FIELD DAY HF ANTENNAS

Lew Thompson

W5IFQ

2 JUN 2020

Purpose of Field Day

- Demonstrate the ability to set up an Amateur radio station in the field on emergency power and communicate effectively over all of CONUS.
- Increase public awareness of Amateur Radio (answer questions from neighbors)
- Training (Seek help – call me, 512-587-9944)
- Recruitment of new hams (neighbors)
- Have fun

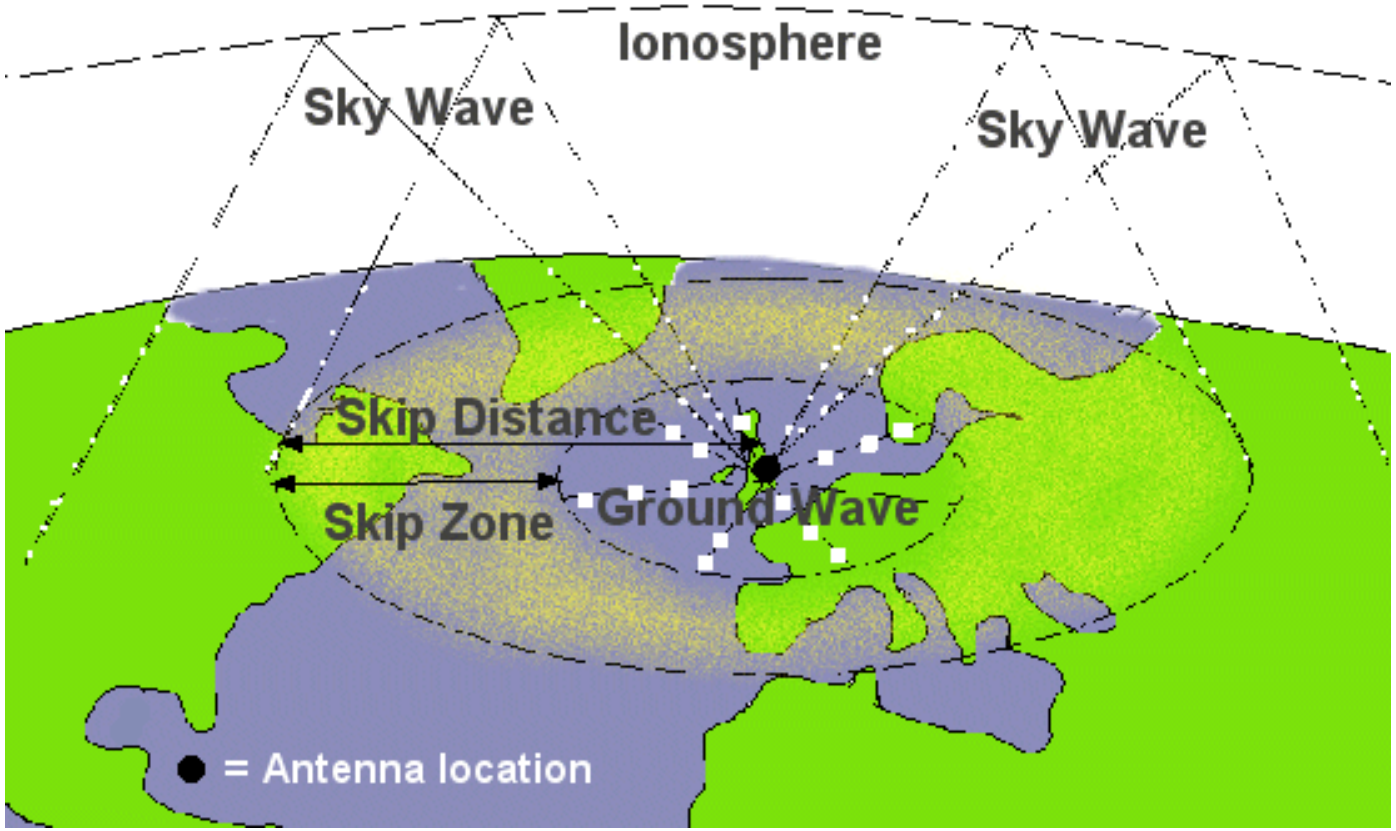
HF Propagation Modes

- Free Space – Line of site
- Ground Wave – Follows Earth's curvature
- Ionospheric Skip
  - Long Distance with a "dead-zone"
  - NVIS (Near Vertical Incidence Sky Wave)

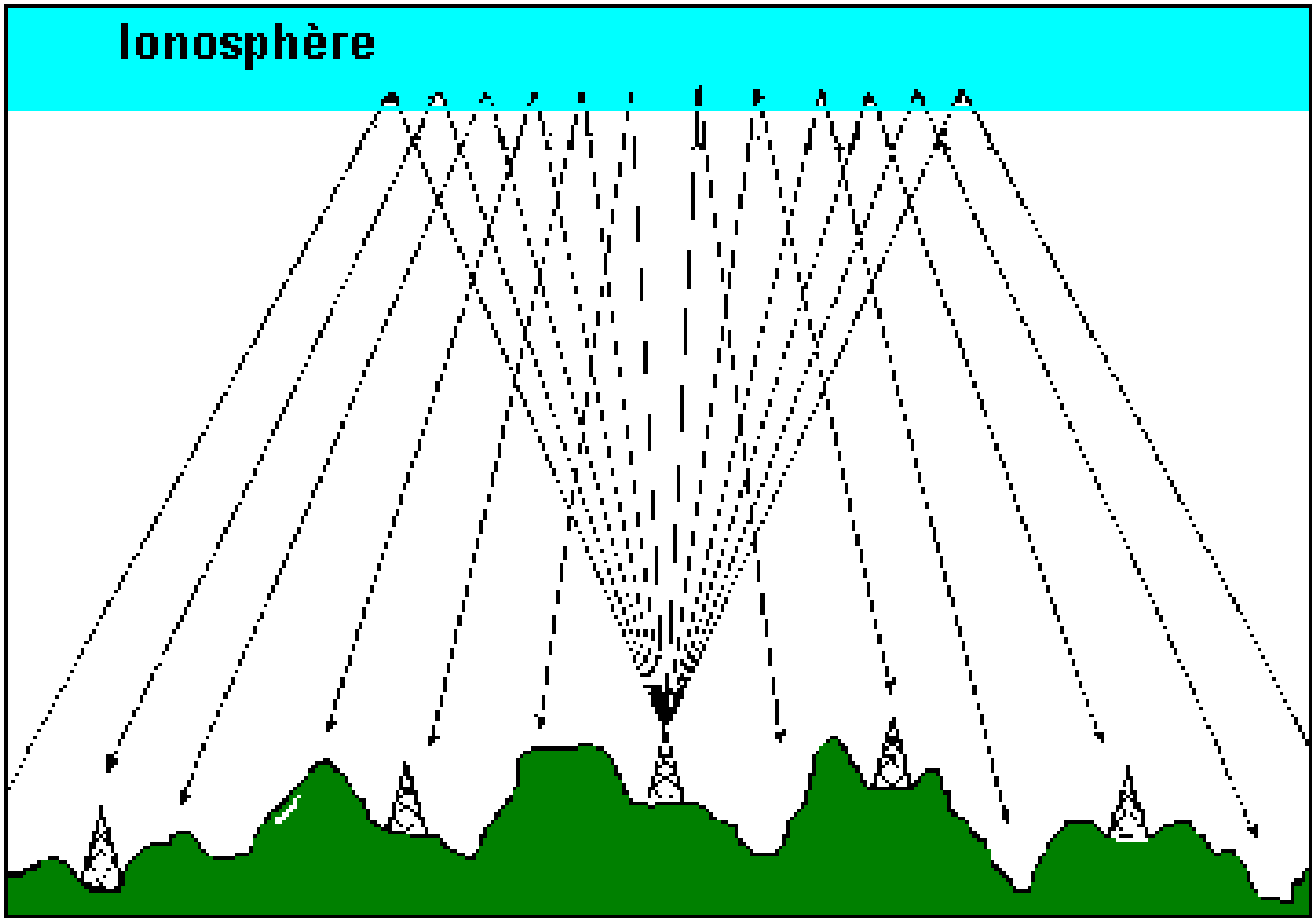
Optimizing HF Communications

- Ionospheric propagation
  - Frequency selection (MUF for target area)
  - Other propagation factors
- Antenna design
  - Correct directivity pattern
  - Provide usable impedance to RF transmitter

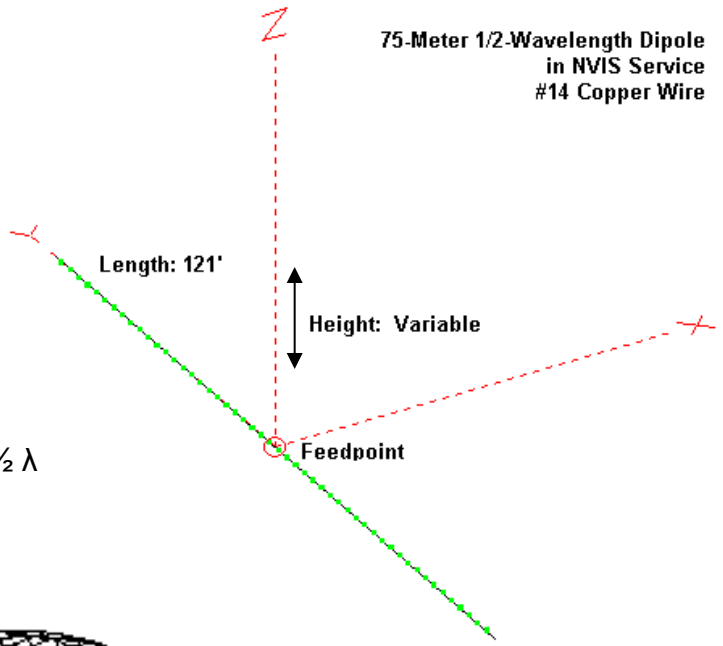
Long Distance Sky Wave



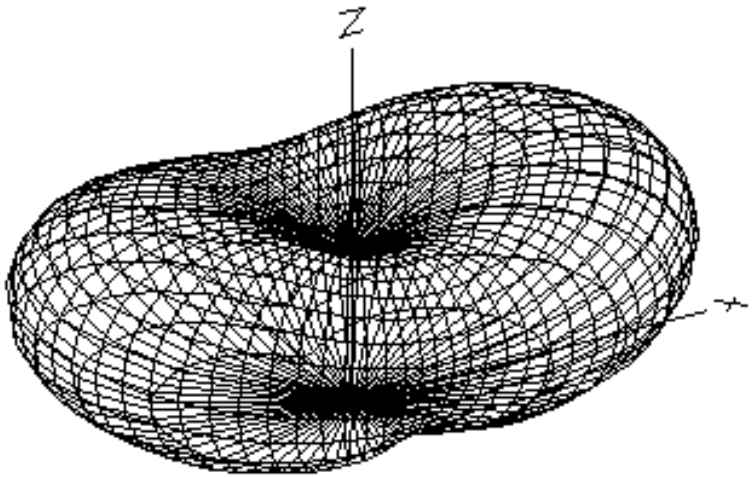
NVIS Propagation



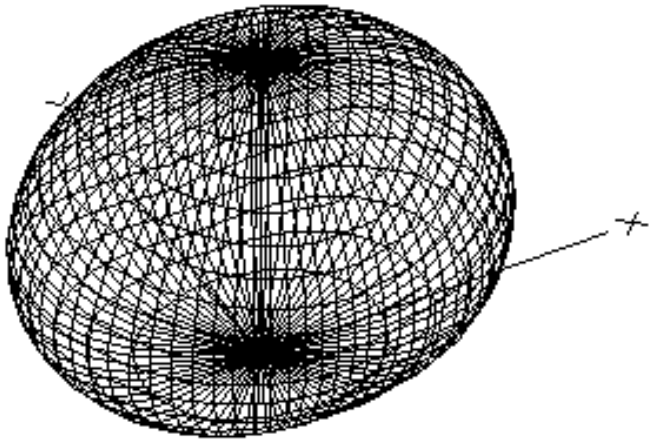
Dipole Height Versus Directivity



Height = 121 ft or ½ λ



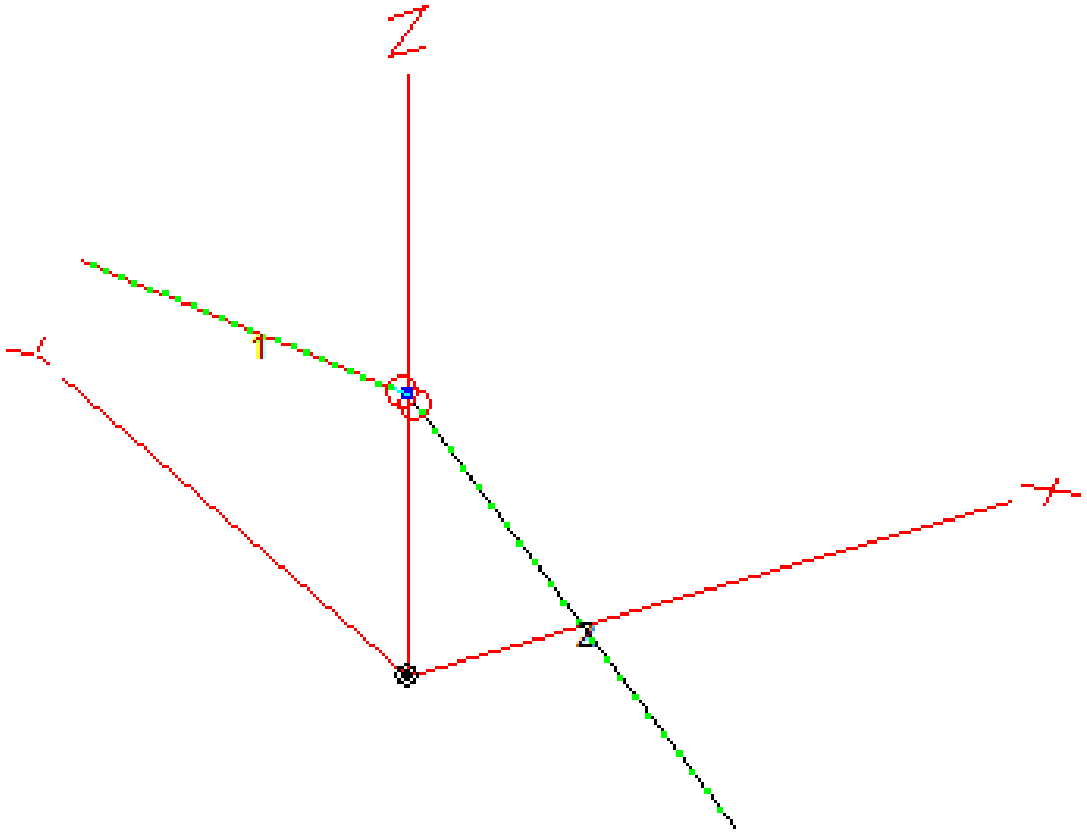
Height = 30 ft or .12 λ



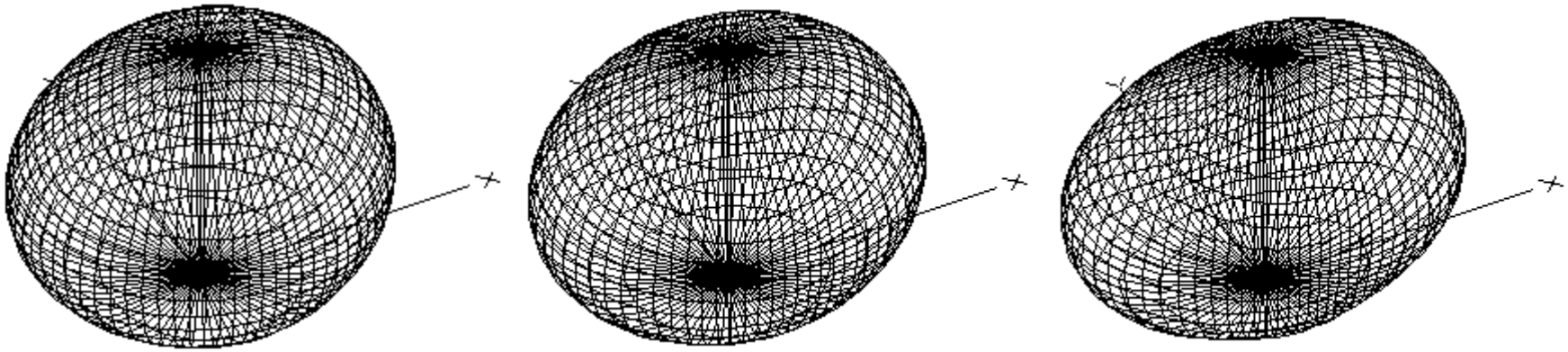
MARS Portable Dipole

Inverted-V:

- Apex – 32 ft.
- Length – 65 ft.
- End heights – 15 ft.
- Wire - #14 AWG



NVIS Performance

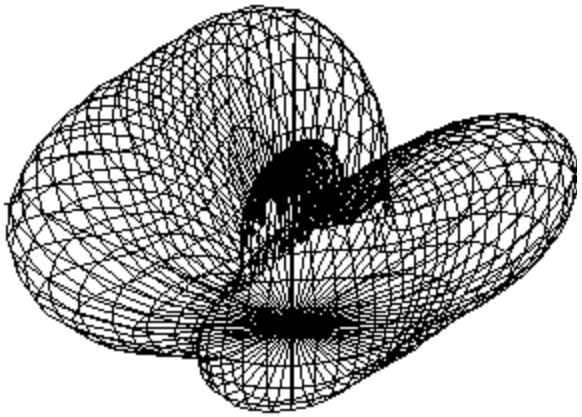


3.8 MHz

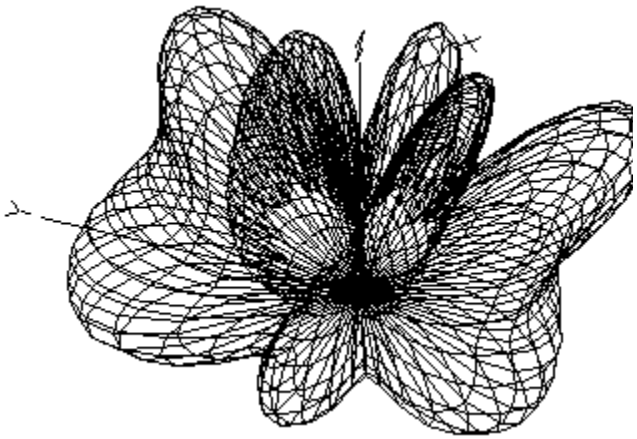
5.2 MHz

7.2 MHz

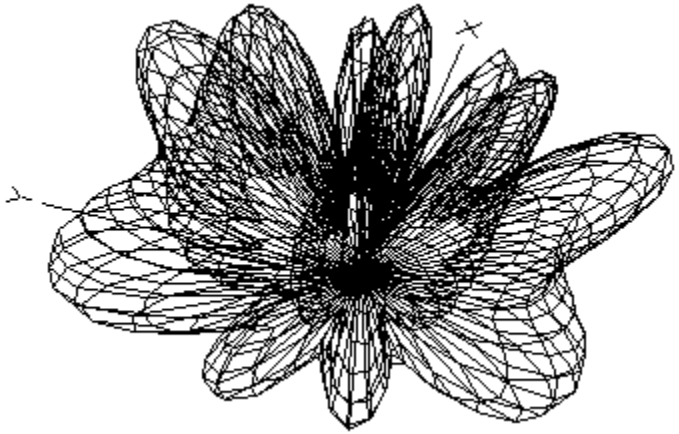
Skip Performance - BAD



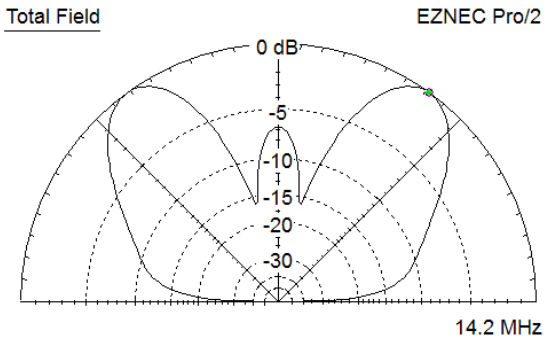
14.3 MHz



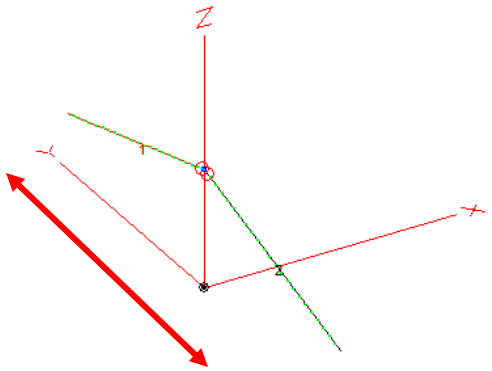
21.4 MHz



28.4 MHz



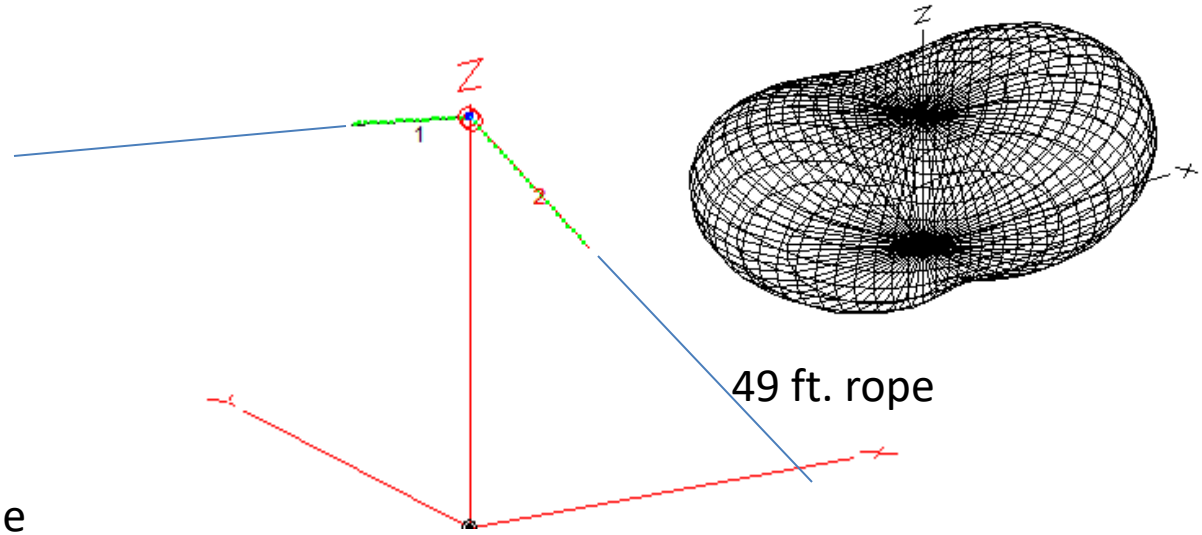
Poor Take-off Angle



Note: Maximum gain
Off ends of wires

Corrections To Directivity

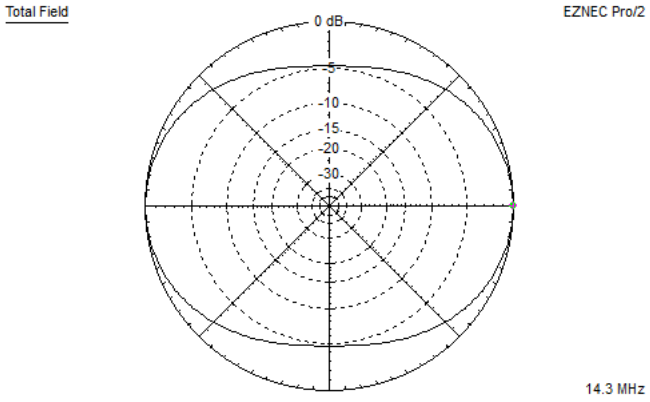
(Shorten each leg from 65 ft. to 18 ft.)

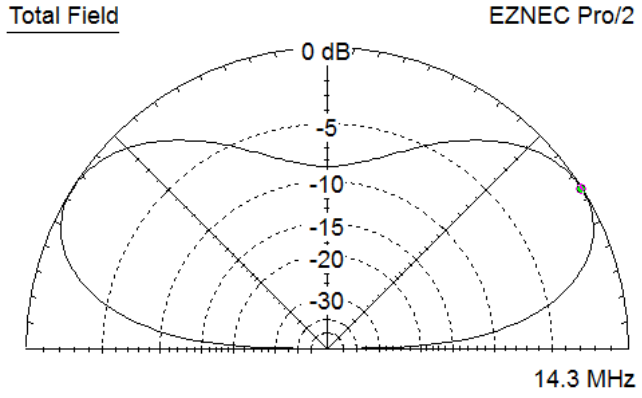


49 ft. rope

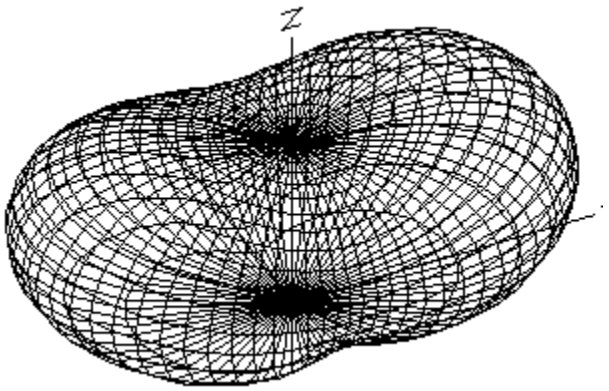
Inverted-V

- Height – 32 ft.
- Leg Length – 18 ft.
- Same angle as full dipole
- Original dipole folded back to length of 18 ft. on each leg.

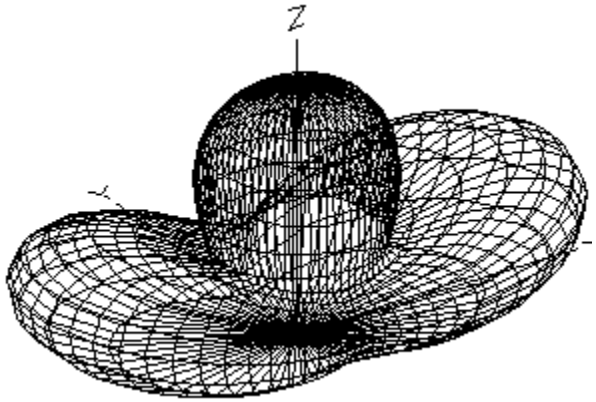




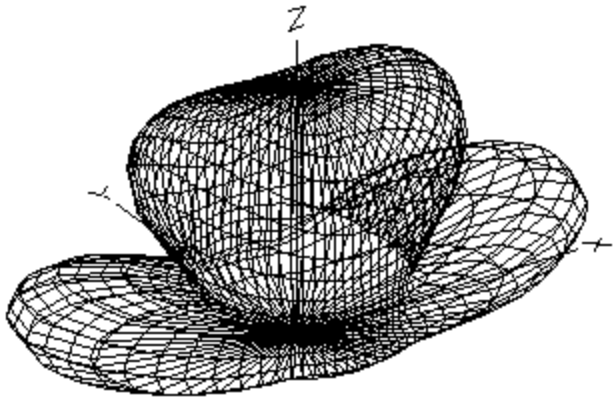
Skip Performance – 20m dipole



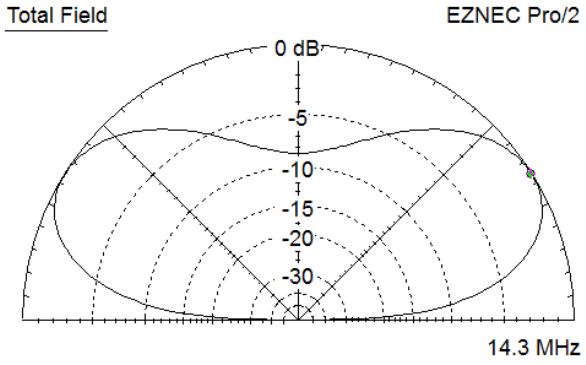
14.3 MHz

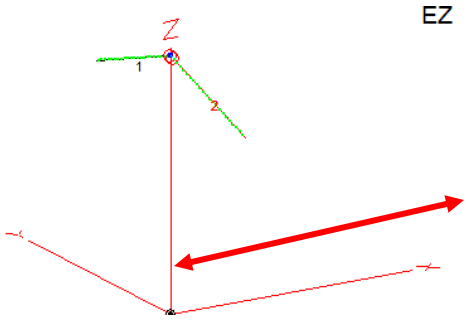


21.4 MHz



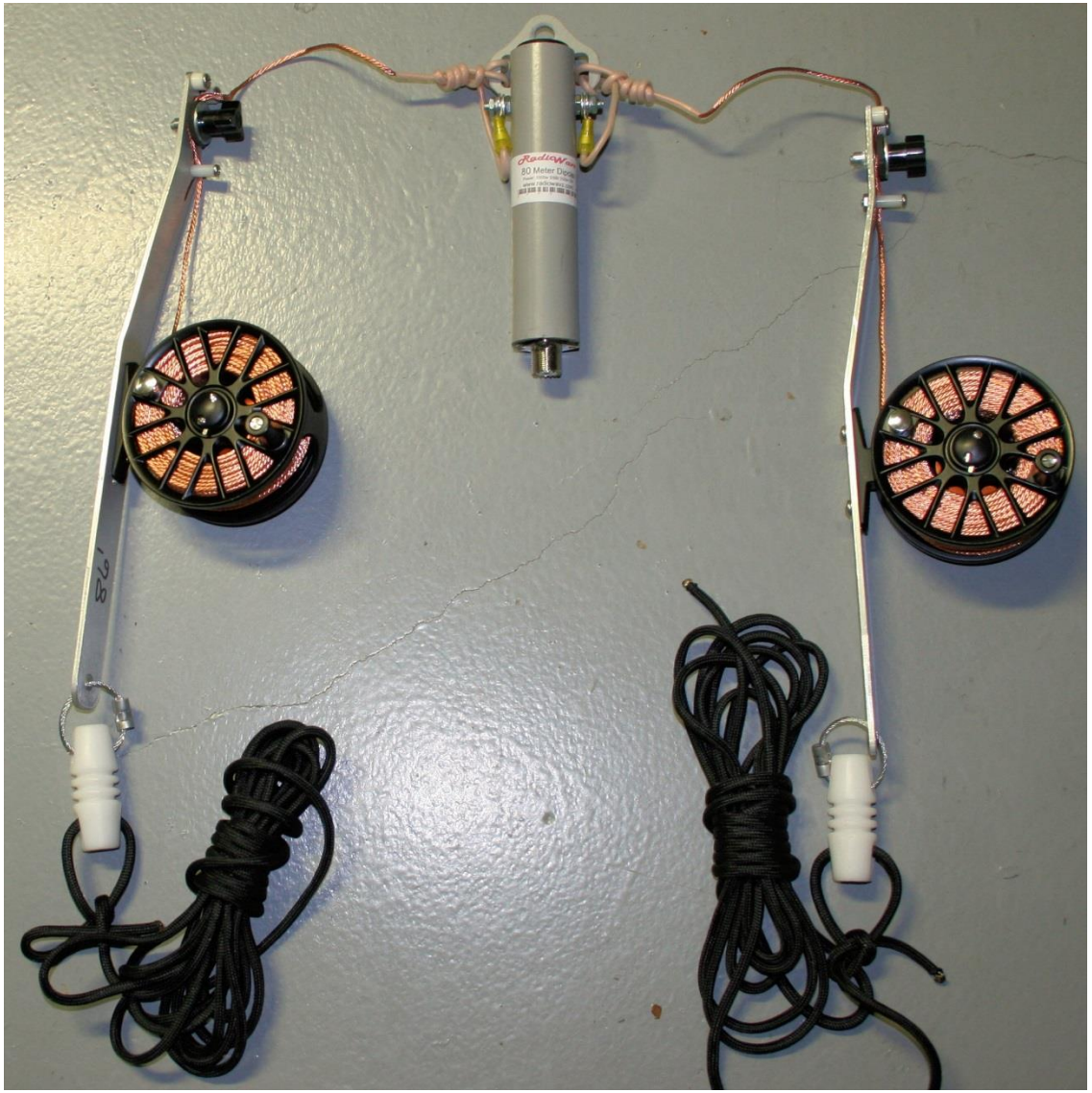
28.4 MHz





Note: Maximum gain
Right angle to wires

Option 2 – Adjustable “Reel” Dipole



LENGTH OF EACH LEG OF DIPOLE* (FT.)

1 MHz

Freq Mc	Dist Ft
20.0	11.2
19.0	11.7
18.0	12.4
17.0	13.1
16.0	13.9
15.0	14.9
14.0	15.9
13.0	17.2
12.0	18.6
11.0	20.3

0.5 MHz

Freq Mc	Dist Ft
11.0	20.3
10.5	21.2
10.0	22.3
9.5	23.5
9.0	24.8
8.5	26.2
8.0	27.9
7.5	29.7
7.0	31.9

0.2 MHz

Freq Mc	Dist Ft
7.0	31.9
6.8	32.8
6.6	33.8
6.4	24.8
6.2	36
6.0	37.2
5.8	38.4
5.6	39.8
5.4	41.3
5.2	42.9
5.0	44.6
4.8	46.5
4.6	48.5
4.4	50.7
4.2	53.1
4.0	55.75

0.1 MHz

Freq Mc	Dist Ft
4.0	55.75
3.9	57.2
3.8	58.7
3.7	60.3
3.6	61.9
3.5	63.7
3.4	65.6
3.3	67.6
3.2	69.7
3.1	71.9
3.0	74.3

0.05 MHz

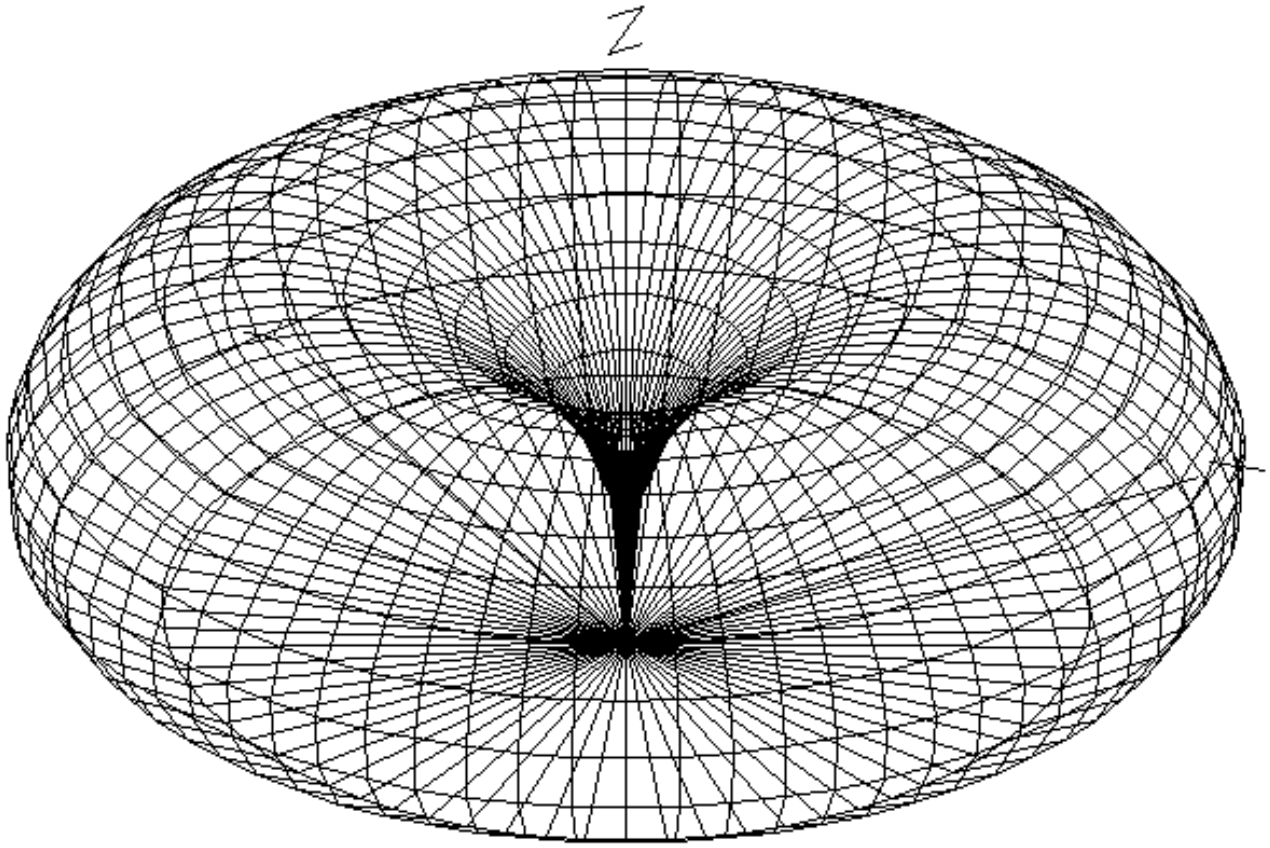
Freq Mc	Dist Ft
3.00	74.3
2.95	75.6
2.90	76.9
2.85	78.25
2.80	79.6
2.75	82.6
2.70	86.7
2.65	84.2

***NOTE: MEASURE FROM BALUN TO REEL END OF ROPE INSULATOR I.E., INCLUDE REEL IN TOTAL LENGTH.**

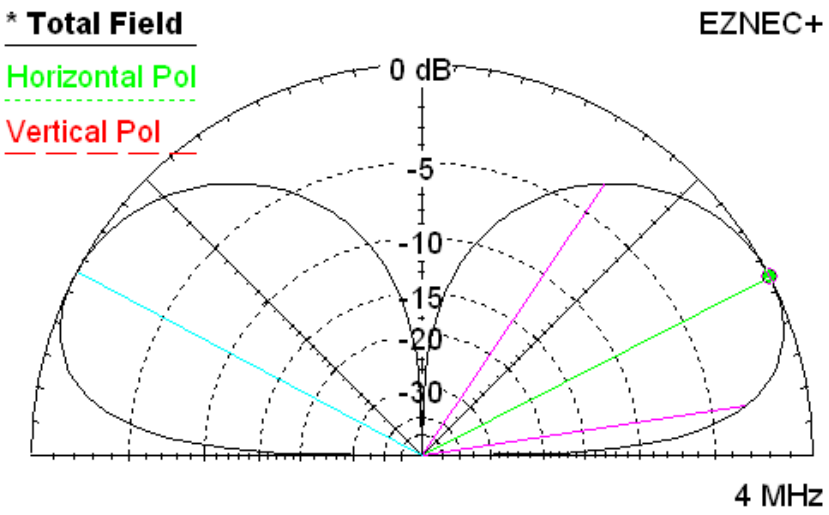
Vertical Antenna Description

- Auto-tuned vertical with ground radials
- Base height above ground – 2 ft.
- Vertical height – 23 ft.
- Vertical Type – Shakespeare 393 Marine SSB HF
- Ground Radial length (each) – 25 ft.
- Number of ground radials – 4
- Auto-tuner – ICOM AH-4

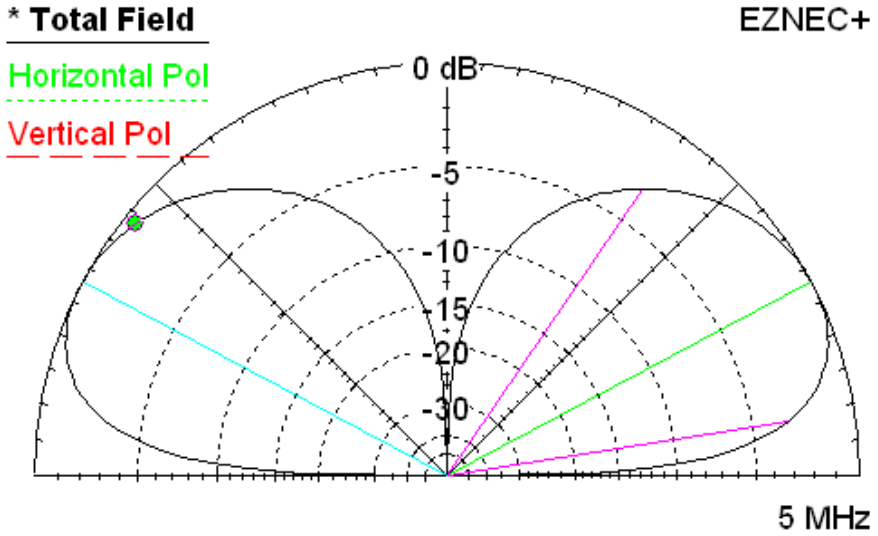
Vertical Antenna Pattern



Modeling – 4, 5 MHz

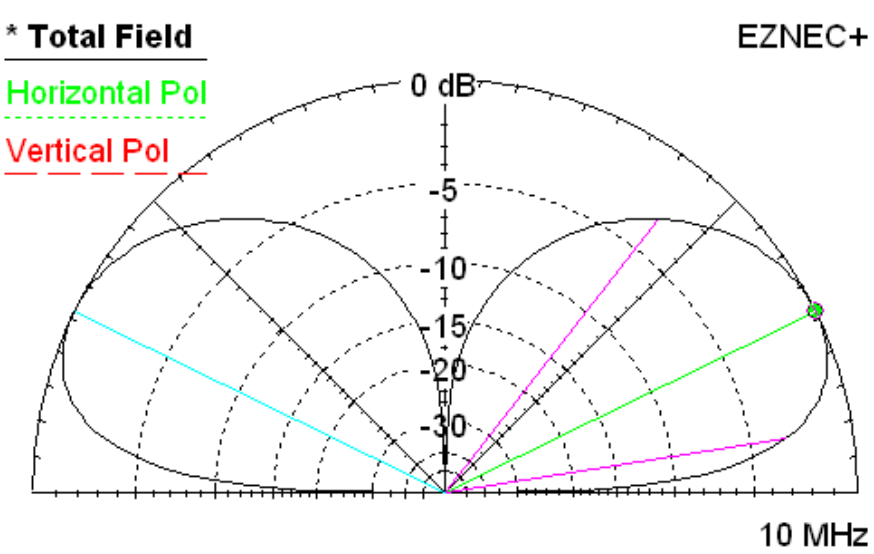


Elevation Plot		Cursor Elev	27.0 deg.
Azimuth Angle	0.0 deg.	Gain	-1.83 dBi
Outer Ring	-1.83 dBi		0.0 dBmax
Slice Max Gain	-1.83 dBi @ Elev Angle = 27.0 deg.		
Beamwidth	47.1 deg.; -3dB @ 8.8, 55.9 deg.		
Sidelobe Gain	-1.83 dBi @ Elev Angle = 152.0 deg.		
Front/Sidelobe	0.0 dB		

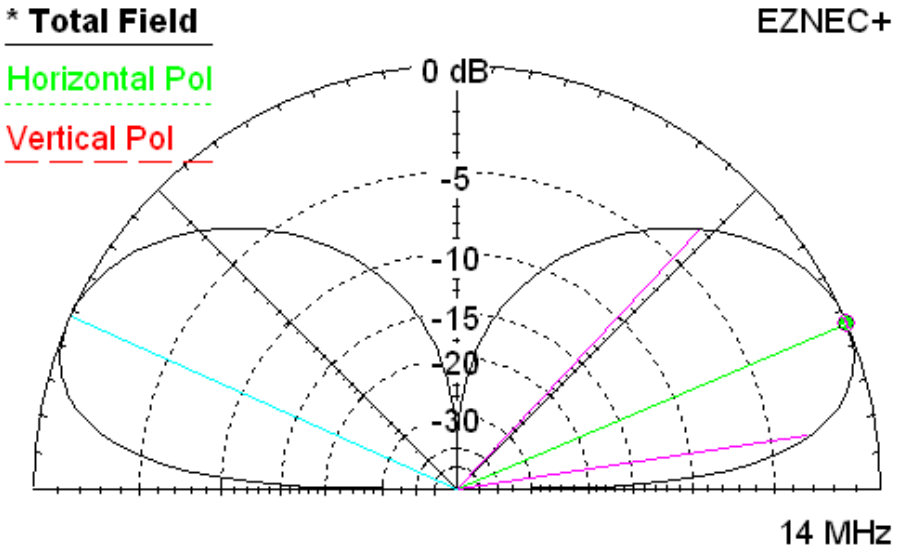


Elevation Plot		Cursor Elev	141.0 deg.
Azimuth Angle	0.0 deg.	Gain	-1.96 dBi
Outer Ring	-1.43 dBi		-0.53 dBmax
Slice Max Gain	-1.43 dBi @ Elev Angle = 28.0 deg.		
Beamwidth	46.7 deg.; -3dB @ 9.1, 55.8 deg.		
Sidelobe Gain	-1.43 dBi @ Elev Angle = 152.0 deg.		
Front/Sidelobe	0.0 dB		

Modeling – 10, 14 MHz

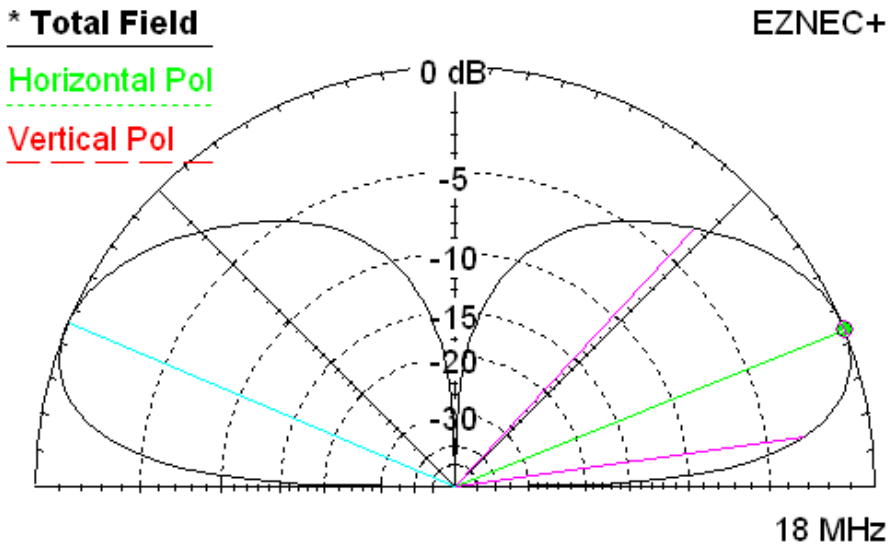


Elevation Plot		Cursor Elev	26.0 deg.
Azimuth Angle	0.0 deg.	Gain	-0.25 dBi
Outer Ring	-0.25 dBi		0.0 dBmax
Slice Max Gain	-0.25 dBi @ Elev Angle = 26.0 deg.		
Beamwidth	42.9 deg.; -3dB @ 9.1, 52.0 deg.		
Sidelobe Gain	-0.25 dBi @ Elev Angle = 154.0 deg.		
Front/Sidelobe	0.0 dB		



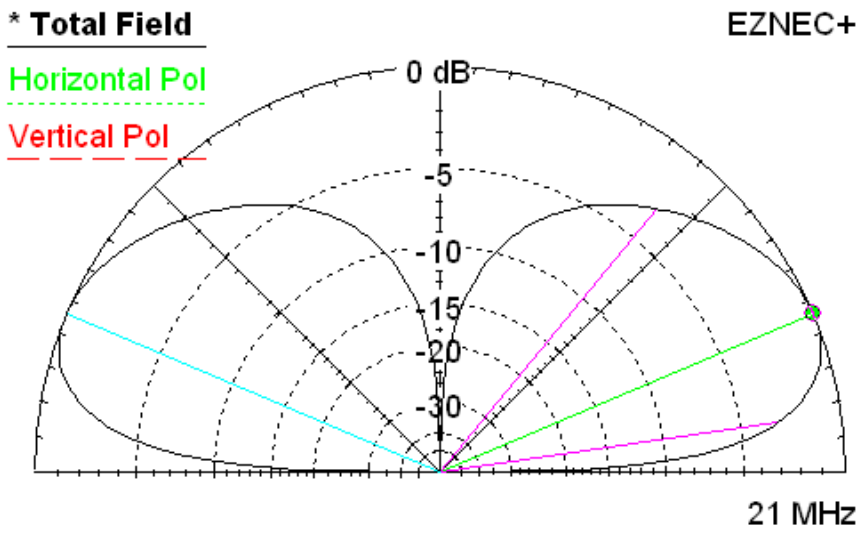
Elevation Plot		Cursor Elev	23.0 deg.
Azimuth Angle	0.0 deg.	Gain	0.11 dBi
Outer Ring	0.11 dBi		0.0 dBmax
Slice Max Gain	0.11 dBi @ Elev Angle = 23.0 deg.		
Beamwidth	38.3 deg.; -3dB @ 8.6, 46.9 deg.		
Sidelobe Gain	0.11 dBi @ Elev Angle = 156.0 deg.		
Front/Sidelobe	0.0 dB		

Modeling – 18, 21 MHz



Elevation Plot	
Azimuth Angle	0.0 deg.
Outer Ring	-0.83 dBi
Slice Max Gain	-0.83 dBi @ Elev Angle = 22.0 deg.
Beamwidth	38.9 deg.; -3dB @ 8.2, 47.1 deg.
Sidelobe Gain	-0.83 dBi @ Elev Angle = 157.0 deg.
Front/Sidelobe	0.0 dB

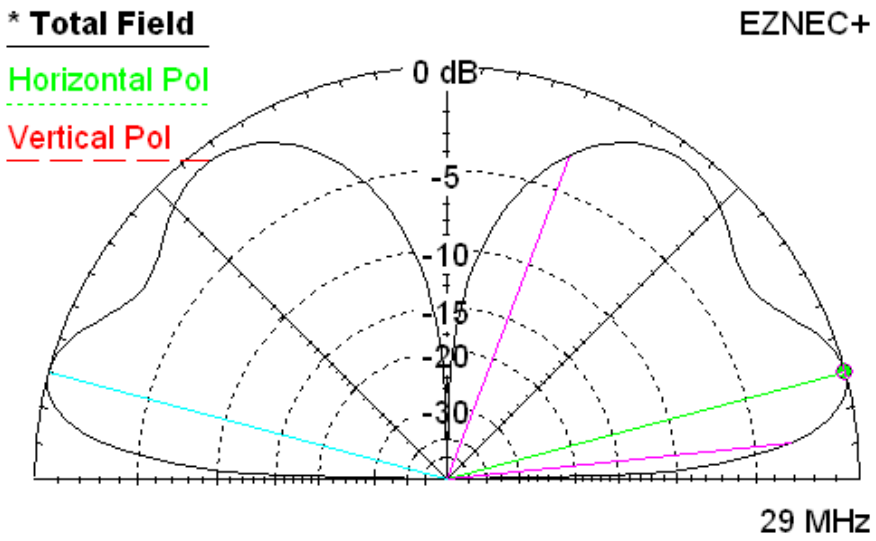
Cursor Elev	22.0 deg.
Gain	-0.83 dBi
	0.0 dBmax



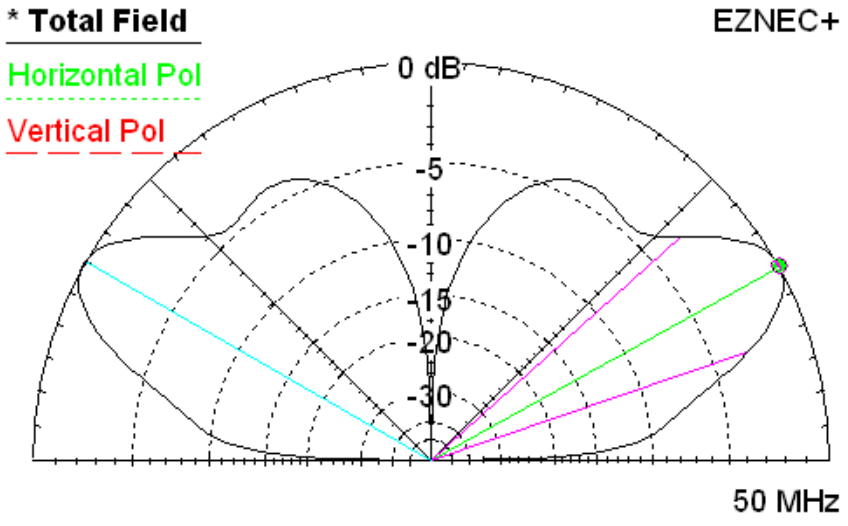
Elevation Plot	
Azimuth Angle	0.0 deg.
Outer Ring	-0.92 dBi
Slice Max Gain	-0.92 dBi @ Elev Angle = 23.0 deg.
Beamwidth	42.3 deg.; -3dB @ 8.3, 50.6 deg.
Sidelobe Gain	-0.92 dBi @ Elev Angle = 157.0 deg.
Front/Sidelobe	0.0 dB

Cursor Elev	23.0 deg.
Gain	-0.92 dBi
	0.0 dBmax

Modeling – 28, 50 MHz



Elevation Plot		Cursor Elev	15.0 deg.
Azimuth Angle	0.0 deg.	Gain	0.75 dBi
Outer Ring	0.75 dBi		0.0 dBmax
Slice Max Gain	0.75 dBi @ Elev Angle = 15.0 deg.		
Beamwidth	63.2 deg.; -3dB @ 6.0, 69.2 deg.		
Sidelobe Gain	0.75 dBi @ Elev Angle = 165.0 deg.		
Front/Sidelobe	0.0 dB		

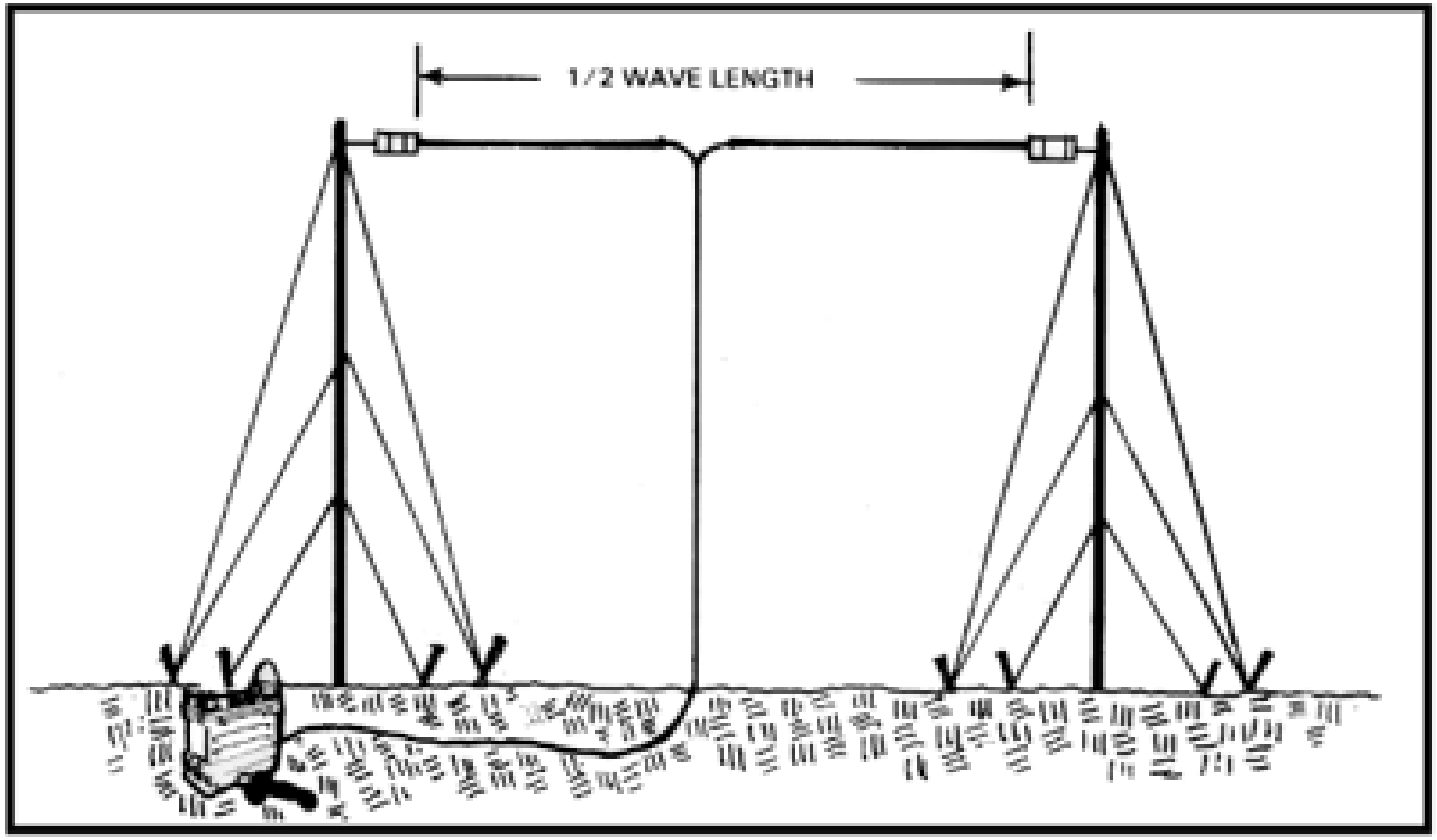


Elevation Plot		Cursor Elev	29.0 deg.
Azimuth Angle	0.0 deg.	Gain	3.93 dBi
Outer Ring	3.93 dBi		0.0 dBmax
Slice Max Gain	3.93 dBi @ Elev Angle = 29.0 deg.		
Beamwidth	23.0 deg.; -3dB @ 18.9, 41.9 deg.		
Sidelobe Gain	3.93 dBi @ Elev Angle = 150.0 deg.		
Front/Sidelobe	0.0 dB		

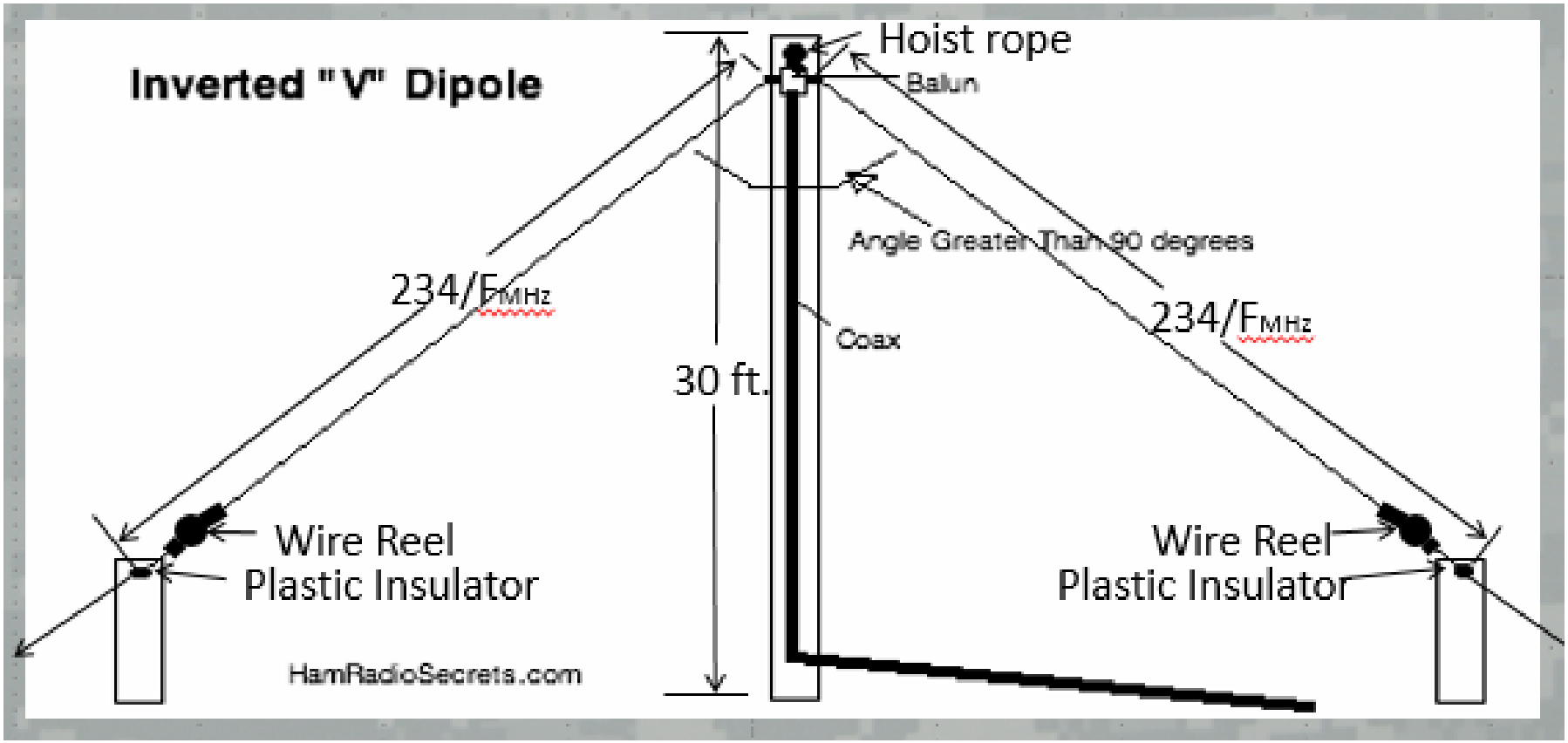
Optimizing HF Communications

- Ionospheric propagation
  - Frequency selection
  - Other propagation factors
- Antenna design
  - Correct directivity pattern
  - Provide usable impedance to RF transmitter

Half Wave Dipole

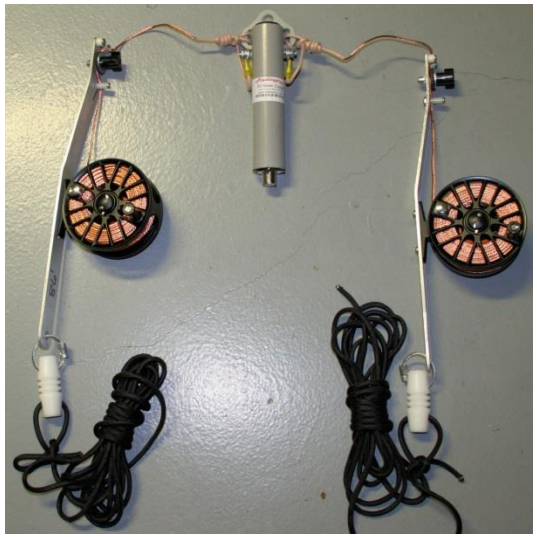


Inverted-V Half-Wave Dipole

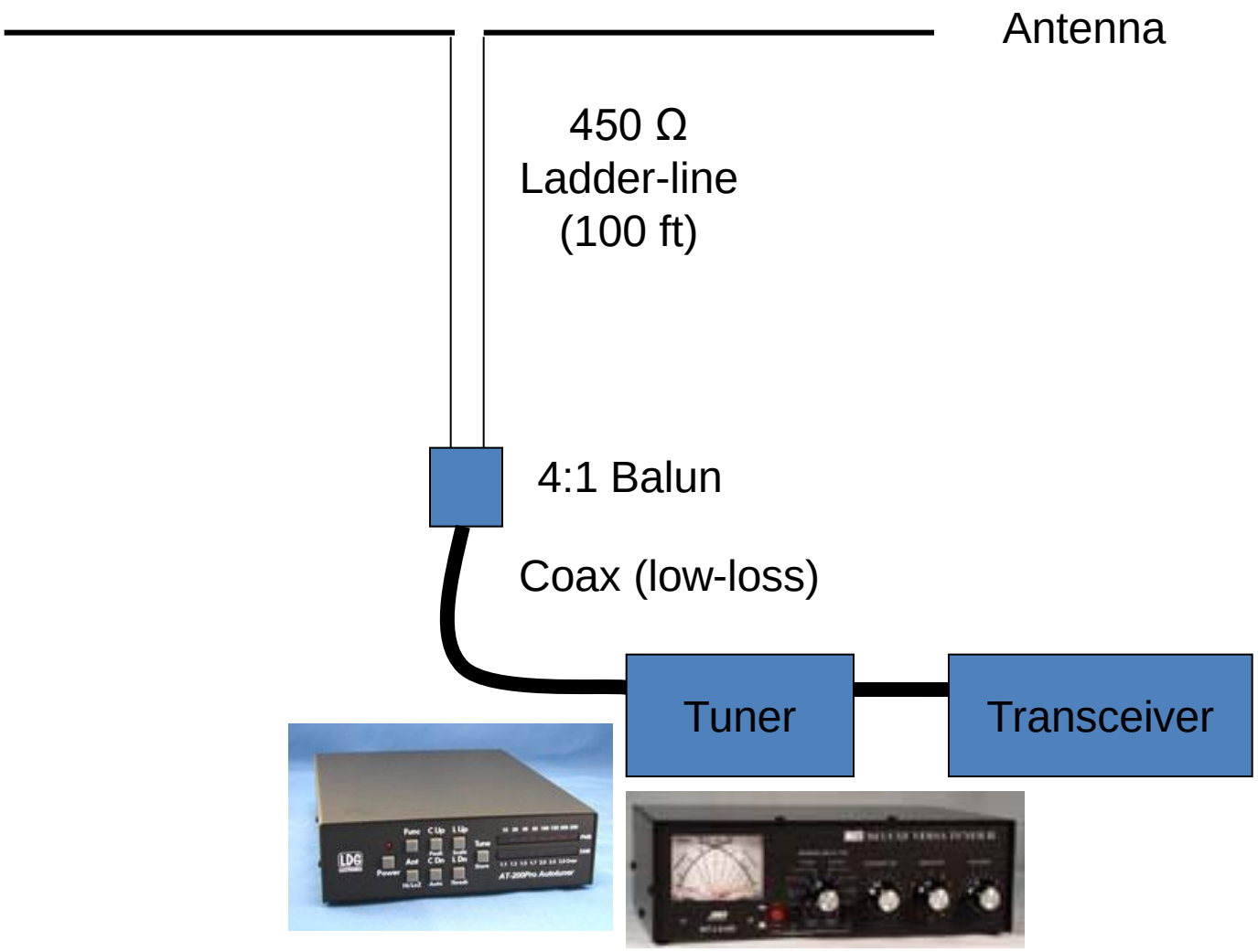


Adjustable “Reel” Dipole

- Adjust length for one-half wavelength
- Impedance will be close to 50 ohms and therefore no tuning required, or internal HF rig tuner can make fine adjustments (<3:1)



TUNER LOCATED AT RIG



LDG-AT 200 Pro

MFJ – 949E

TUNER AT ANTENNA

SGC-SG-230

ICOM AH-4

Auto-Tuner Near Antenna

SGC-SG-230

ICOM AH-4