladder line and tuned with a Johnson Match Box.
It can be used on all bands from 160 to 6 meters. Gain on 160 is about 2.8 dbi at a 40-degree take off angle with maximum gain directly over head. The antennas design frequency is 40-meters.



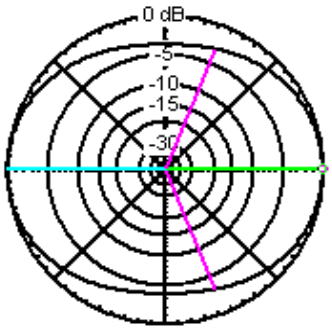
170 foot Double Extended Zepp Antenna. Used for CW station at the 2009 Field Day by the North Fulton Amateur Radio League. Center height 57.5 ft.

By using 450-ohm ladder line this antenna can be utilized on almost any frequency in the HF region. A good balanced tuner is required for optimum operation. Other methods, such as a 4:1 or 9:1 balun and then coax into the shack can be tried however, there will be a high SWR on the coax in most cases.

The matched line loss per 100 feet of 450-ohm ladder line is 0.146 db at 28 MHz. The matched line loss in RG-213 at the same frequency is 1.142 db. With a 7:1 SWR the RG-213 will have an additional loss of 1.903 db for a total loss of 3.045 db. 450-ohm ladder line with the same 7:1 SWR has an additional loss of 0.332 db for a total loss of 0.478 db. That is a difference of 2.57 db. That means that almost twice as much power would reach the antenna for a 100 foot run using the 450-ohm ladder line then you would get with 100 feet of RG-213. There are also other items to consider such as obtaining a match and voltage break down when operation at a high SWR for multi-band operation.

The 40M Extended Double Zepp

Total Field EZNEC Pro/2

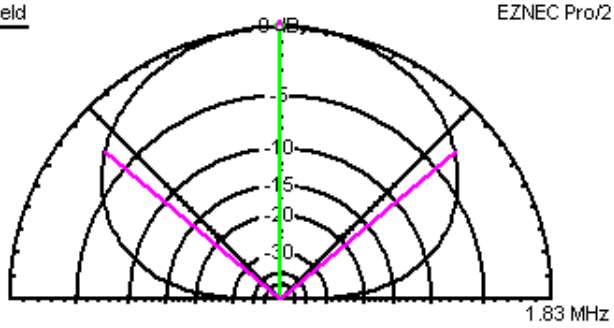


1.83 MHz

Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	40.0 deg.	Gain	2.82 dBi
Outer Ring	2.82 dBi		0.0 dBmax

Slice Max Gain	2.82 dBi @ Az Angle = 0.0 deg.
Front/Side	3.68 dB
Beamwidth	136.4 deg.; -3dB @ 291.8, 68.2 deg.
Sidelobe Gain	2.82 dBi @ Az Angle = 180.0 deg.
Front/Sidelobe	0.0 dB

Total Field EZNEC Pro/2

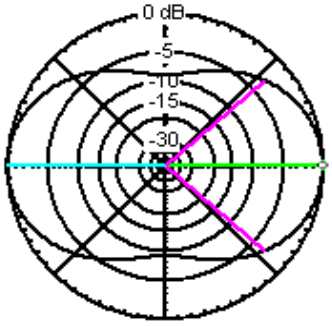


1.83 MHz

Elevation Plot		Cursor Elev	90.0 deg.
Azimuth Angle	0.0 deg.	Gain	5.82 dBi
Outer Ring	5.82 dBi		0.0 dBmax

Slice Max Gain	5.82 dBi @ Elev Angle = 90.0 deg.
Beamwidth	100.0 deg.; -3dB @ 40.0, 140.0 deg.
Sidelobe Gain	< -100 dBi
Front/Sidelobe	> 100 dB

Total Field EZNEC Pro/2

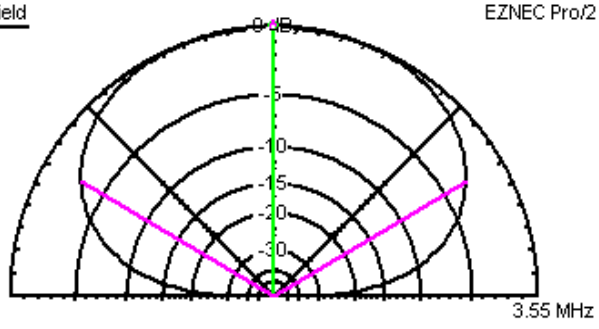


3.55 MHz

Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	30.0 deg.	Gain	3.83 dBi
Outer Ring	3.83 dBi		0.0 dBmax

Slice Max Gain	3.83 dBi @ Az Angle = 0.0 deg.
Front/Side	9.02 dB
Beamwidth	83.0 deg.; -3dB @ 318.5, 41.5 deg.
Sidelobe Gain	3.83 dBi @ Az Angle = 180.0 deg.
Front/Sidelobe	0.0 dB

Total Field EZNEC Pro/2

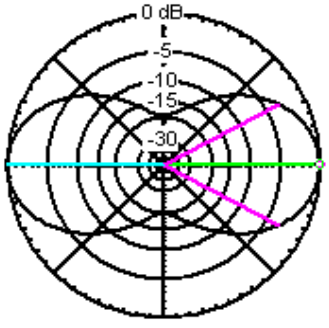


3.55 MHz

Elevation Plot		Cursor Elev	90.0 deg.
Azimuth Angle	0.0 deg.	Gain	6.86 dBi
Outer Ring	6.86 dBi		0.0 dBmax

Slice Max Gain	6.86 dBi @ Elev Angle = 90.0 deg.
Beamwidth	119.6 deg.; -3dB @ 30.2, 149.8 deg.
Sidelobe Gain	< -100 dBi
Front/Sidelobe	> 100 dB

Total Field EZNEC Pro/2

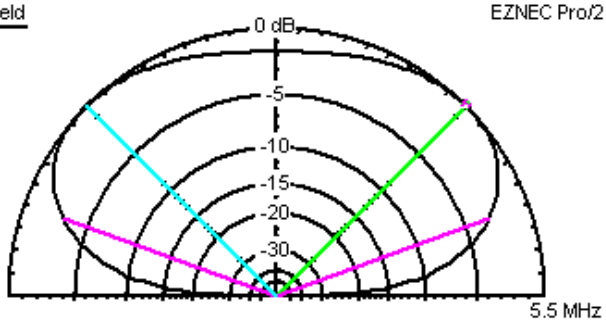


5.5 MHz

Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	30.0 deg.	Gain	6.8 dBi
Outer Ring	6.8 dBi		0.0 dBmax

Slice Max Gain	6.8 dBi @ Az Angle = 0.0 deg.
Front/Side	19.47 dB
Beamwidth	56.0 deg.; -3dB @ 332.0, 28.0 deg.
Sidelobe Gain	6.8 dBi @ Az Angle = 180.0 deg.
Front/Sidelobe	0.0 dB

Total Field EZNEC Pro/2



5.5 MHz

Elevation Plot		Cursor Elev	45.0 deg.
Azimuth Angle	0.0 deg.	Gain	7.64 dBi
Outer Ring	7.64 dBi		0.0 dBmax

Slice Max Gain	7.64 dBi @ Elev Angle = 45.0 deg.
Beamwidth	140.2 deg.; -3dB @ 19.9, 160.1 deg.
Sidelobe Gain	7.64 dBi @ Elev Angle = 135.0 deg.
Front/Sidelobe	0.0 dB

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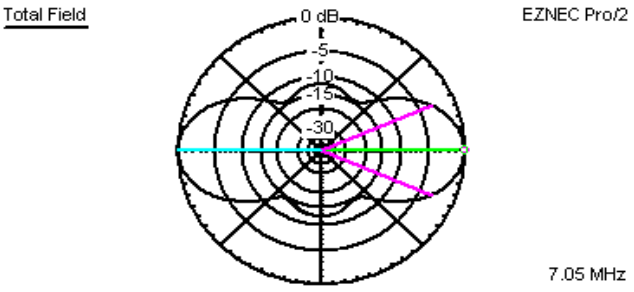
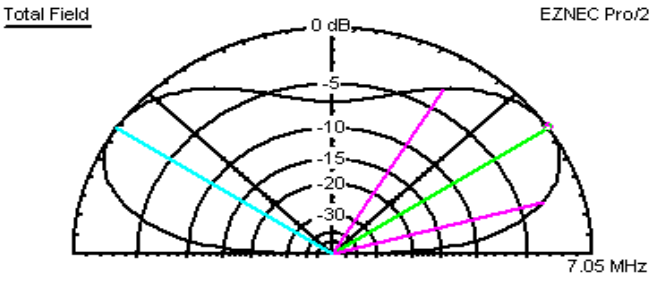


Azimuth Plot		Cursor Az	0.0 deg.
Elevation Angle	45.0 deg.	Gain	8.83 dBi
Outer Ring	8.83 dBi		0.0 dBmax

Slice Max Gain	8.83 dBi @ Az Angle = 0.0 deg.
Front/Side	12.05 dB
Beamwidth	46.8 deg.; -3dB @ 336.6, 23.4 deg.
Sidelobe Gain	8.83 dBi @ Az Angle = 180.0 deg.
Front/Sidelobe	0.0 dB



Elevation Plot		Cursor Elev	34.0 deg.
Azimuth Angle	0.0 deg.	Gain	9.51 dBi
Outer Ring	9.51 dBi		0.0 dBmax

Slice Max Gain	9.51 dBi @ Elev Angle = 34.0 deg.
Beamwidth	43.9 deg.; -3dB @ 15.7, 59.6 deg.
Sidelobe Gain	9.51 dBi @ Elev Angle = 146.0 deg.
Front/Sidelobe	0.0 dB

Source Data:

1.830 MHz. Voltage = 2819 V at 0.0 deg.
Current = 10.16 A at 87.0 deg.
Impedance = 14.52 - J 277 ohms
Power = 1500 watts
SWR (50 ohm system) > 100 (450 ohm system) = 42.735

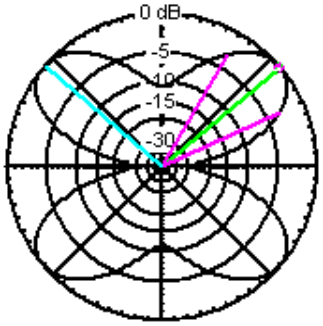
3.550 MHz. Voltage = 994.5 V at 0.0 deg.
Current = 2.405 A at -51.15 deg.
Impedance = 259.4 + J 322.1 ohms
Power = 1500 watts
SWR (50 ohm system) = 13.306 (450 ohm system) = 2.849

5.500 MHz. Voltage = 1343 V at 0.0 deg.
Current = 1.59 A at 45.41 deg.
Impedance = 593.1 - J 601.5 ohms
Power = 1500 watts
SWR (50 ohm system) = 24.107 (450 ohm system) = 3.111

7.050 MHz. Voltage = 1189 V at 0.0 deg.
Current = 3.601 A at 69.49 deg.
Impedance = 115.7 - J 309.3 ohms
Power = 1500 watts
SWR (50 ohm system) = 19.231 (450 ohm system) = 5.812

The 40M Extended Double Zepp

Total Field



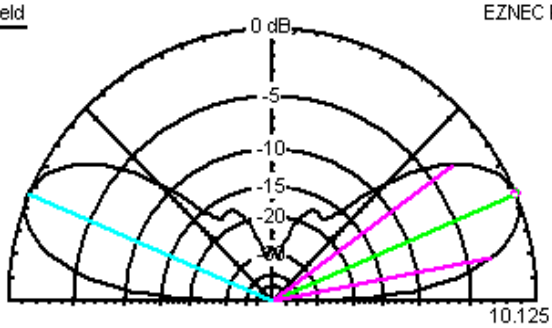
EZNEC Pro/2

10.125 MHz

Azimuth Plot		Cursor Az	40.0 deg.
Elevation Angle	23.0 deg.	Gain	8.95 dBi
Outer Ring	8.95 dBi		0.0 dBmax

Slice Max Gain	8.95 dBi @ Az Angle = 40.0 deg.
Front/Side	0.8 dB
Beamwidth	35.1 deg.; -3dB @ 24.9, 60.0 deg.
Sidelobe Gain	8.95 dBi @ Az Angle = 139.0 deg.
Front/Sidelobe	0.0 dB

Total Field



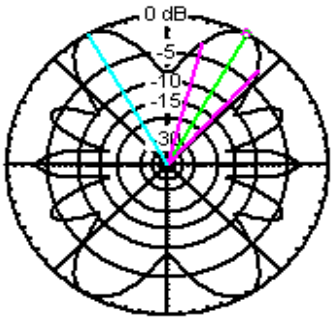
EZNEC Pro/2

10.125 MHz

Elevation Plot		Cursor Elev	23.0 deg.
Azimuth Angle	40.0 deg.	Gain	8.95 dBi
Outer Ring	8.95 dBi		0.0 dBmax

Slice Max Gain	8.95 dBi @ Elev Angle = 23.0 deg.
Beamwidth	25.3 deg.; -3dB @ 10.9, 36.2 deg.
Sidelobe Gain	8.95 dBi @ Elev Angle = 157.0 deg.
Front/Sidelobe	0.0 dB

Total Field



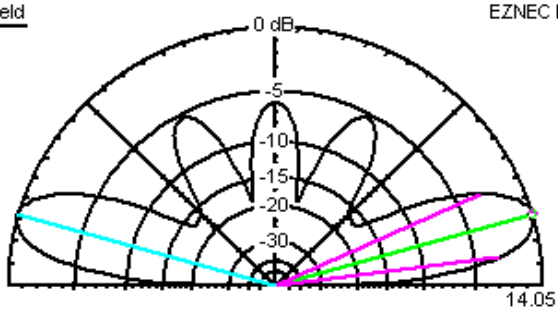
EZNEC Pro/2

14.05 MHz

Azimuth Plot		Cursor Az	60.0 deg.
Elevation Angle	16.0 deg.	Gain	9.29 dBi
Outer Ring	9.29 dBi		0.0 dBmax

Slice Max Gain	9.29 dBi @ Az Angle = 60.0 deg.
Front/Side	5.09 dB
Beamwidth	27.1 deg.; -3dB @ 47.9, 75.0 deg.
Sidelobe Gain	9.29 dBi @ Az Angle = 120.0 deg.
Front/Sidelobe	0.0 dB

Total Field



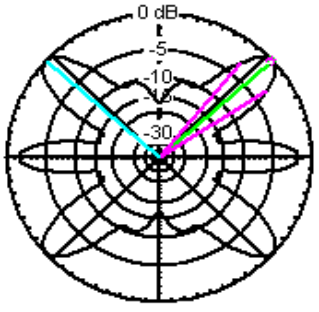
EZNEC Pro/2

14.05 MHz

Elevation Plot		Cursor Elev	16.0 deg.
Azimuth Angle	59.0 deg.	Gain	9.28 dBi
Outer Ring	9.28 dBi		0.0 dBmax

Slice Max Gain	9.28 dBi @ Elev Angle = 16.0 deg.
Beamwidth	17.2 deg.; -3dB @ 7.6, 24.8 deg.
Sidelobe Gain	9.28 dBi @ Elev Angle = 164.0 deg.
Front/Sidelobe	0.0 dB

Total Field



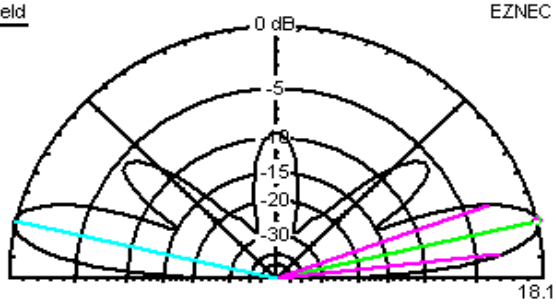
EZNEC Pro/2

18.1 MHz

Azimuth Plot		Cursor Az	42.0 deg.
Elevation Angle	13.0 deg.	Gain	10.0 dBi
Outer Ring	10.0 dBi		0.0 dBmax

Slice Max Gain	10.0 dBi @ Az Angle = 42.0 deg.
Front/Side	1.35 dB
Beamwidth	18.2 deg.; -3dB @ 33.0, 51.2 deg.
Sidelobe Gain	10.0 dBi @ Az Angle = 138.0 deg.
Front/Sidelobe	0.0 dB

Total Field



EZNEC Pro/2

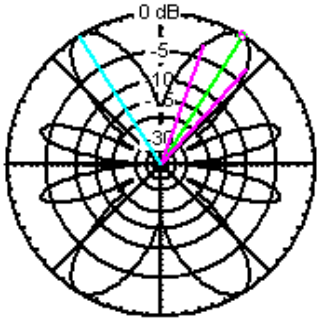
18.1 MHz

Elevation Plot		Cursor Elev	13.0 deg.
Azimuth Angle	42.0 deg.	Gain	10.0 dBi
Outer Ring	10.0 dBi		0.0 dBmax

Slice Max Gain	10.0 dBi @ Elev Angle = 13.0 deg.
Beamwidth	13.7 deg.; -3dB @ 6.5, 20.2 deg.
Sidelobe Gain	10.0 dBi @ Elev Angle = 167.0 deg.
Front/Sidelobe	0.0 dB

The 40M Extended Double Zepp

Total Field



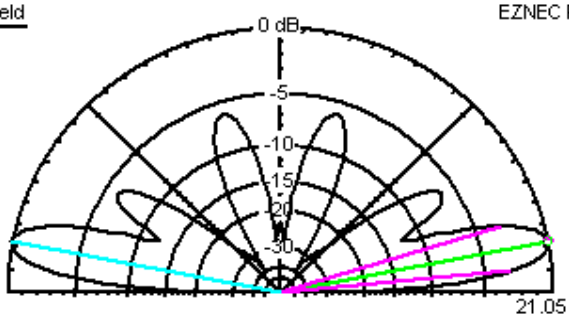
EZNEC Pro/2

21.05 MHz

Azimuth Plot		Cursor Az	58.0 deg.
Elevation Angle	11.0 deg.	Gain	10.79 dBi
Outer Ring	10.79 dBi		0.0 dBmax

Slice Max Gain	10.79 dBi @ Az Angle = 58.0 deg.
Front/Side	20.69 dB
Beamwidth	21.9 deg.; -3dB @ 48.5, 70.4 deg.
Sidelobe Gain	10.79 dBi @ Az Angle = 122.0 deg.
Front/Sidelobe	0.0 dB

Total Field



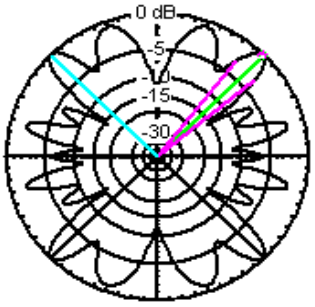
EZNEC Pro/2

21.05 MHz

Elevation Plot		Cursor Elev	11.0 deg.
Azimuth Angle	59.0 deg.	Gain	10.78 dBi
Outer Ring	10.78 dBi		0.0 dBmax

Slice Max Gain	10.78 dBi @ Elev Angle = 11.0 deg.
Beamwidth	11.8 deg.; -3dB @ 5.4, 17.2 deg.
Sidelobe Gain	10.78 dBi @ Elev Angle = 169.0 deg.
Front/Sidelobe	0.0 dB

Total Field



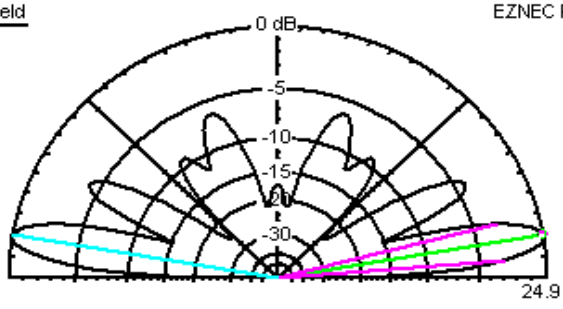
EZNEC Pro/2

24.9 MHz

Azimuth Plot		Cursor Az	45.0 deg.
Elevation Angle	10.0 deg.	Gain	9.57 dBi
Outer Ring	9.57 dBi		0.0 dBmax

Slice Max Gain	9.57 dBi @ Az Angle = 45.0 deg.
Front/Side	0.0 dB
Beamwidth	12.2 deg.; -3dB @ 39.8, 52.0 deg.
Sidelobe Gain	9.57 dBi @ Az Angle = 135.0 deg.
Front/Sidelobe	0.0 dB

Total Field



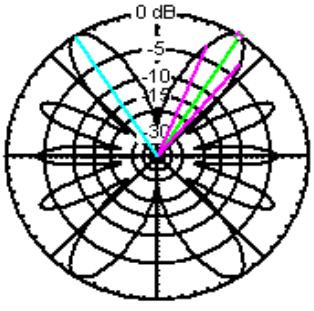
EZNEC Pro/2

24.9 MHz

Elevation Plot		Cursor Elev	10.0 deg.
Azimuth Angle	46.0 deg.	Gain	9.56 dBi
Outer Ring	9.56 dBi		0.0 dBmax

Slice Max Gain	9.56 dBi @ Elev Angle = 10.0 deg.
Beamwidth	9.9 deg.; -3dB @ 4.8, 14.7 deg.
Sidelobe Gain	9.56 dBi @ Elev Angle = 170.0 deg.
Front/Sidelobe	0.0 dB

Total Field



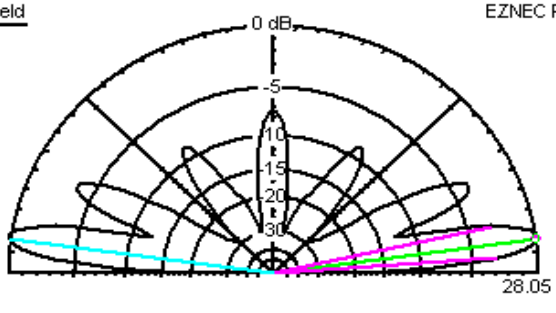
EZNEC Pro/2

28.05 MHz

Azimuth Plot		Cursor Az	57.0 deg.
Elevation Angle	8.0 deg.	Gain	11.13 dBi
Outer Ring	11.13 dBi		0.0 dBmax

Slice Max Gain	11.13 dBi @ Az Angle = 57.0 deg.
Front/Side	11.57 dB
Beamwidth	17.3 deg.; -3dB @ 49.4, 66.7 deg.
Sidelobe Gain	11.13 dBi @ Az Angle = 123.0 deg.
Front/Sidelobe	0.0 dB

Total Field



EZNEC Pro/2

28.05 MHz

Elevation Plot		Cursor Elev	8.0 deg.
Azimuth Angle	58.0 deg.	Gain	11.11 dBi
Outer Ring	11.11 dBi		0.0 dBmax

Slice Max Gain	11.11 dBi @ Elev Angle = 8.0 deg.
Beamwidth	8.8 deg.; -3dB @ 4.2, 13.0 deg.
Sidelobe Gain	11.11 dBi @ Elev Angle = 172.0 deg.
Front/Sidelobe	0.0 dB

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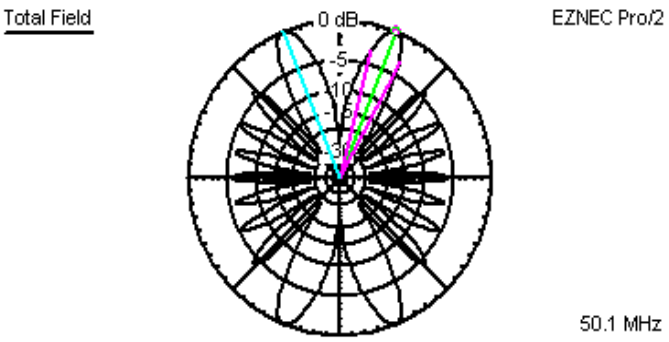
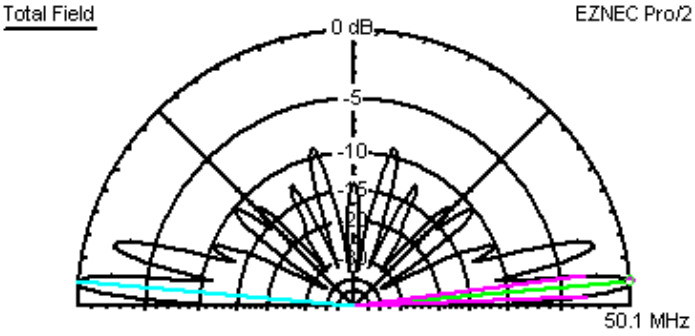


Azimuth Plot		Cursor Az	68.0 deg.
Elevation Angle	5.0 deg.	Gain	13.03 dBi
Outer Ring	13.03 dBi		0.0 dBmax

Slice Max Gain	13.03 dBi @ Az Angle = 68.0 deg.
Front/Side	19.34 dB
Beamwidth	13.8 deg.; -3dB @ 62.0, 75.8 deg.
Sidelobe Gain	13.03 dBi @ Az Angle = 112.0 deg.
Front/Sidelobe	0.0 dB



Elevation Plot		Cursor Elev	5.0 deg.
Azimuth Angle	69.0 deg.	Gain	12.99 dBi
Outer Ring	12.99 dBi		0.0 dBmax

Slice Max Gain	12.99 dBi @ Elev Angle = 5.0 deg.
Beamwidth	4.9 deg.; -3dB @ 2.4, 7.3 deg.
Sidelobe Gain	12.99 dBi @ Elev Angle = 175.0 deg.
Front/Sidelobe	0.0 dB

Source Data:

50.1 MHz Voltage = 618 V at 0.0 deg.
Current = 2.504 A at 14.26 deg.
Impedance = 239.2 - J 60.77 ohms
Power = 1500 watts
SWR (50 ohm system) = 5.106 (450 ohm system) = 1.929

28.050 MHz Voltage = 815.7 V at 0.0 deg.
Current = 2.303 A at 37.0 deg.
Impedance = 282.9 - J 213.2 ohms
Power = 1500 watts
SWR (50 ohm system) = 8.935 (450 ohm system) = 2.100

24.900 MHz Voltage = 579.6 V at 0.0 deg.
Current = 4.07 A at 50.51 deg.
Impedance = 90.55 - J 109.9 ohms
Power = 1500 watts
SWR (50 ohm system) = 4.823 (450 ohm system) = 5.278

21.050 MHz Voltage = 803.3 V at 0.0 deg.
Current = 1.938 A at 15.57 deg.
Impedance = 399.2 - J 111.2 ohms
Power = 1500 watts
SWR (50 ohm system) = 8.614 (450 ohm system) = 1.333

18.100 MHz Voltage = 937.1 V at 0.0 deg.
Current = 3.355 A at 61.5 deg.
Impedance = 133.3 - J 245.5 ohms
Power = 1500 watts
SWR (50 ohm system) = 12.001 (450 ohm system) = 4.452

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14.050 MHz Voltage = 413.7 V at 0.0 deg.
Current = 3.764 A at 15.58 deg.
Impedance = 105.9 - J 29.52 ohms
Power = 1500 watts
SWR (50 ohm system) = 2.324 (450 ohm system) = 4.269

10.125 MHz Voltage = 982.8 V at 0.0 deg.
Current = 1.537 A at -6.75 deg.
Impedance = 635 + J 75.2 ohms
Power = 1500 watts
SWR (50 ohm system) = 12.879 (450 ohm system) = 1.450

All plots were made at a height above ground of 57.5 feet.
There will be some variations if the height is much different but, the azimuth patterns will be very much the same. The take off angle will be lower if the height is higher and they will be higher if the height is lower.