# A Comparison of Common Antennas

# For DX Use

# Using

# EZNEC

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# Live EZNEC Demo

-EZNEC demo version is free download.
-Segment limit = 22 – really a complexity limit.
-You can do a lot with 22 segments.

# 40m dipole at 30'

## 1 wire with source at 50%

free space, in meters

468/f = total length near ground; free space = longer

elevation vs azimuth

20 degrees elevation vs straight up

Real ground – Resonance moves down.

## Radiation mostly straight up if near ground

Move height up 15m (~75') =>  Gain at $20^o$ goes up ~8dB!

## For DX use, a 40' tower =.3λ at 40m

.6λ at 20m

1.2λ at 10m

**A dipole really needs to be up > ½ λ**

# 40m Vertical

- 1 wire with source at 0% (bottom at ground)
- free space –hardly radiates
- For DX work using Perfect Ground
  - No vertical radiation and
  - Gain = 5.1dBi at horizon; 4.3dBi at $20^{o}$.
  - Best implementation = very many radials.

- For Real ground
  - Still no vertical radiation and
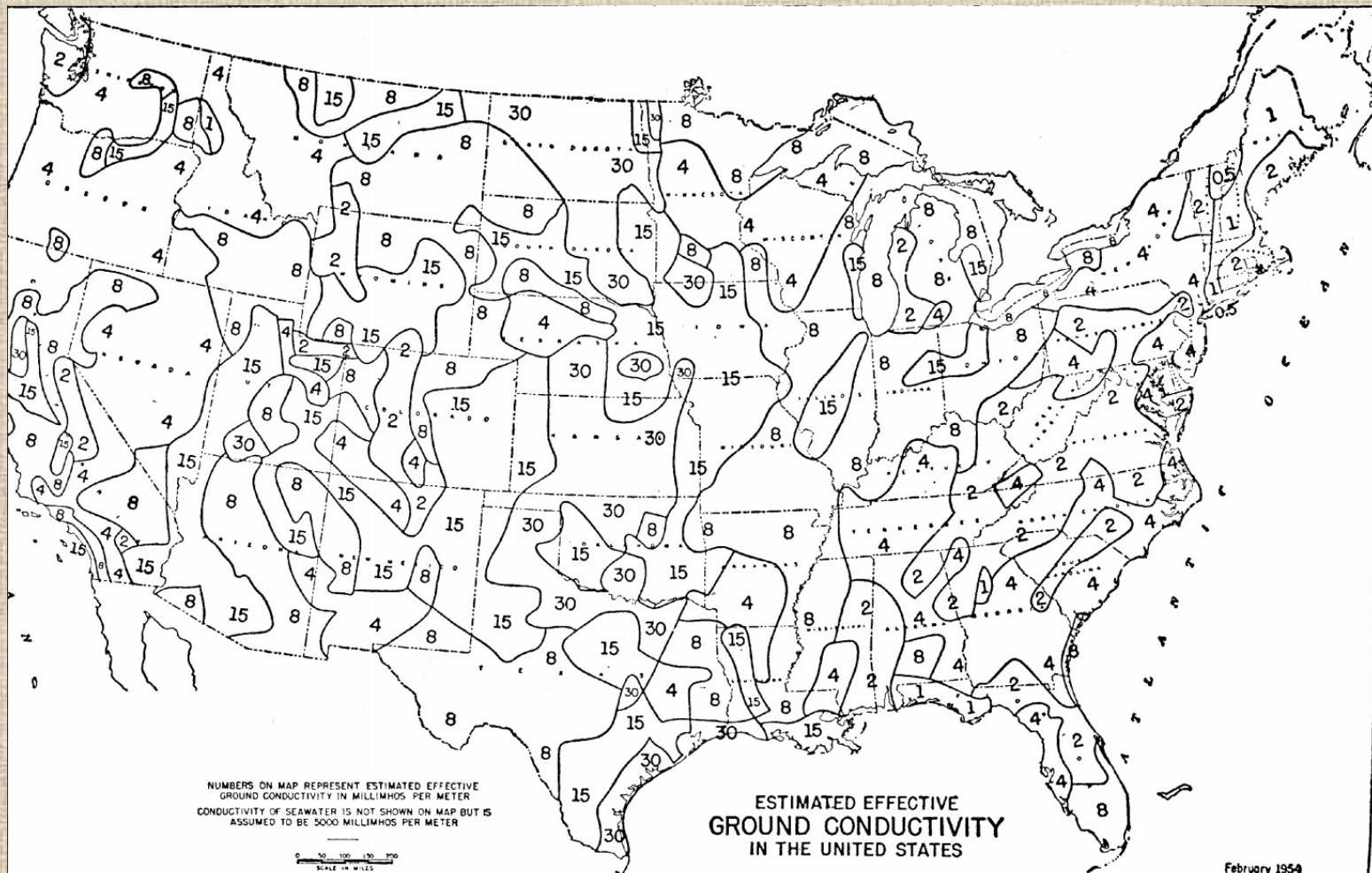  - But max gain at $26^{o}$ = -.09dBi

# So How Do You Get Those 5.91dB Back

Getting Those 5.91dB Back (perfect ground)

-Make the 4 radials 10x longer => lose 2.3dB
-Make radials 0.1x (shorter) => Gain=-0.84dBi
-Use 8 radials instead of 4 => Gain= 0.06dBi
-Over very salty water, 1S/m=> Gain= 4.35dBi
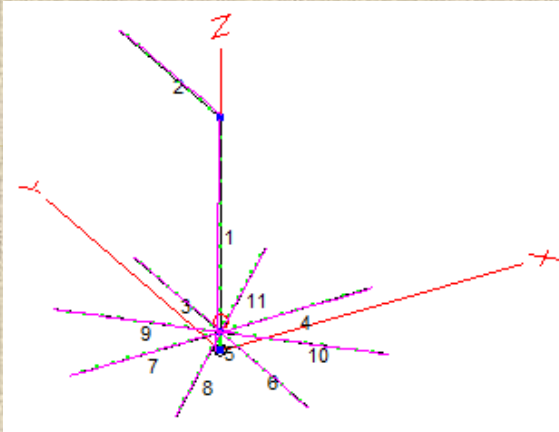-No-Loss wire => Gain= 4.42dBi

Advantage of a Vertical:
-For DX, no radiation directly up.
-At $20^o$ elevation, similar gain to a
low dipole (.06 vs .72 dBi).

NUMBERS ON MAP REPRESENT ESTIMATED EFFECTIVE
GROUND CONDUCTIVITY IN MILLIMHOS PER METER
CONDUCTIVITY OF SEAWATER IS NOT SHOWN ON MAP BUT IS
ASSUMED TO BE 5000 MILLIMHOS PER METER

SCALE IN MILES

ESTIMATED EFFECTIVE
GROUND CONDUCTIVITY
IN THE UNITED STATES

February 1954

# 160m Inverted L (76'/58')
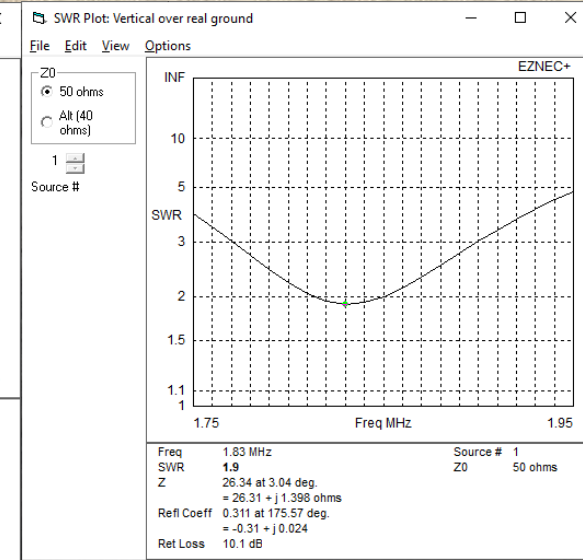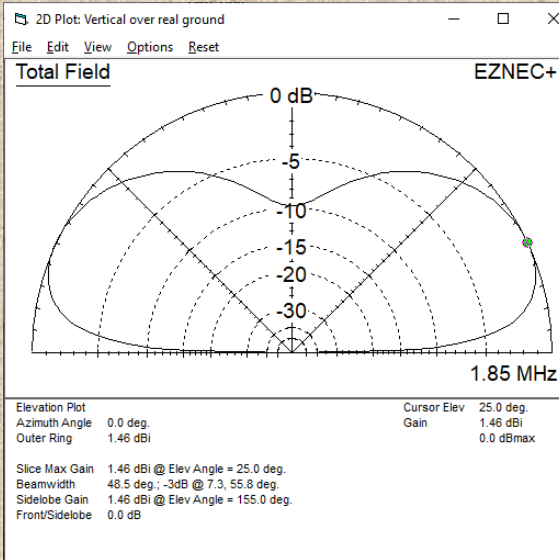
8 radials at 50'long, 6' up



**Wires**

Wire  Create  Edit  Other

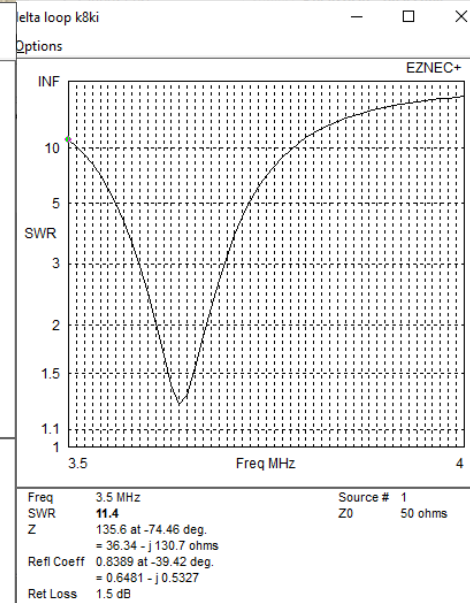☐ Coord Entry Mode   ☐ Preserve Connections   ☑ Show Wire Insulation

Wires

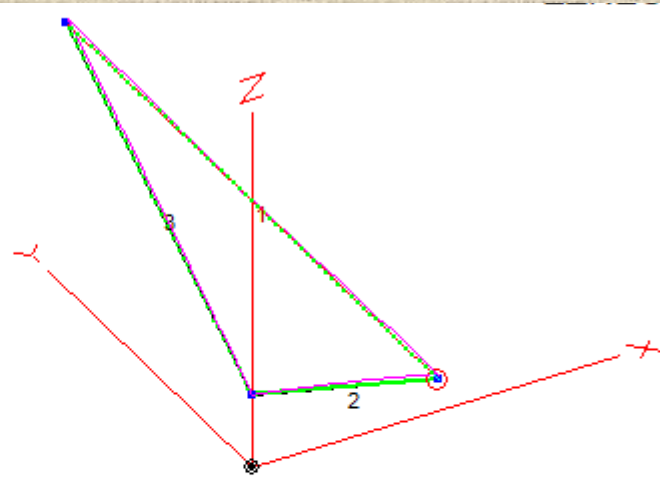| No. | End 1 | | | | End 2 | | | | Diameter | Segs | Insulation | |
| | X (ft) | Y (ft) | Z (ft) | Conn | X (ft) | Y (ft) | Z (ft) | Conn | (in) | | Diel C | Thk (in) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 6 | W3E1 | 0 | 0 | 76 | W2E1 | #14 | 10 | 1 | 0 |
| 2 | 0 | 0 | 76 | W1E2 | 0 | 58 | 76 | | #14 | 10 | 1 | 0 |
| 3 | 0 | 0 | 6 | W4E1 | 0 | 50 | 6 | | #14 | 10 | 1 | 0 |
| 4 | 0 | 0 | 6 | W5E1 | 50 | 0 | 6 | | #14 | 10 | 1 | 0 |
| 5 | 0 | 0 | 6 | W6E1 | 0 | 0 | 0 | Ground | #14 | 10 | 1 | 0 |
| 6 | 0 | 0 | 6 | W7E1 | 0 | -50 | 6 | | #14 | 10 | 1 | 0 |
| 7 | 0 | 0 | 6 | W8E1 | -50 | 0 | 6 | | #14 | 10 | 1 | 0 |
| 8 | 0 | 0 | 6 | W9E1 | -35 | -35 | 6 | | #14 | 10 | 1 | 0 |
| 9 | 0 | 0 | 6 | W10E1 | -35 | 35 | 6 | | #14 | 10 | 1 | 0 |
| 10 | 0 | 0 | 6 | W11E1 | 35 | -35 | 6 | | #14 | 10 | 1 | 0 |
| 11 | 0 | 0 | 6 | W1E1 | 35 | 35 | 6 | | #14 | 10 | 1 | 0 |

In this case it pays to connect a wire to ground.



**2D Plot: Vertical over real ground**

File  Edit  View  Options  Reset

Total Field                                    EZNEC+

Elevation Plot
Azimuth Angle   0.0 deg.
Outer Ring      1.46 dBi

Cursor Elev   25.0 deg.
Gain          1.46 dBi
              0.0 dBmax

Slice Max Gain   1.46 dBi @ Elev Angle = 25.0 deg.
Beamwidth        48.5 deg.; -3dB @ 7.3, 55.8 deg.
Sidelobe Gain    1.46 dBi @ Elev Angle = 155.0 deg.
Front/Sidelobe   0.0 dB



**SWR Plot: Vertical over real ground**

File  Edit  View  Options

Z0
⦿ 50 ohms
○ Alt (40 ohms)

1
Source #

EZNEC+

Freq       1.83 MHz
SWR        1.9
Z          26.34 at 3.04 deg.
           = 26.31 + j 1.398 ohms
Refl Coeff 0.311 at 175.57 deg.
           = -0.31 + j 0.024
Ret Loss   10.1 dB

Source #  1
Z0        50 ohms

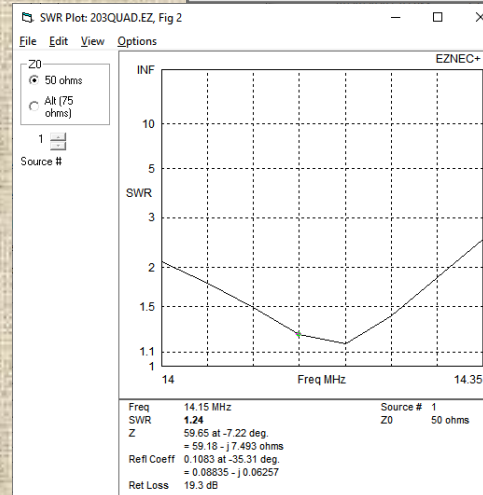Max Gain=1.46dBi
Avg Gain=-3.30dBi
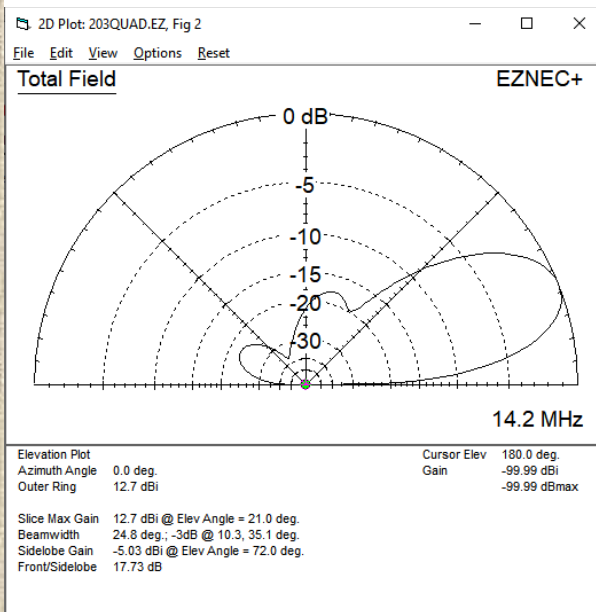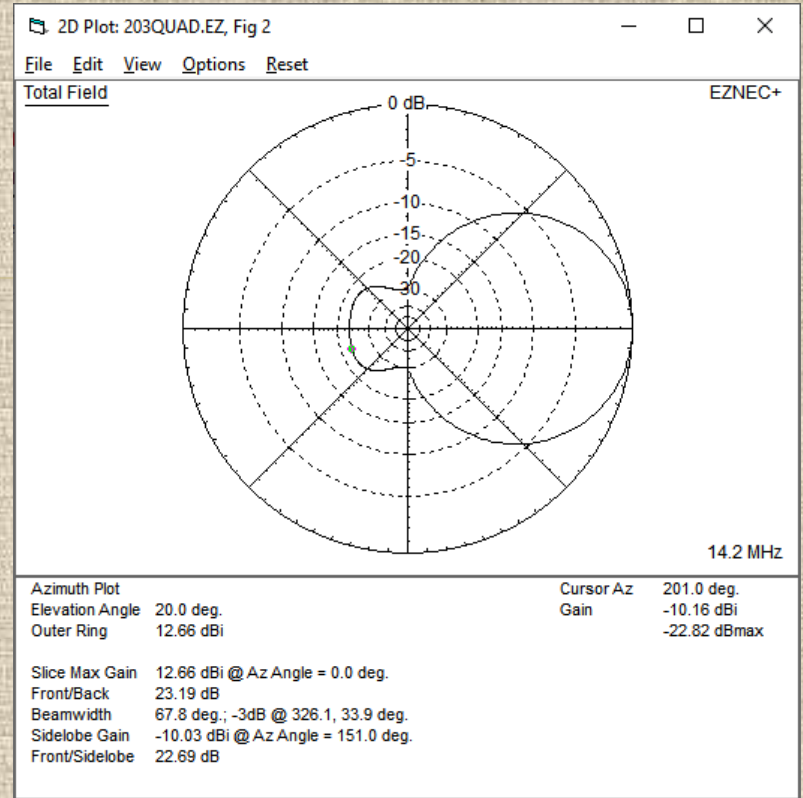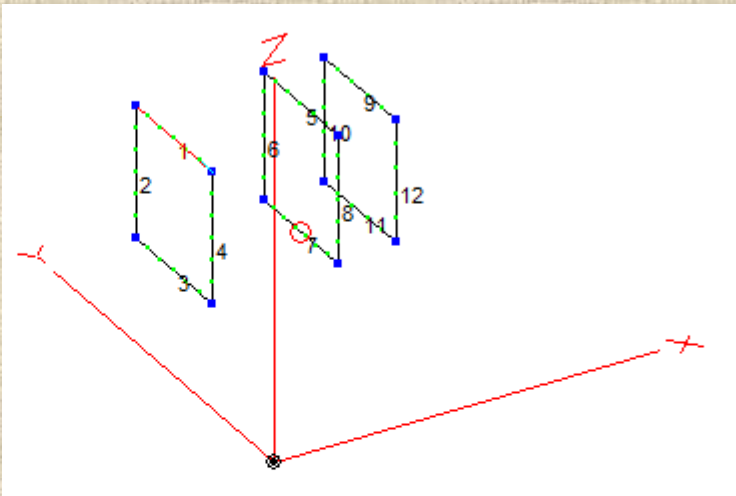RDF=4.76dB

# 80m Delta Loop at 55'
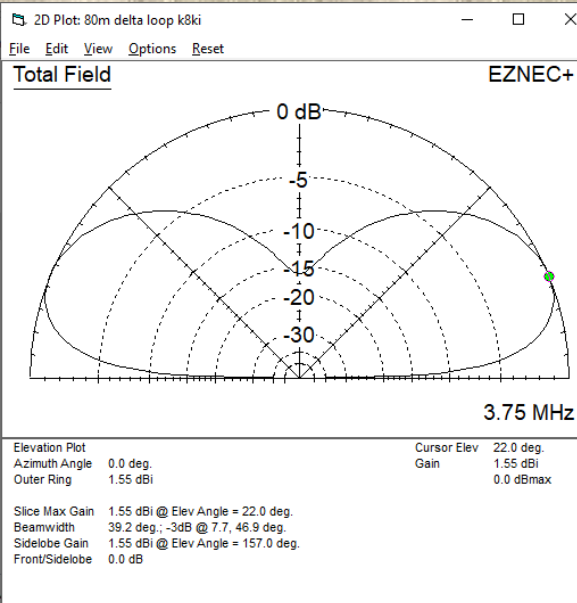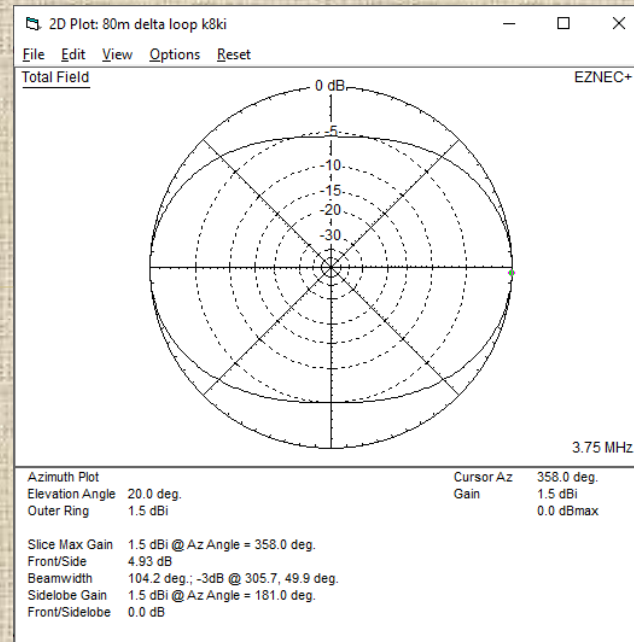


Max Gain= 1.5dB
Avg Gain= -5.66dB
RDF= 7.16dB
F/S= 4.93dB

Feedpoint location is critical

# 20m Quad – 40'

Real ground





**2D Plot: 203QUAD.EZ, Fig 2**

File   Edit   View   Options   Reset

**Total Field**                                    EZNEC+

14.2 MHz

| Azimuth Plot | | Cursor Az | 201.0 deg. |
| Elevation Angle | 20.0 deg. | Gain | -10.16 dBi |
| Outer Ring | 12.66 dBi | | -22.82 dBmax |

Slice Max Gain   12.66 dBi @ Az Angle = 0.0 deg.
Front/Back        23.19 dB
Beamwidth         67.8 deg.; -3dB @ 326.1, 33.9 deg.
Sidelobe Gain     -10.03 dBi @ Az Angle = 151.0 deg.
Front/Sidelobe    22.69 dB

**2D Plot: 203QUAD.EZ, Fig 2**

File   Edit   View   Options   Reset

**Total Field**                                    EZNEC+

14.2 MHz

| Elevation Plot | | Cursor Elev | 180.0 deg. |
| Azimuth Angle | 0.0 deg. | Gain | -99.99 dBi |
| Outer Ring | 12.7 dBi | | -99.99 dBmax |

Slice Max Gain   12.7 dBi @ Elev Angle = 21.0 deg.
Beamwidth         24.8 deg.; -3dB @ 10.3, 35.1 deg.
Sidelobe Gain     -5.03 dBi @ Elev Angle = 72.0 deg.
Front/Sidelobe    17.73 dB

**SWR Plot: 203QUAD.EZ, Fig 2**

File   Edit   View   Options

Z0
◉ 50 ohms
○ Alt (75 ohms)

1
Source #

EZNEC+

INF

10

5

SWR

3

2

1.5

1.1

1

14        Freq MHz        14.35

Freq        14.15 MHz          Source #   1
SWR         **1.24**            Z0   50 ohms
Z           59.65 at -7.22 deg.
            = 59.18 - j 7.493 ohms
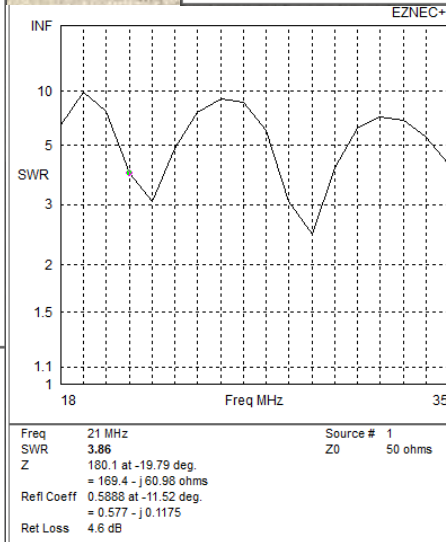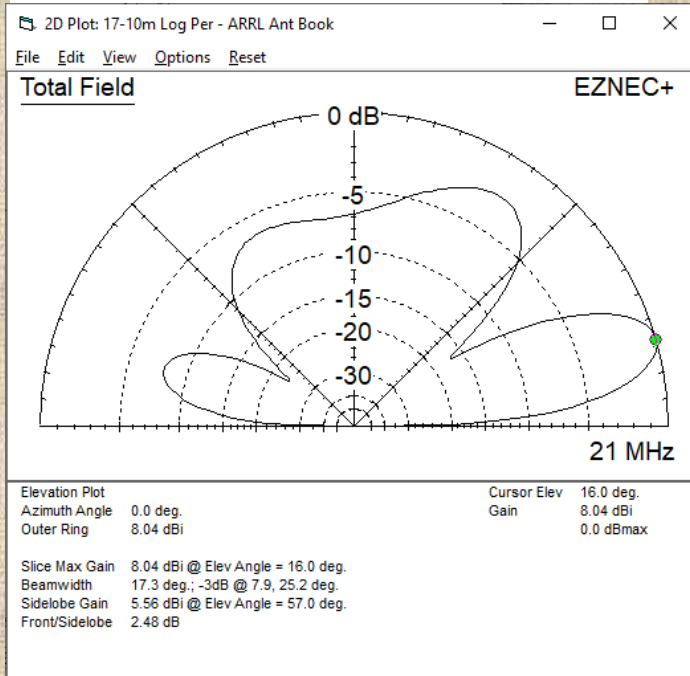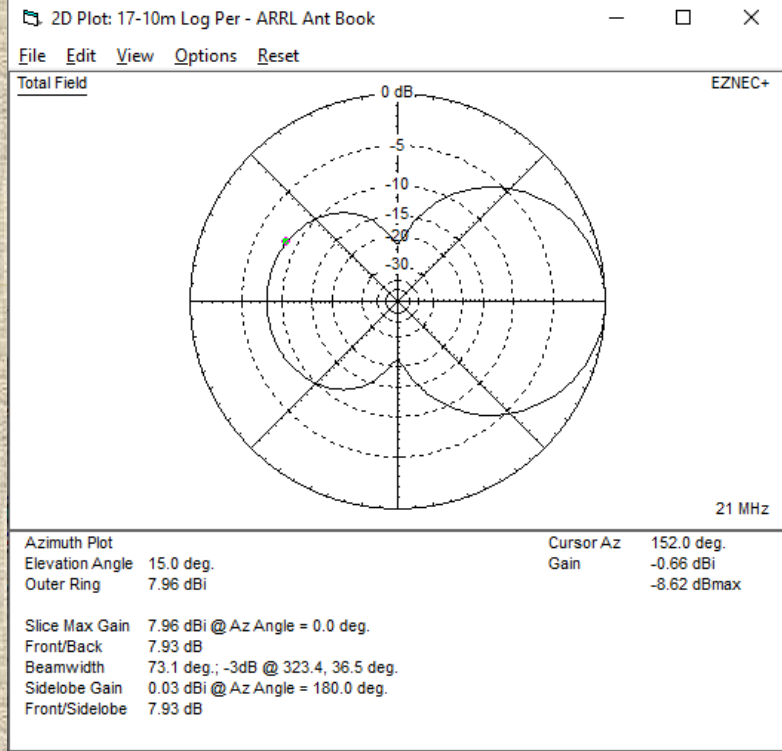Refl Coeff  0.1083 at -35.31 deg.
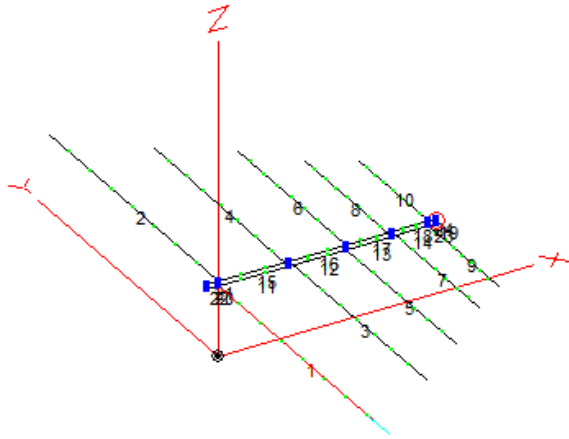            = 0.08835 - j 0.06257
Ret Loss    19.3 dB

Avg Gain = -1.16dB
Max Gain = 12.7dBi
F/B=23.19dB
RDF=13.86dB

9

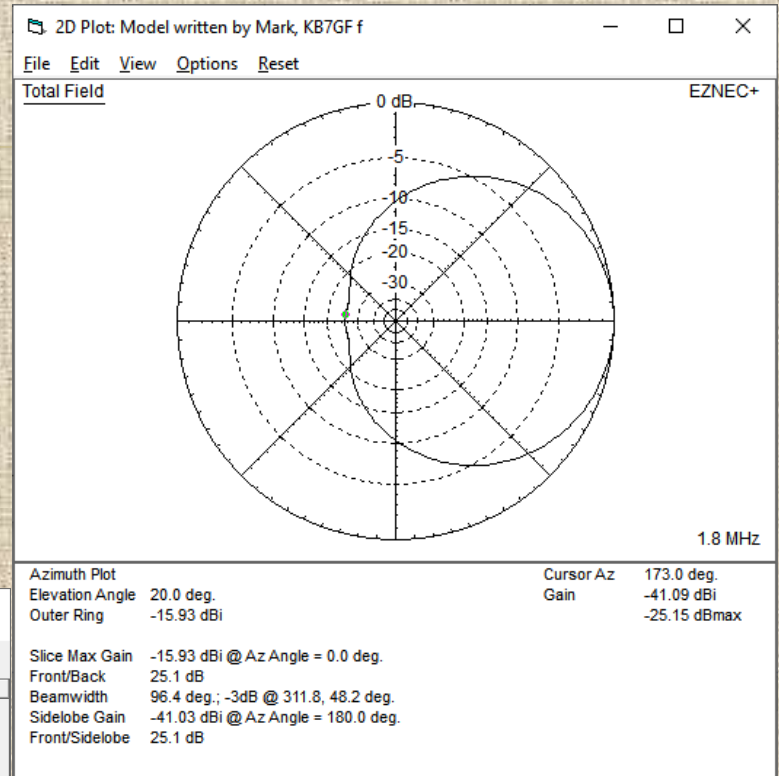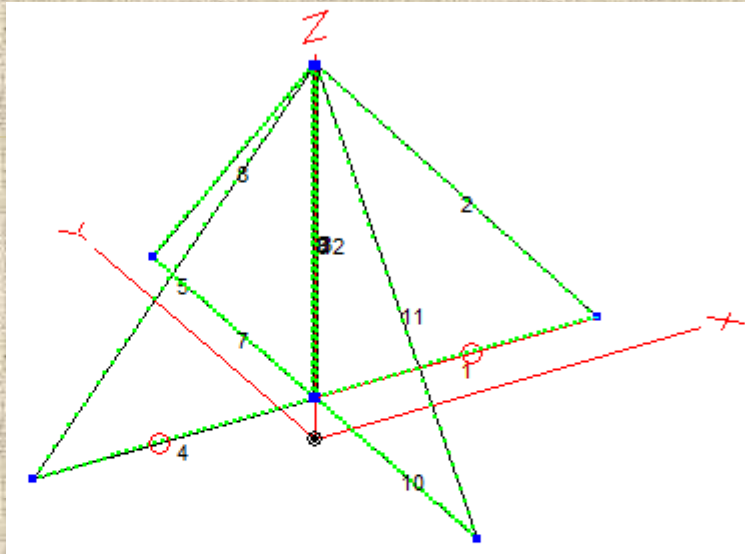# Log Periodic-40'

Real Ground

Max Gain=7.96dBi
Avg Gain=-3.04dB
RDF=11.00dB
F/B=7.93dB

# Shared Apex Array SAL30





2D Plot: Model written by Mark, KB7GF f  — □ ×

File   Edit   View   Options   Reset

Total Field                                    EZNEC+

1.8 MHz

**Azimuth Plot** | | **Cursor Az** | 173.0 deg.
Elevation Angle | 20.0 deg. | Gain | -41.09 dBi
Outer Ring | -15.93 dBi | | -25.15 dBmax

Slice Max Gain | -15.93 dBi @ Az Angle = 0.0 deg.
Front/Back | 25.1 dB
Beamwidth | 96.4 deg.; -3dB @ 311.8, 48.2 deg.
Sidelobe Gain | -41.03 dBi @ Az Angle = 180.0 deg.
Front/Sidelobe | 25.1 dB

## Wires

Wire   Create   Edit   Other

☐ Coord Entry Mode   ☐ Preserve Connections   ☑ Show Wire Insulation

| | No. | End 1 | | | | End 2 | | | | Diameter | Segs | Insulation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | X (ft) | Y (ft) | Z (ft) | Conn | X (ft) | Y (ft) | Z (ft) | Conn | (in) | | Diel C | Thk (in) |
| ▶ | 1 | 25.1667 | 0 | 3.70833 | W2E1 | 0.166667 | 0 | 3.70833 | W3E2 | 0.079 | 39 | 1 | 0 |
| | 2 | 25.1667 | 0 | 3.70833 | W1E1 | 0.166667 | 0 | 33.375 | W3E1 | 0.079 | 39 | 1 | 0 |
| | 3 | 0.166667 | 0 | 33.375 | W2E2 | 0.166667 | 0 | 3.70833 | W1E2 | 0.079 | 39 | 1 | 0 |
| | 4 | -0.166667 | 0 | 3.70833 | W6E2 | -25.1667 | 0 | 3.70833 | W5E1 | 0.079 | 39 | 1 | 0 |
| | 5 | -25.1667 | 0 | 3.70833 | W4E2 | -0.166667 | 0 | 33.375 | W6E1 | 0.079 | 39 | 1 | 0 |
| | 6 | -0.166667 | 0 | 33.375 | W5E2 | -0.166667 | 0 | 3.70833 | W4E1 | 0.079 | 39 | 1 | 0 |
| | 7 | 0 | 25.1667 | 3.70833 | W8E1 | 0 | 0.166667 | 3.70833 | W9E2 | 0.079 | 39 | 1 | 0 |
| | 8 | 0 | 25.1667 | 3.70833 | W7E1 | 0 | 0.166667 | 33.375 | W9E1 | 0.079 | 39 | 1 | 0 |
| | 9 | 0 | 0.166667 | 33.375 | W8E2 | 0 | 0.166667 | 3.70833 | W7E2 | 0.079 | 39 | 1 | 0 |
| | 10 | 0 | -0.166667 | 3.70833 | W12E2 | 0 | -25.1667 | 3.70833 | W11E1 | 0.079 | 39 | 1 | 0 |
| | 11 | 0 | -25.1667 | 3.70833 | W10E2 | 0 | -0.166667 | 33.375 | W12E1 | 0.079 | 39 | 1 | 0 |
| | 12 | 0 | -0.166667 | 33.375 | W11E2 | 0 | -0.166667 | 3.70833 | W10E1 | 0.079 | 39 | 1 | 0 |
| ✱ | | | | | | | | | | | | | |

## Sources

Source   Edit

| | No. | Specified Pos. | | Actual Pos. | | Amplitude | Phase | Type |
|---|---|---|---|---|---|---|---|---|
| | | Wire # | % From E1 | % From E1 | Seg | (V, A) | (deg.) | |
| ▶ | 1 | 1 | 44.87 | 44.8718 | 18 | 0.707107 | 17.415 | V |
| | 2 | 4 | 55.13 | 55.1282 | 22 | 0.707107 | 180 | V |
| ✱ | | | | | | | | |

Max Gain= -15.93dBi
Avg Gain=-24.67dB
RDF= 8.74dB

# K9AY 160m
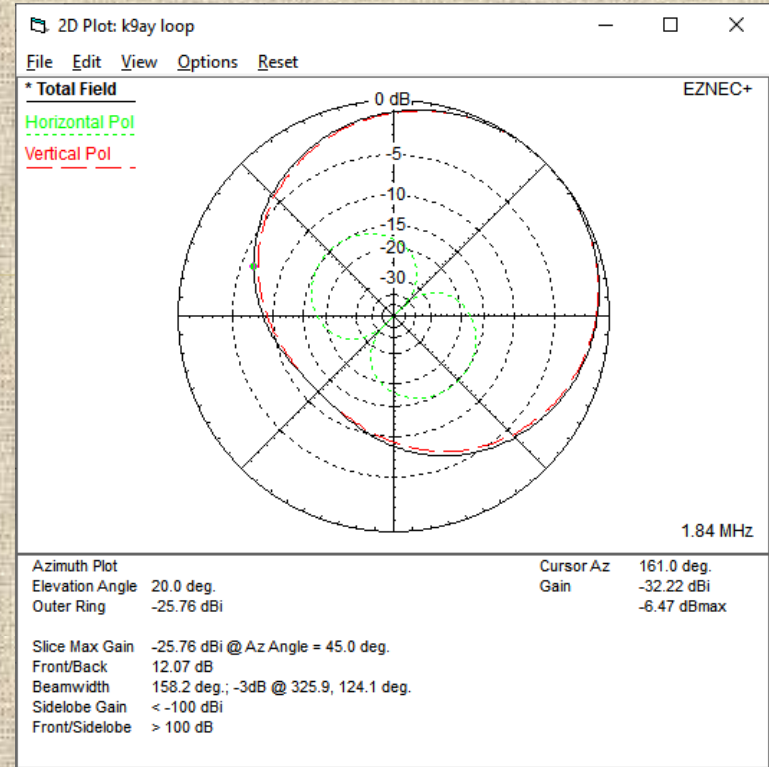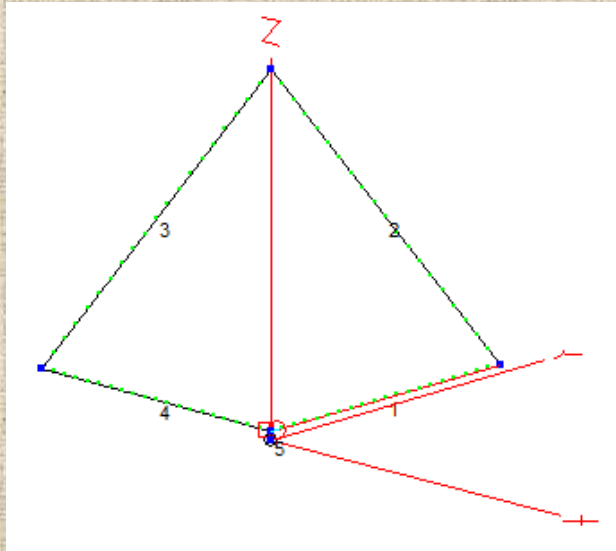


## 2D Plot: k9ay loop

File  Edit  View  Options  Reset

\* **Total Field**                                           EZNEC+

Horizontal Pol

Vertical Pol

1.84 MHz

| Azimuth Plot | | Cursor Az | 161.0 deg. |
| Elevation Angle | 20.0 deg. | Gain | -32.22 dBi |
| Outer Ring | -25.76 dBi | | -6.47 dBmax |

| Slice Max Gain | -25.76 dBi @ Az Angle = 45.0 deg. |
| Front/Back | 12.07 dB |
| Beamwidth | 158.2 deg.; -3dB @ 325.9, 124.1 deg. |
| Sidelobe Gain | < -100 dBi |
| Front/Sidelobe | > 100 dB |

## Wires

Wire  Create  Edit  Other

☐ Coord Entry Mode    ☐ Preserve Connections    ☑ Show Wire Insulation

| No. | End 1 | | | | End 2 | | | | Diameter | Segs | Insulation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X (ft) | Y (ft) | Z (ft) | Conn | X (ft) | Y (ft) | Z (ft) | Conn | (in) | | Diel C | Thk (in) |
| 1 | 0 | 0 | 0.6 | W4E2 | 10.5 | 10.5 | 5 | W2E1 | #12 | 20 | 1 | 0 |
| 2 | 10.5 | 10.5 | 5 | W1E2 | 0 | 0 | 25 | W3E1 | #12 | 20 | 1 | 0 |
| 3 | 0 | 0 | 25 | W2E2 | -10.5 | -10.5 | 5 | W4E1 | #12 | 20 | 1 | 0 |
| 4 | -10.5 | -10.5 | 5 | W3E2 | 0 | 0 | 0.6 | W5E2 | #12 | 20 | 1 | 0 |
| 5 | 0 | 0 | 0 | Ground | 0 | 0 | 0.6 | W1E1 | #12 | 1 | 1 | 0 |
| * | | | | | | | | | | | | |

Max Gain= -25.76dBi
Avg Gain=-32.98dB
RDF= 7.22 dB
F/B=12.07dB

# 160m 4-Square

**2D Plot: 160 TX 4 square** — EZNEC Demo

File  Edit  View  Options  Reset

**Total Field**

1.85 MHz

Azimuth Plot
Elevation Angle   23.0 deg.
Outer Ring        6.83 dBi

Cursor Az   163.0 deg.
Gain        -16.31 dBi
            -23.13 dBmax

Slice Max Gain   6.83 dBi @ Az Angle = 45.0 deg.
Front/Back       24.26 dB
Beamwidth        99.8 deg.; -3dB @ 355.1, 94.9 deg.
Sidelobe Gain    -17.43 dBi @ Az Angle = 225.0 deg.
Front/Sidelobe   24.26 dB

**2D Plot: 160 TX 4 square** — EZNEC+

File  Edit  View  Options  Reset

**Total Field**

1.85 MHz

Elevation Plot
Azimuth Angle   0.0 deg.
Outer Ring      4.42 dBi

Cursor Elev   135.0 deg.
Gain          -11.22 dBi
              -15.64 dBmax

Slice Max Gain   4.42 dBi @ Elev Angle = 22.0 deg.
Beamwidth        41.9 deg.; -3dB @ 6.9, 48.8 deg.
Sidelobe Gain    -9.6 dBi @ Elev Angle = 121.0 deg.
Front/Sidelobe   14.02 dB

**Wires**

Wire  Create  Edit  Other

☐ Coord Entry Mode      ☐ Prese

| No. | End 1 | | | | End 2 | | | | Diameter | Segs | Insulation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | X (ft) | Y (ft) | Z (ft) | Conn | X (ft) | Y (ft) | Z (ft) | Conn | (in) | | Diel C | Thk (in) |
| 1 | 0 | 0 | 0 | Ground | 0 | 0 | 126.574 | | 5.7973 | 5 | 1 | 0 |
| 2 | 0 | 133.029 | 0 | Ground | 0 | 133.029 | 126.574 | | 5.7973 | 5 | 1 | 0 |
| 3 | 133.029 | 0 | 0 | Ground | 133.029 | 0 | 126.574 | | 5.7973 | 5 | 1 | 0 |
| 4 | 133.029 | 133.029 | 0 | Ground | 133.029 | 133.029 | 126.574 | | 5.7973 | 5 | 1 | 0 |
| * | | | | | | | | | | | | |

**Sources**

Source  Edit

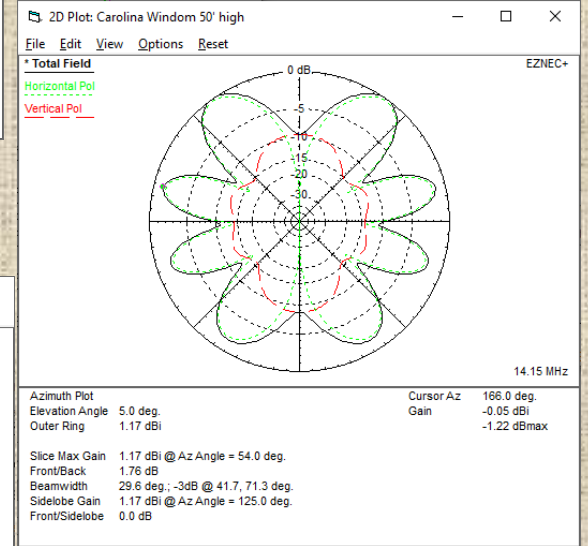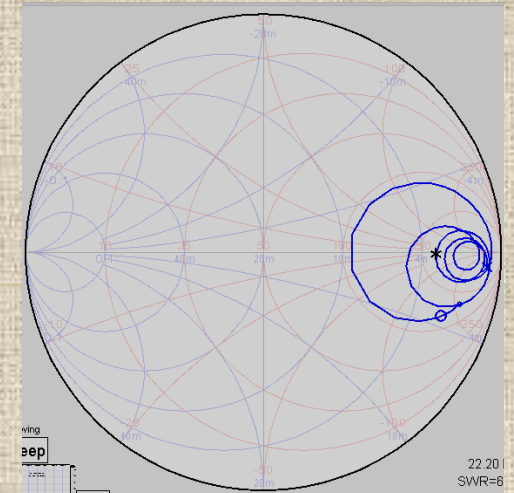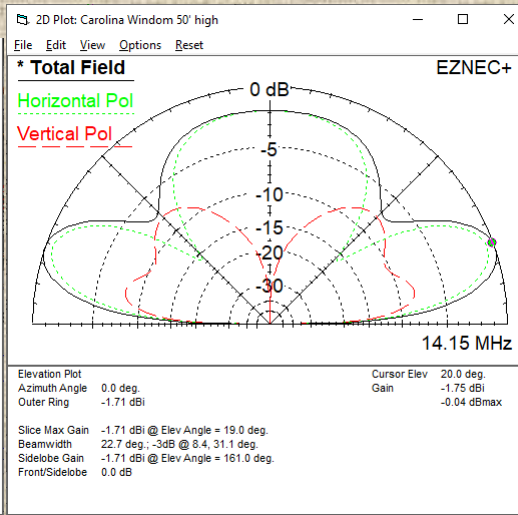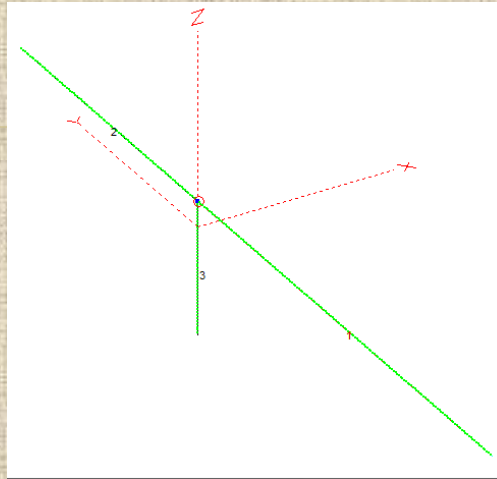| No. | Specified Pos. | | Actual Pos. | | Amplitude | Phase | Type |
|---|---|---|---|---|---|---|---|
| | Wire # | % From E1 | % From E1 | Seg | (V, A) | (deg.) | |
| 1 | 1 | 0 | 10 | 1 | 1 | 0 | I |
| 2 | 2 | 0 | 10 | 1 | 1 | -90 | I |
| 3 | 3 | 0 | 10 | 1 | 1 | -90 | I |
| 4 | 4 | 0 | 10 | 1 | 1 | 180 | I |
| * | | | | | | | |

Max Gain= 6.83dBi
Avg Gain= -3.67dB
RDF= 10.50dB

# 1000' Beverage at 10'
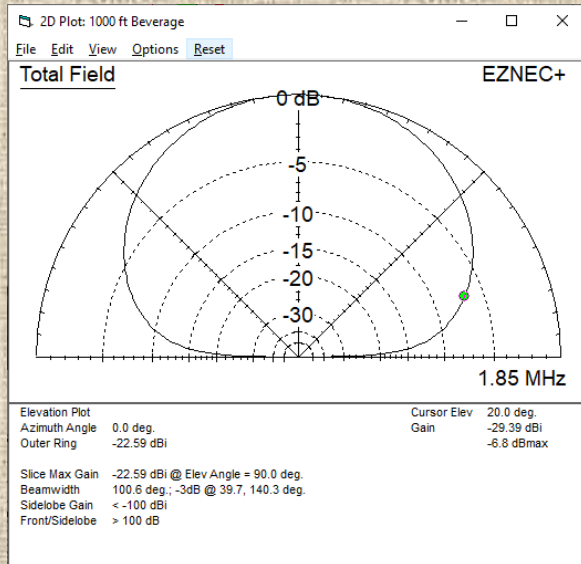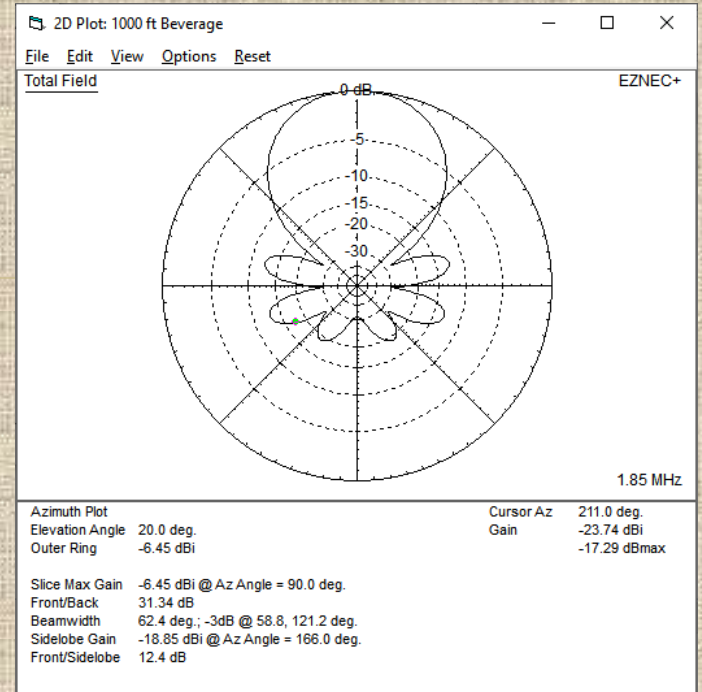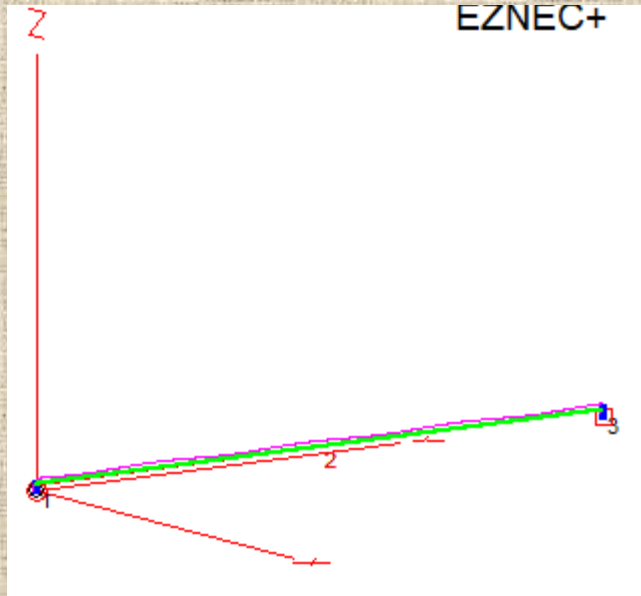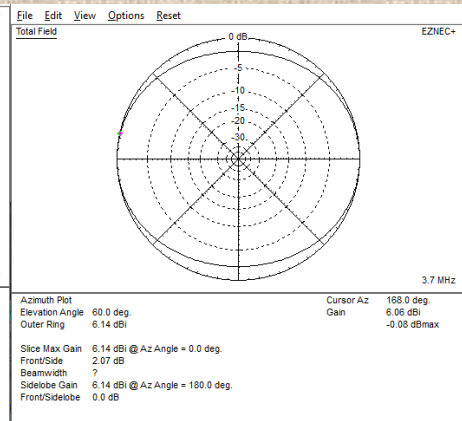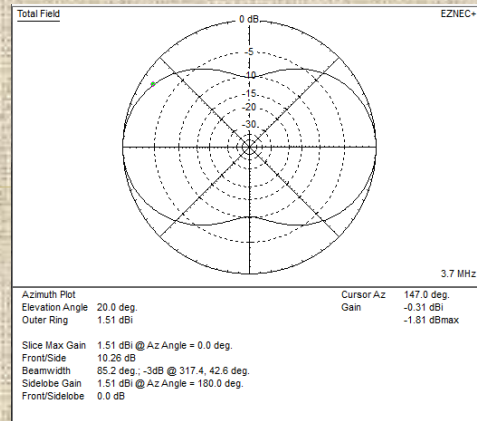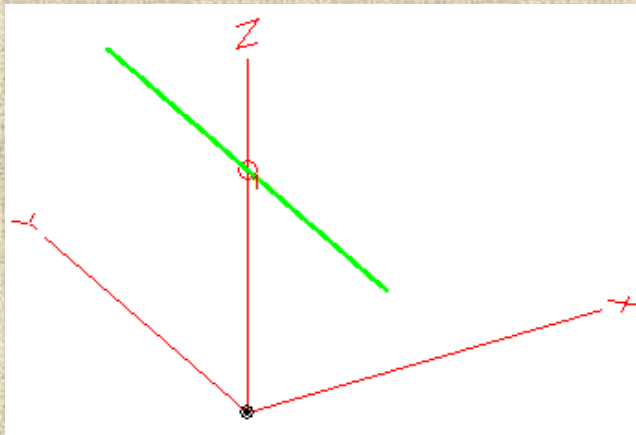
Max Gain= -6.45dBi
Avg Gain = -18.78dB
RDF= 12.33dB

# Carolina Windom (OCFD)

## 50' up, legs 50' and 83'



**2D Plot: Carolina Windom 50' high**
File  Edit  View  Options  Reset

\* Total Field                                          EZNEC+
Horizontal Pol
Vertical Pol
0 dB
-5
-10
-15
-20
-30

14.15 MHz

Elevation Plot                          Cursor Elev  20.0 deg.
Azimuth Angle  0.0 deg.              Gain          -1.75 dBi
Outer Ring     -1.71 dBi                            -0.04 dBmax

Slice Max Gain  -1.71 dBi @ Elev Angle = 19.0 deg.
Beamwidth       22.7 deg.; -3dB @ 8.4, 31.1 deg.
Sidelobe Gain   -1.71 dBi @ Elev Angle = 161.0 deg.
Front/Sidelobe  0.0 dB


22.20
SWR=6

**2D Plot: Carolina Windom 50' high**
File  Edit  View  Options  Reset

\* Total Field                                          EZNEC+
Horizontal Pol
Vertical Pol
0 dB
-5
-15
-20
-30

14.15 MHz

Azimuth Plot                            Cursor Az   166.0 deg.
Elevation Angle  5.0 deg.             Gain         -0.05 dBi
Outer Ring      1.17 dBi                            -1.22 dBmax

Slice Max Gain   1.17 dBi @ Az Angle = 54.0 deg.
Front/Back       1.76 dB
Beamwidth        29.6 deg.; -3dB @ 41.7, 71.3 deg.
Sidelobe Gain    1.17 dBi @ Az Angle = 125.0 deg.
Front/Sidelobe   0.0 dB

**SWR Plot: Carolina Windom 50' high**
File  Edit  View  Options

Z0
● 50 ohms
○ Alt (300 ohms)

1
Source #

INF                                                  EZNEC+
10
5
SWR
3
2
1.5
1.1
1
14          Freq MHz              30

Freq      28.6 MHz                 Source #  1
SWR       8.98                     Z0        50 ohms
Z         446.7 at -5.52 deg.
          = 444.6 - j 42.94 ohms
Refl Coeff  0.7995 at -1.25 deg.
          = 0.7993 - j 0.01742
Ret Loss   1.9 dB

**SWR Plot: Carolina Windom 50' high**
File  Edit  View  Options

Z0
○ 50 ohms
● Alt (300 ohms)

1
Source #

INF                                                  EZNEC+
10
5
SWR
3
2
1.5
1.1
1
14          Freq MHz              30

Freq      28.6 MHz                 Source #  1
SWR       1.51                     Z0        300 ohms
Z         446.7 at -5.52 deg.
          = 444.6 - j 42.94 ohms
Refl Coeff  0.2022 at -13.24 deg.
          = 0.1969 - j 0.04631
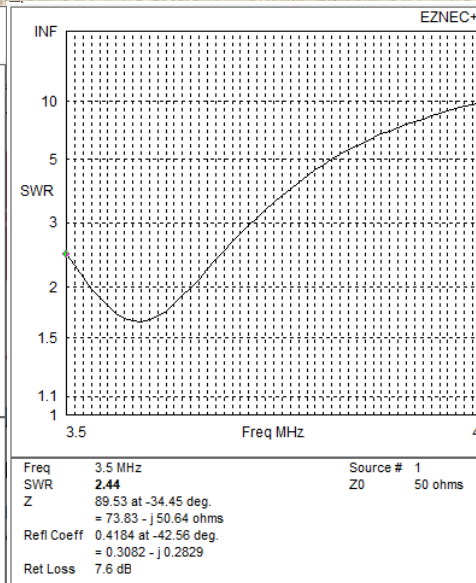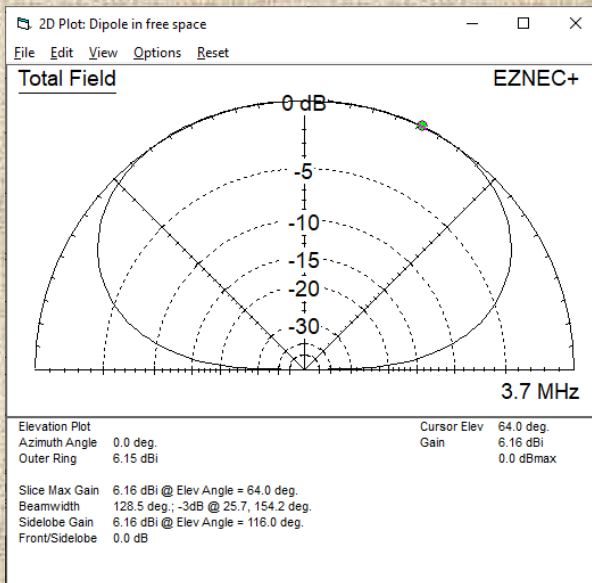Ret Loss   13.9 dB

Max Gain= 1.17dBi
Avg Gain= -1.76dB
RDF= 2.93dB

# 80m Dipole at 65'
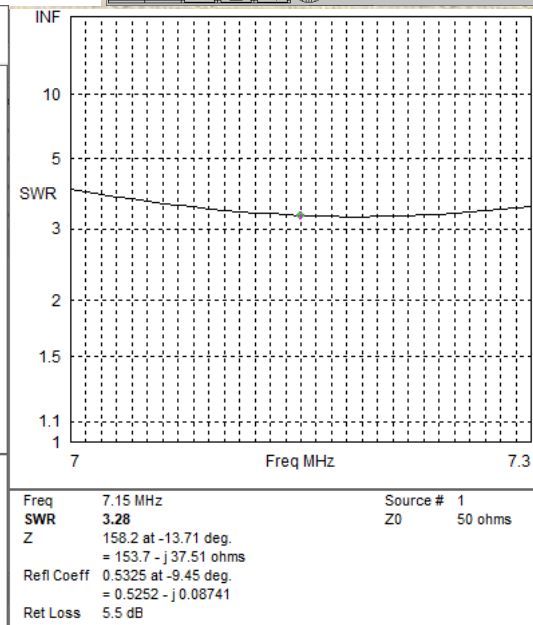






15 deg elevation
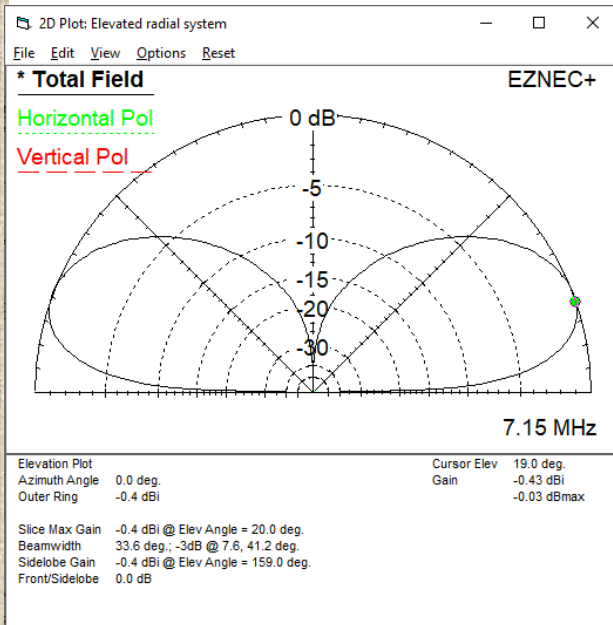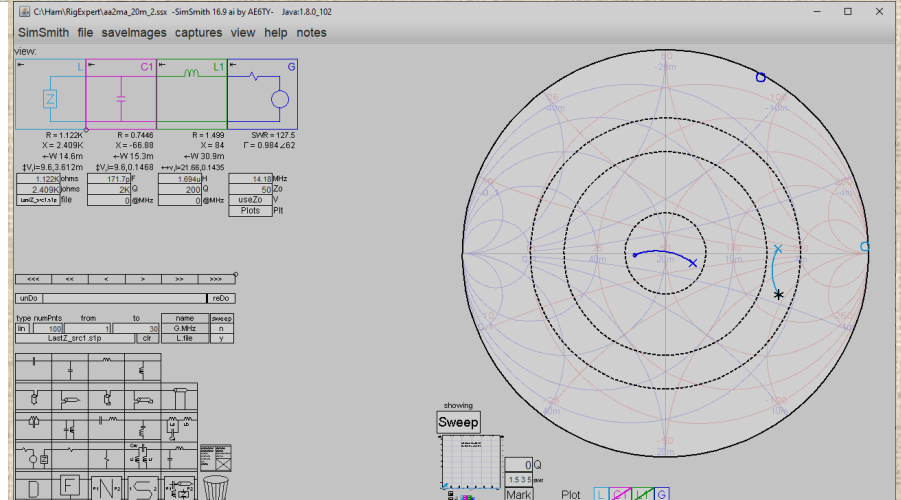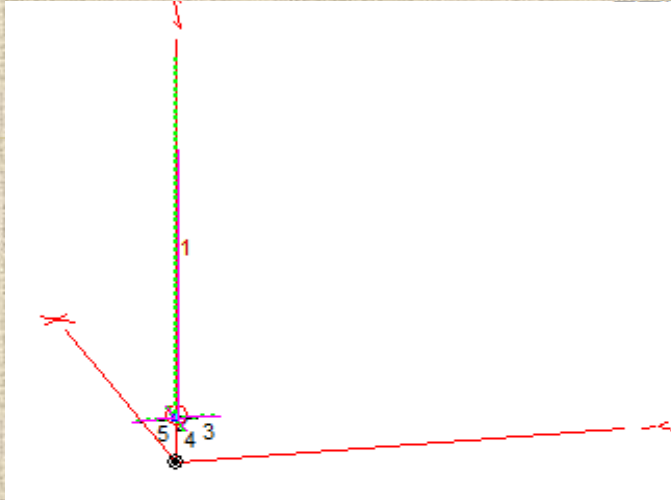Max Gain= -.6dBi
F/S=10.83dB

60 deg elevation
Max Gain= 6.14dBi
 F/S=2.07dB





Max Gain= 6.14dBi
Avg Gain= -.99dB
RDF=6.14 - -.99 = 7.13dB

# 40m Vertical (57' tall)

## Very short radials (6')



Max Gain =-.4dBi
Avg Gain= -6.20dB
RDF= 5.8dB