The Villages Amateur Radio Club

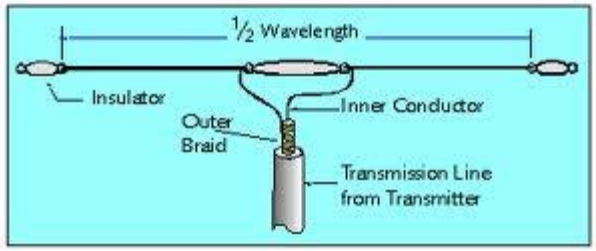
Vertical Delta Loop Elmer Hour

September 18, 2014

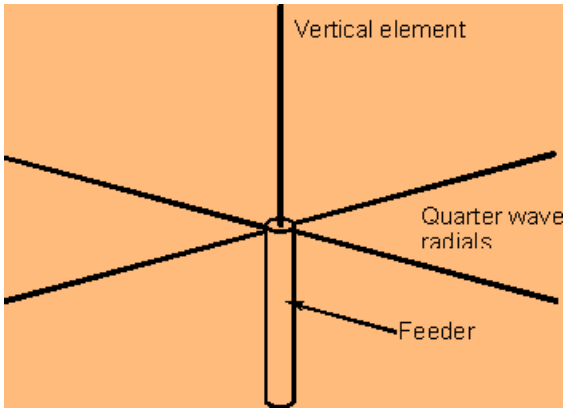
- **What is it?**
- **Why do I care?**
- **How can I make one!**

Basic Antenna Types

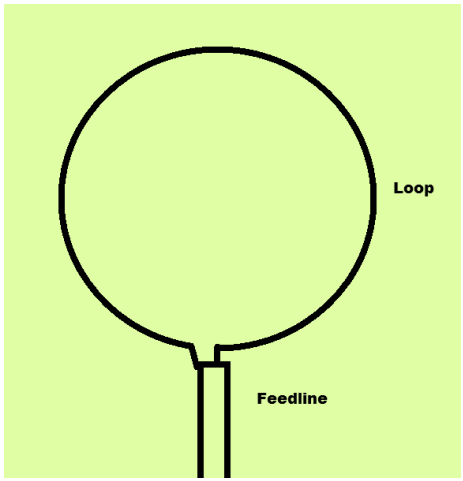
Dipole



Monopole

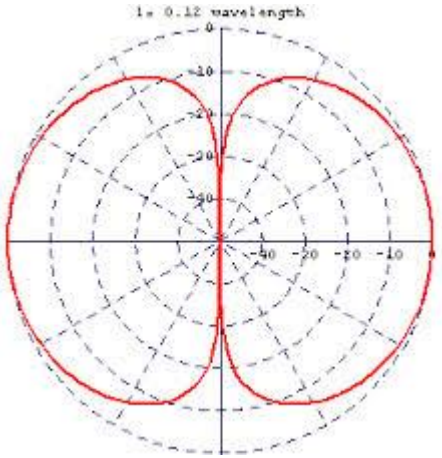


Loop



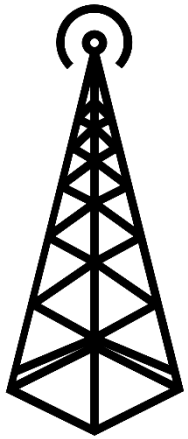
Basic Antenna Types Con't.

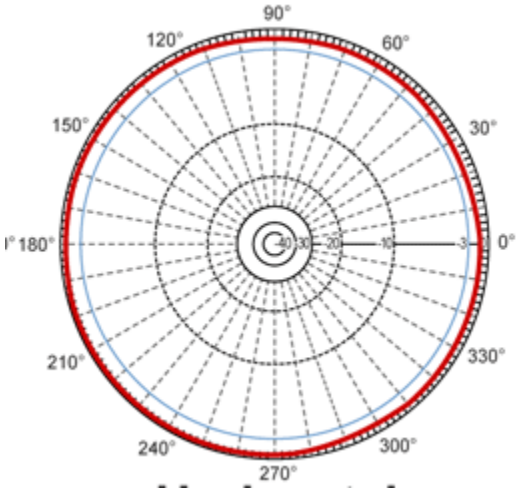
½ Wave Dipole



Bow Tie Pattern

¼ Wave Monopole



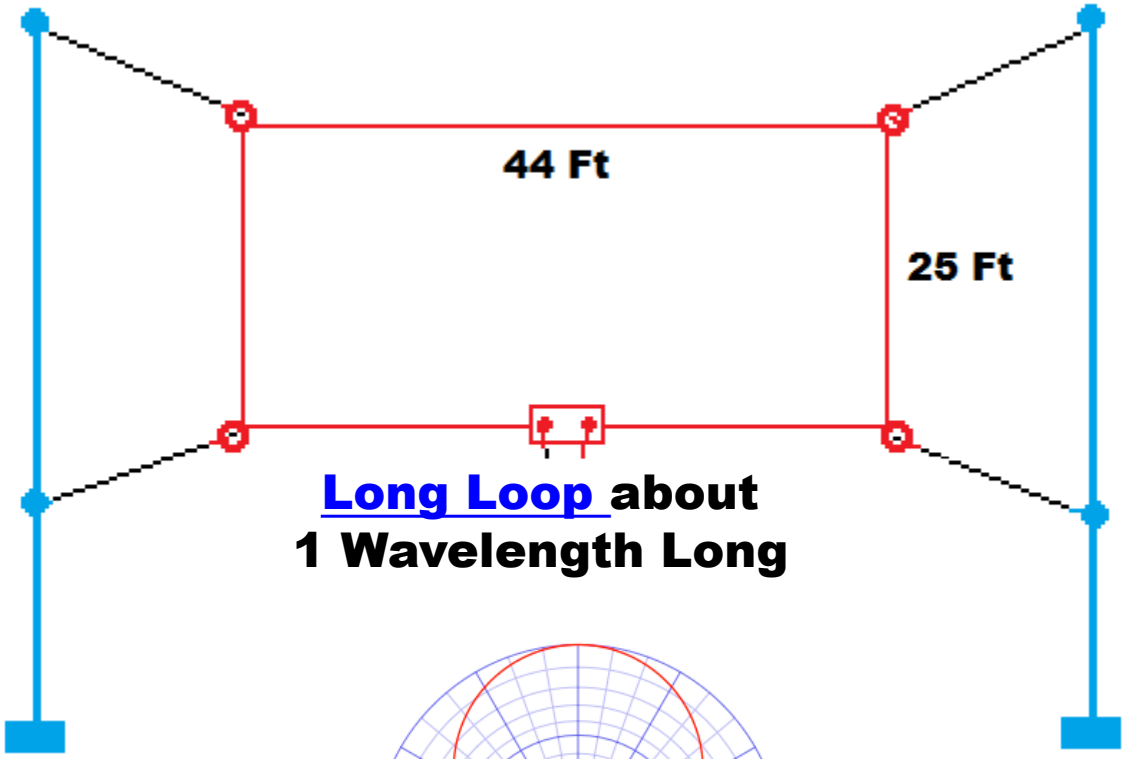


Round Pattern

Basic Antenna Types Con't.

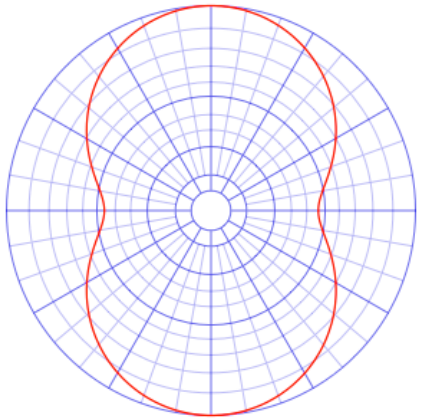
Loop Antennas (both 40M)

Small Loop less than 1/10 Wavelength Long



Long Loop about 1 Wavelength Long

Oval Pattern

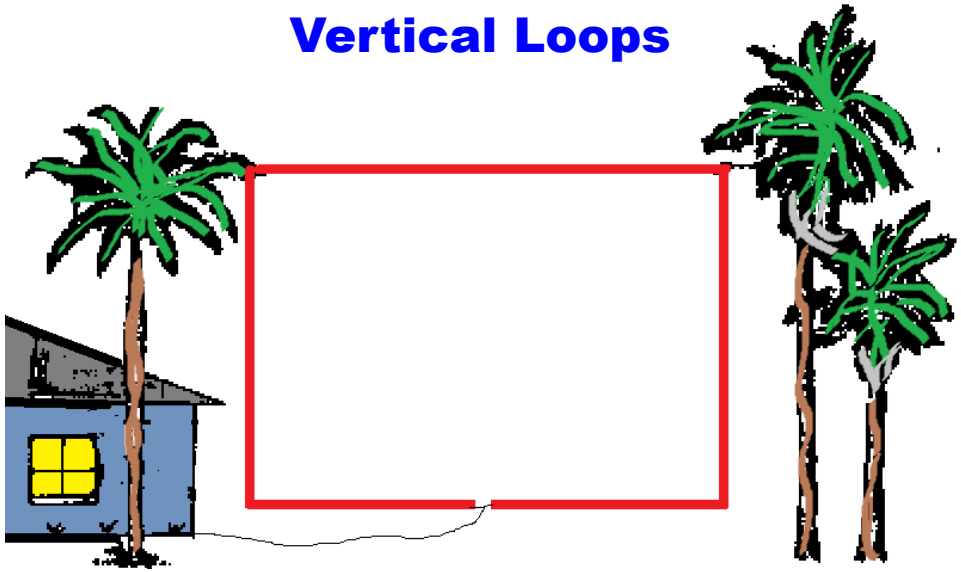


Basic Antenna Types Con't.

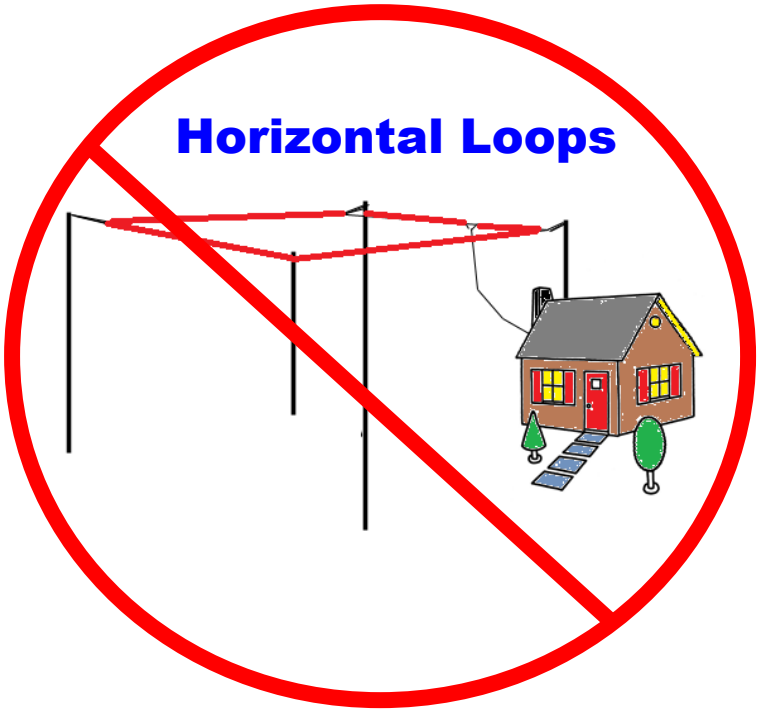
Most articles are about Horizontal Loops

tonight is about Vertical Loops

Vertical Loops

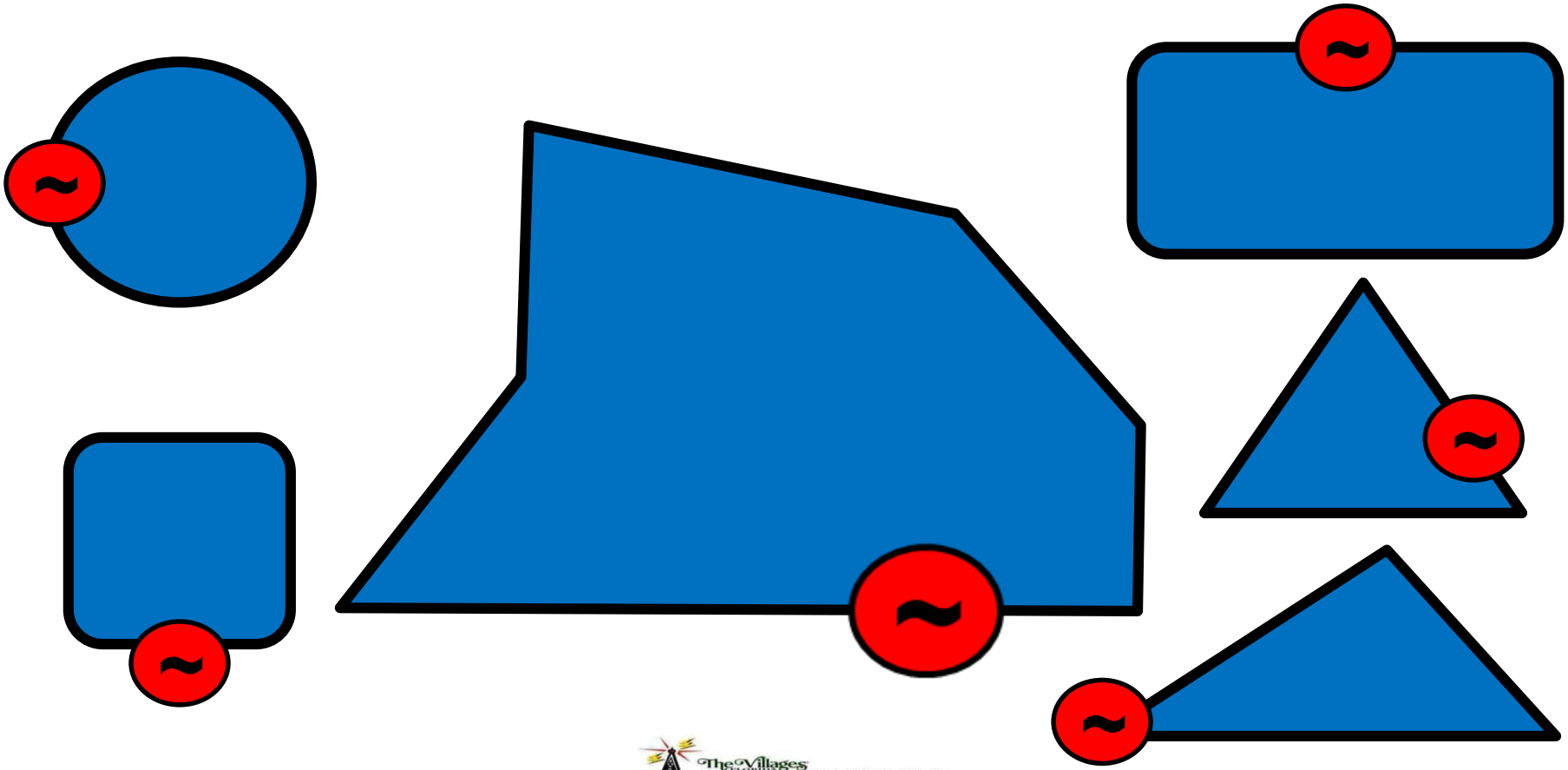


Horizontal Loops



WL Loop Fundamentals

- A loop antenna is composed of a loop of wire a wavelength long.
- The loop does not have to be any particular shape.
- RF power can be fed anywhere on the loop.

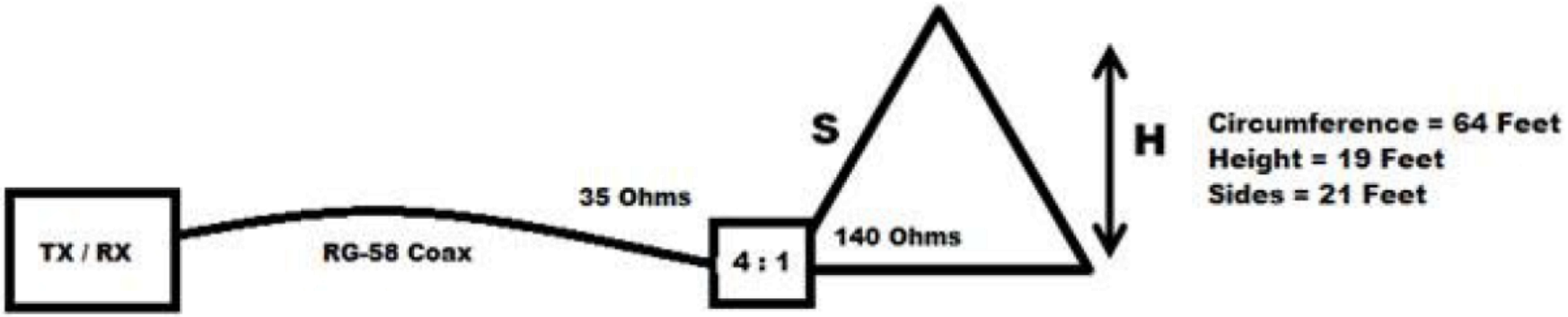


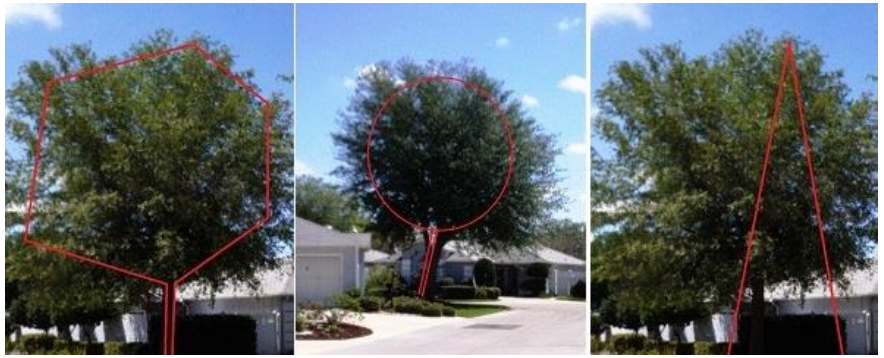
Round, Square, Rectangular, Triangular and Vertical Delta Loop

All are the Same Length

Example of 20M Vertical Delta

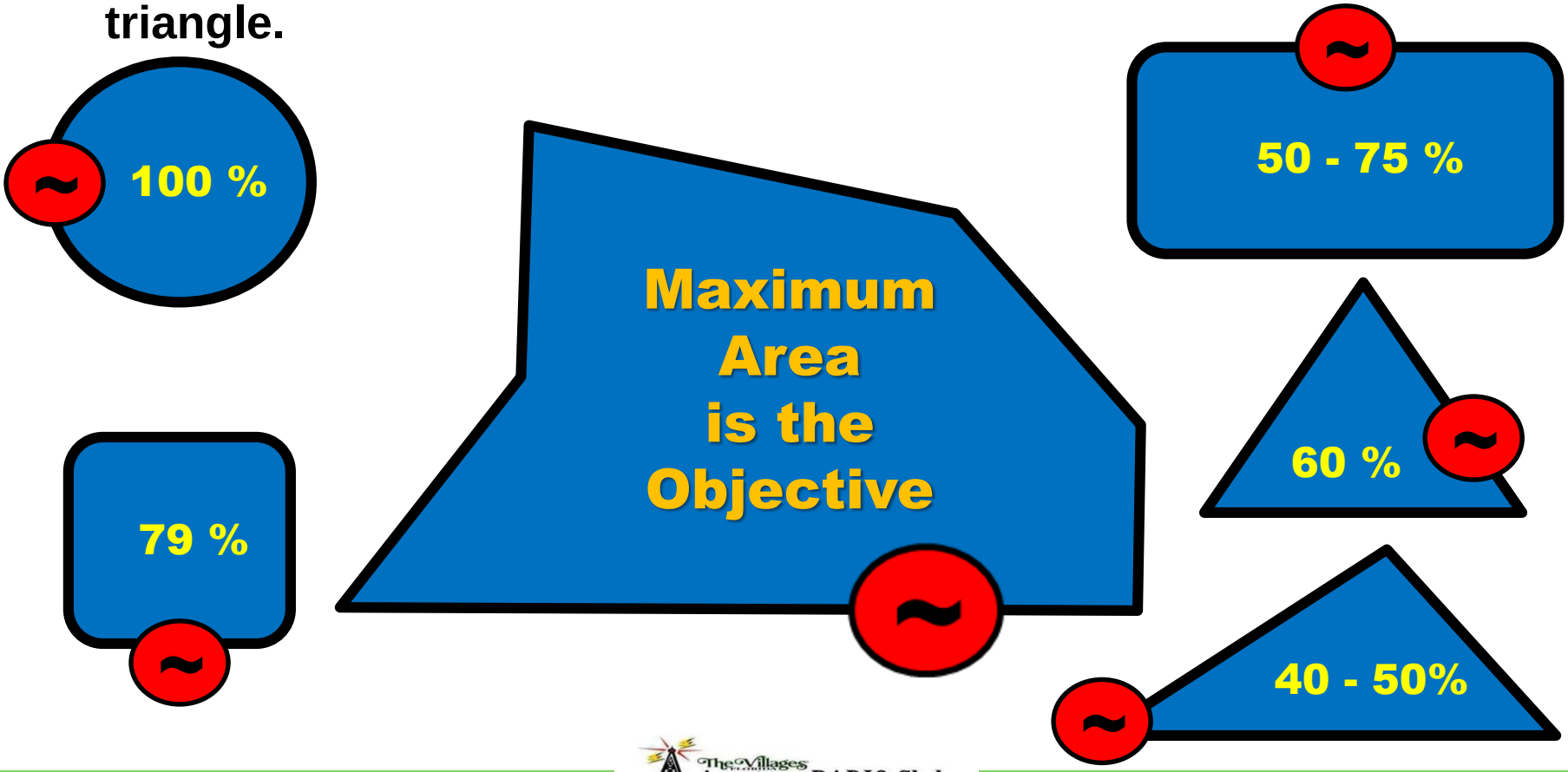
- **Can be any shape to fit your landscape**
- **Material**
  - **64 Feet #20 AWG Bell Wire**
  - **4:1 Current BALUN**
  - **Fishing Pole (Something for Support)**





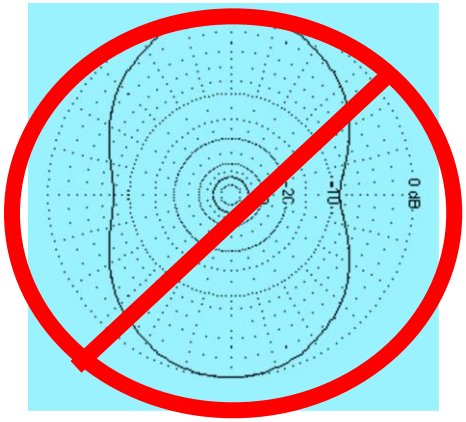
Area of Loop = Efficiency

- The goal is to get the greatest area inside the loop.
- A circle is the perfect shape, but difficult to build for HF.
- Both Triangles and Rectangles are good performers.
- A Vertical Delta Loop uses a single support on an equilateral triangle.

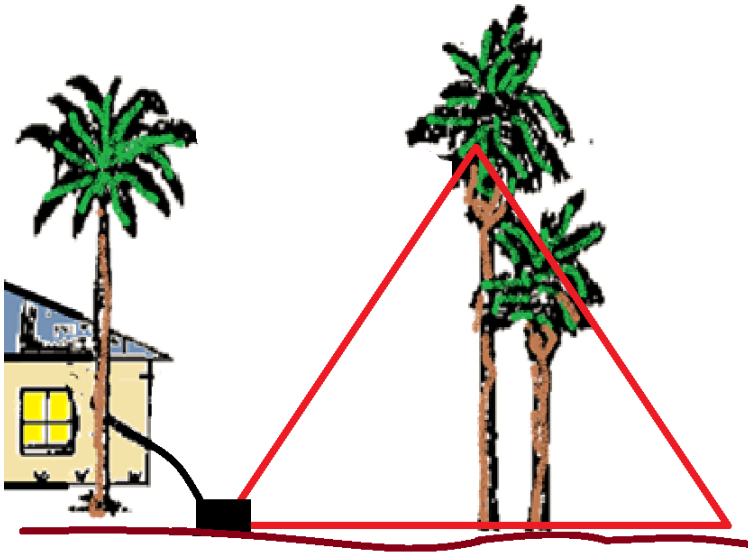


The Vertical Delta Loop

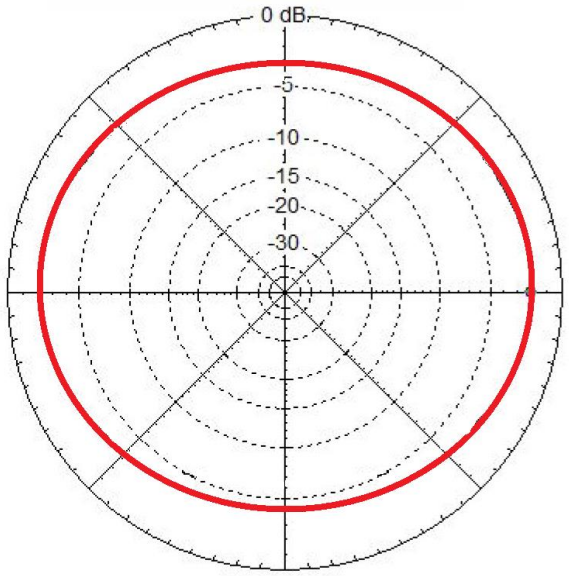
- A three sided loop is known as a Vertical Delta loop sitting on the ground.
- For best results, the lengths of the 3 sides should be approximately equal
- The resistive impedance is ~130 Ω interface with 4:1 BALUN
- 2:1 VSWR Bandwidth Covers whole band at 40M and up (~ 4 % of Freq)
- The pattern is almost round, +/- 1 dB and the radiation pattern has no nulls. Max radiation is broadside to loop.



They Lied!



Almost Omni !



Why do I care?

Why use a Vertical Delta Loop?

Pro's

- Good on the Air Performance Sitting on Ground
- Single Support
- Almost Omni-Directional
- Wide VSWR range (no tuner)
- Cheap (wire + fishing pole + BALUN)
- Simple to build
- Great for portable or backpacking
- Low visibility

Con's

- Size a problem for 80M and 160M

Why not use a Dipole?

(G5RV, Windom, Sloper or other dipole variant)

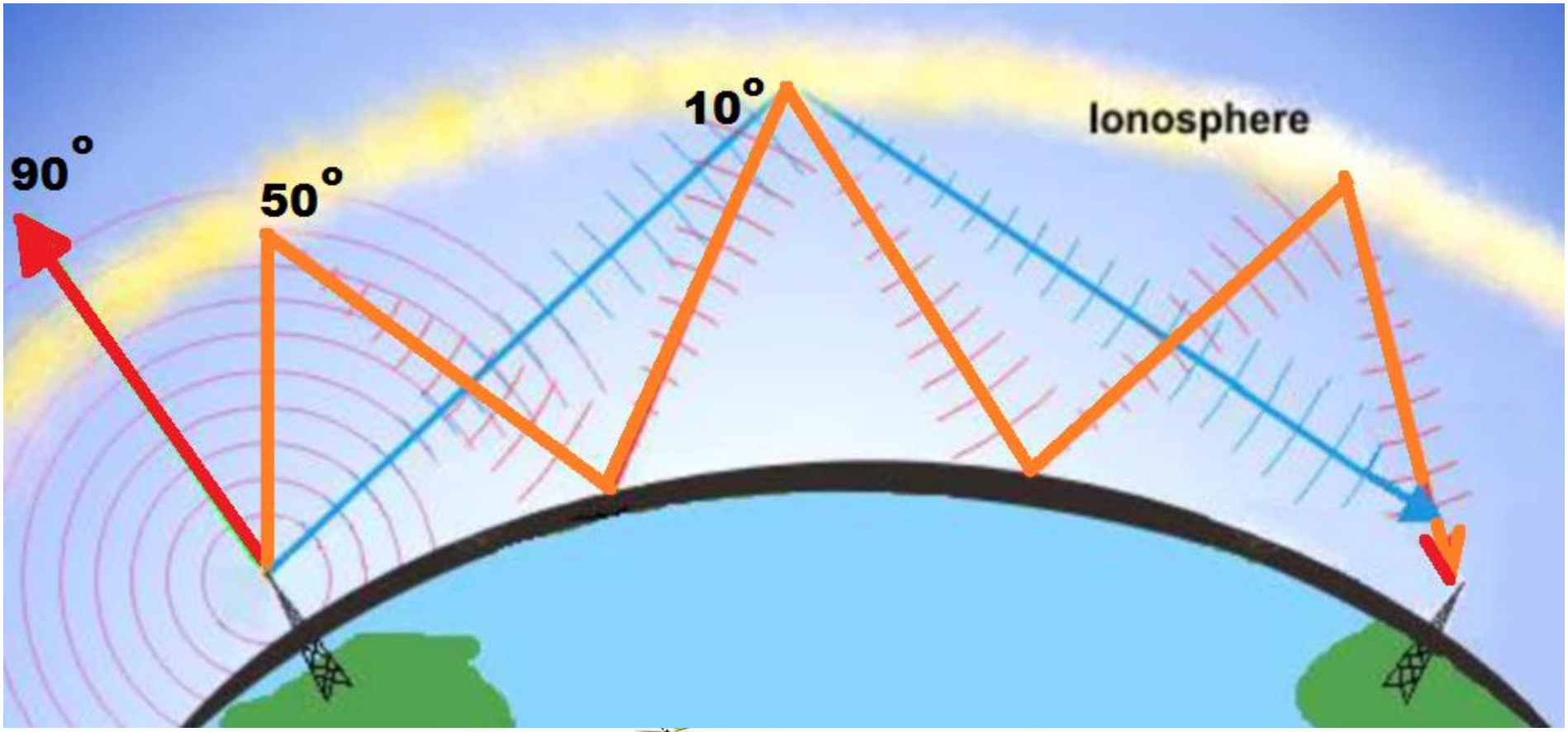
- All these dipole related antennas are good
- Performance suffers when too close to the ground
- Everyone has lied to you about your antenna pattern

  (or they didn't tell the whole truth)

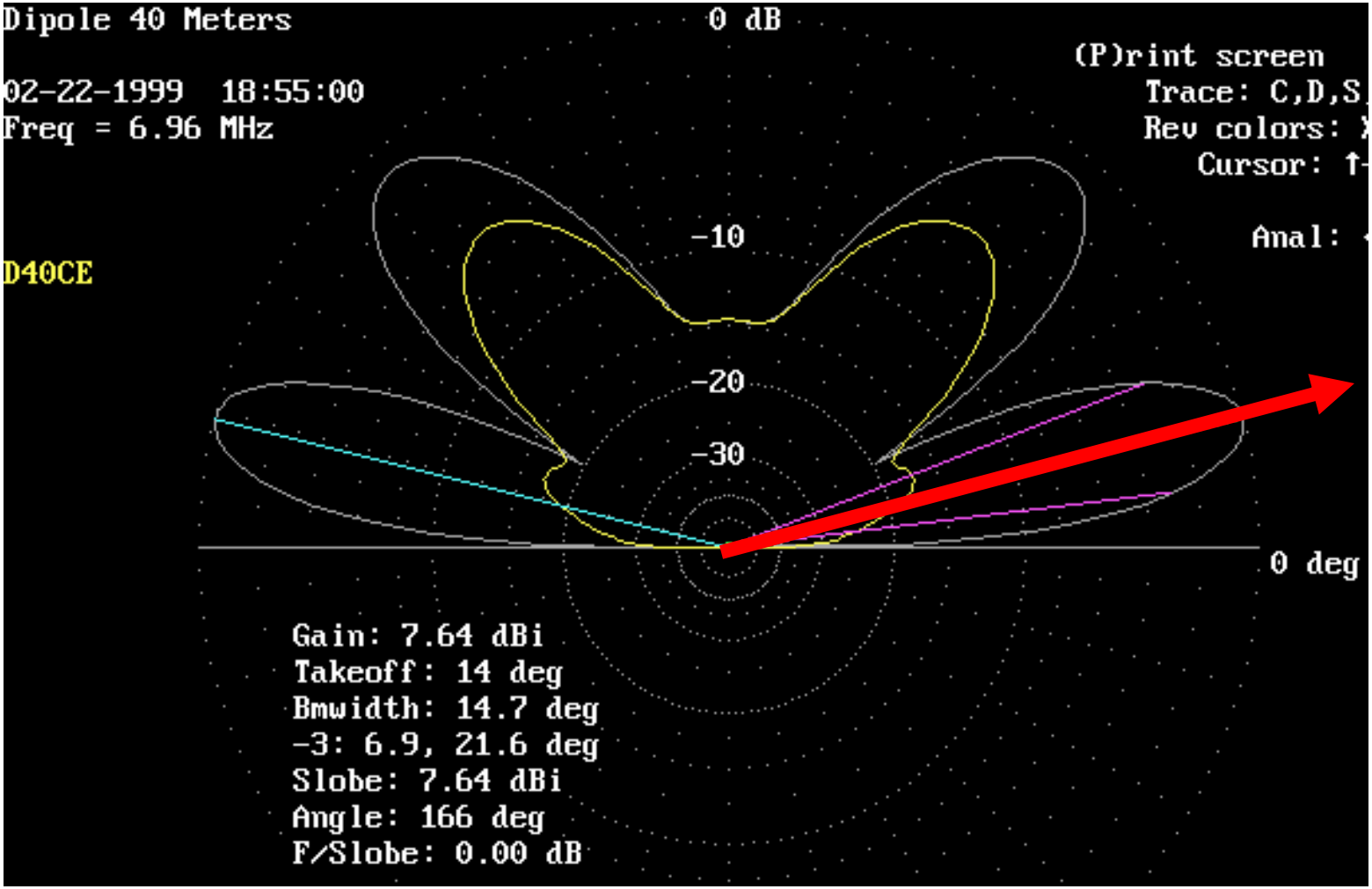
Why not use a Dipole?

(performance is all about radiation takeoff angle)

- 10˚ is good because you get more distance per hop & less loss
- 50˚ still works, but may cost 3 hops & not always make it
- 90˚ is bad because there can be only ONE hop

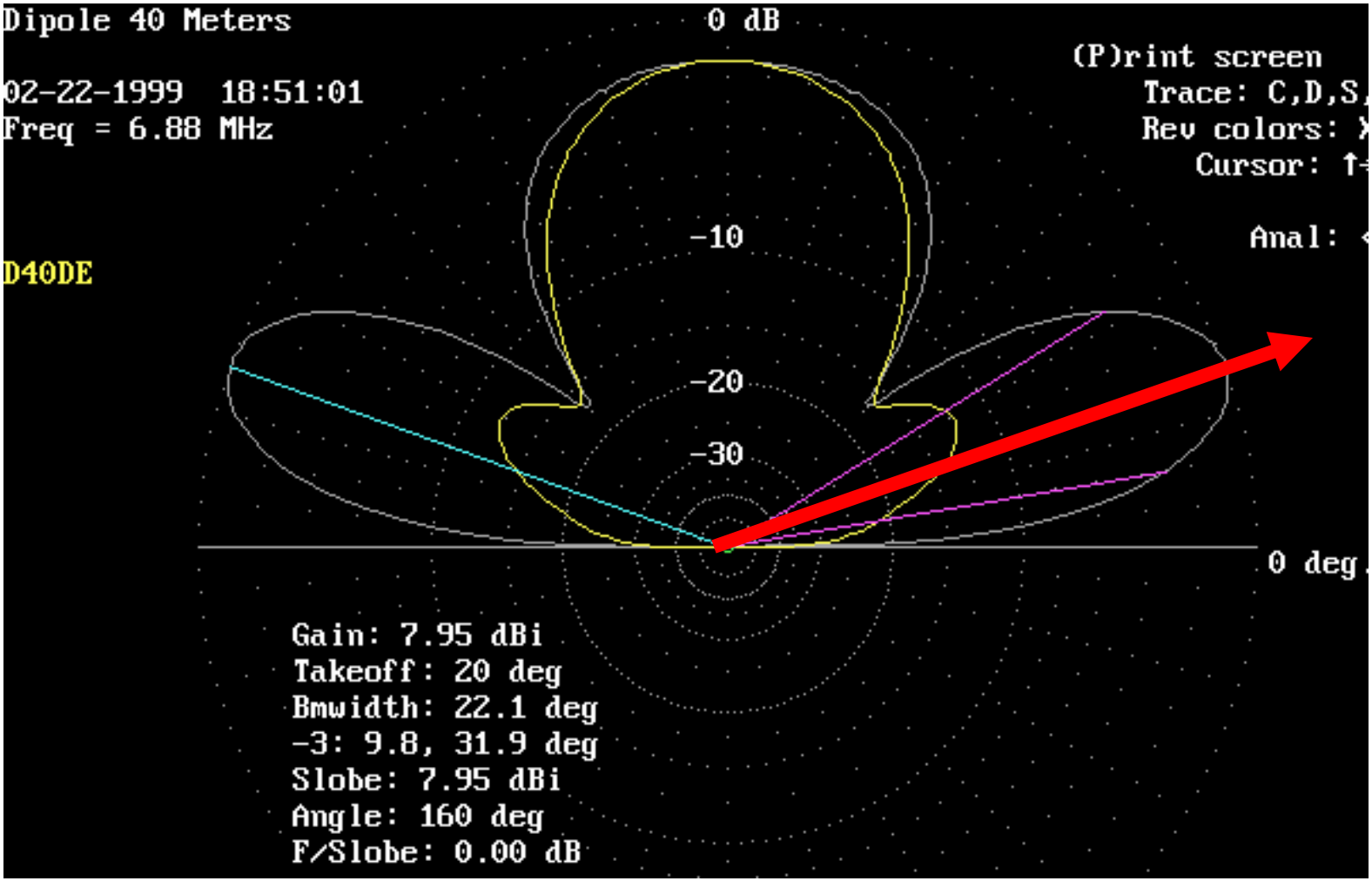


40M Dipole at 140 Ft above ground



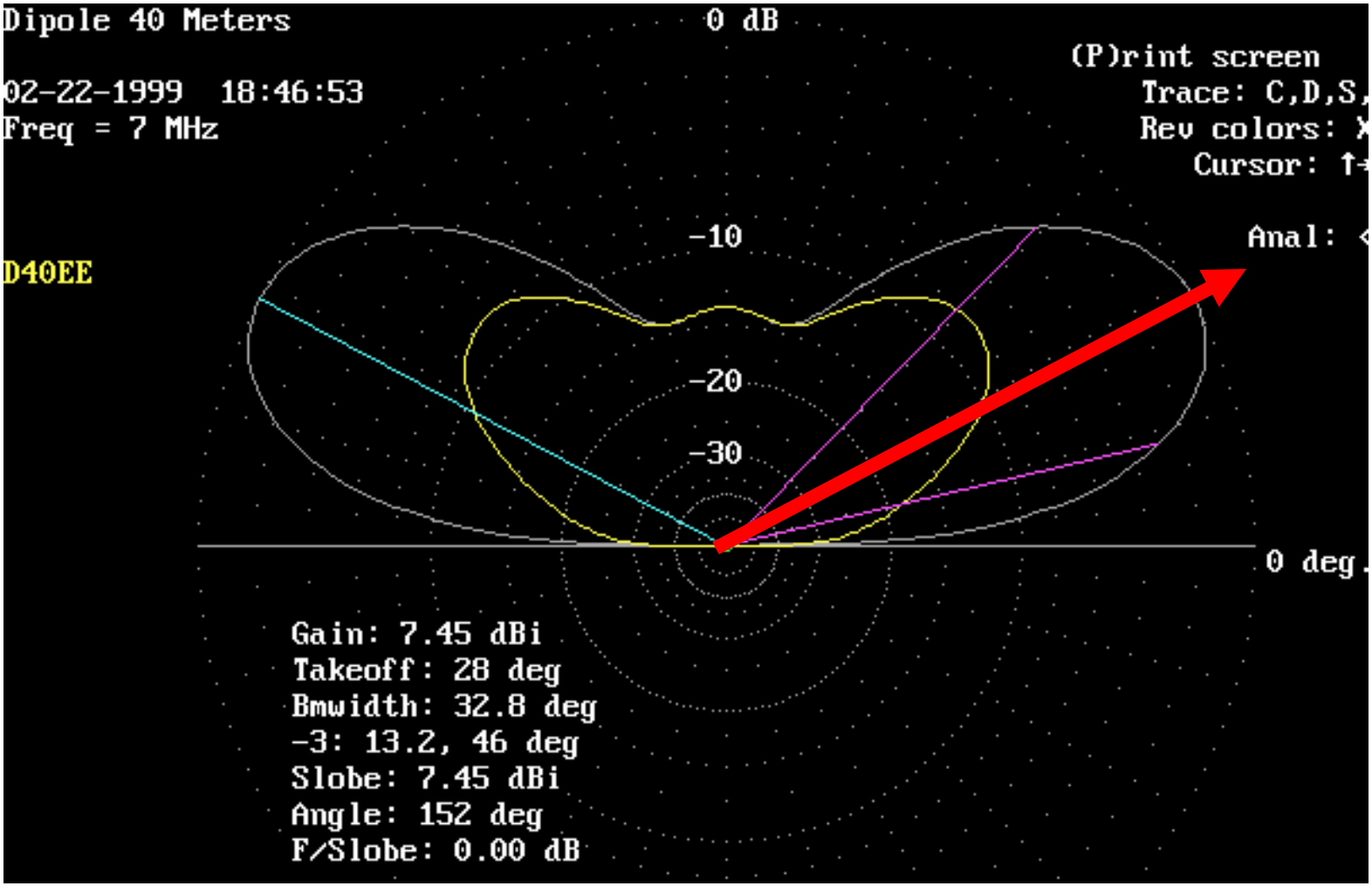
Feedpoint Impedance = 74 + j08

40M Dipole at 98 Ft above ground



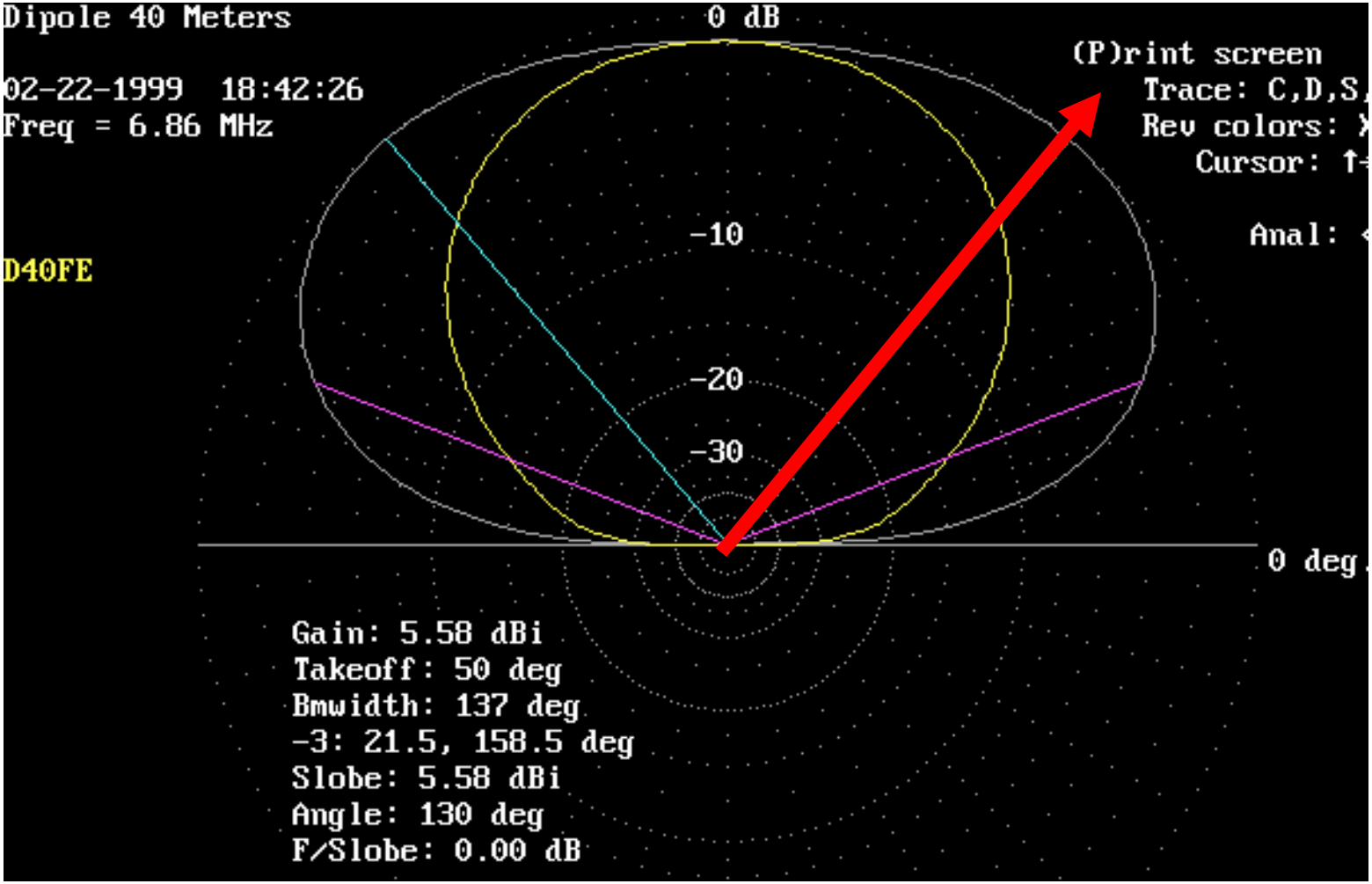
Feedpoint Impedance = 70 + j30

40M Dipole at 70 Ft above ground



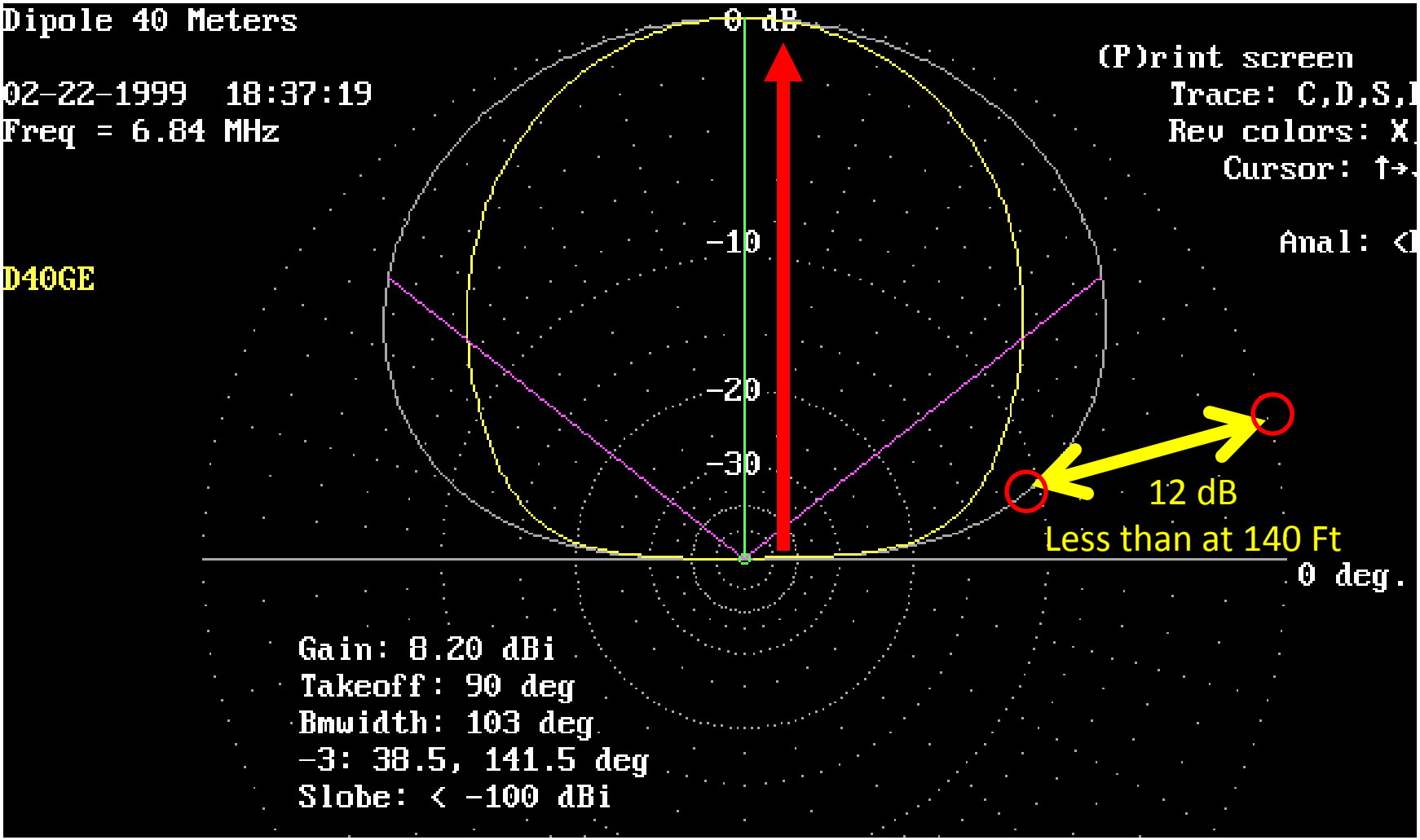
Feedpoint Impedance = 71 – j0

40M Dipole at 42 Ft above ground



Feedpoint Impedance = 100 + j32

40M Dipole at 14 Ft above ground



Feedpoint Impedance = 23 + j39

Why not use a Dipole?

(Conclusion)

Dipoles are at a disadvantage when

too close to the ground,

but you can get a better result with a Vertical Delta Loop

Why not use a Vertical?

(1/4 WL, 5/8 WL, 3/4 WL Flagpole or other vertical variant)

- All these vertical monopole antennas are good
- Performance suffers in poor sandy soil like The Villages
- Performance suffers without sufficient radials
- Radials require lots of work to install, but you got to have them

Verticals vs Ground Radials

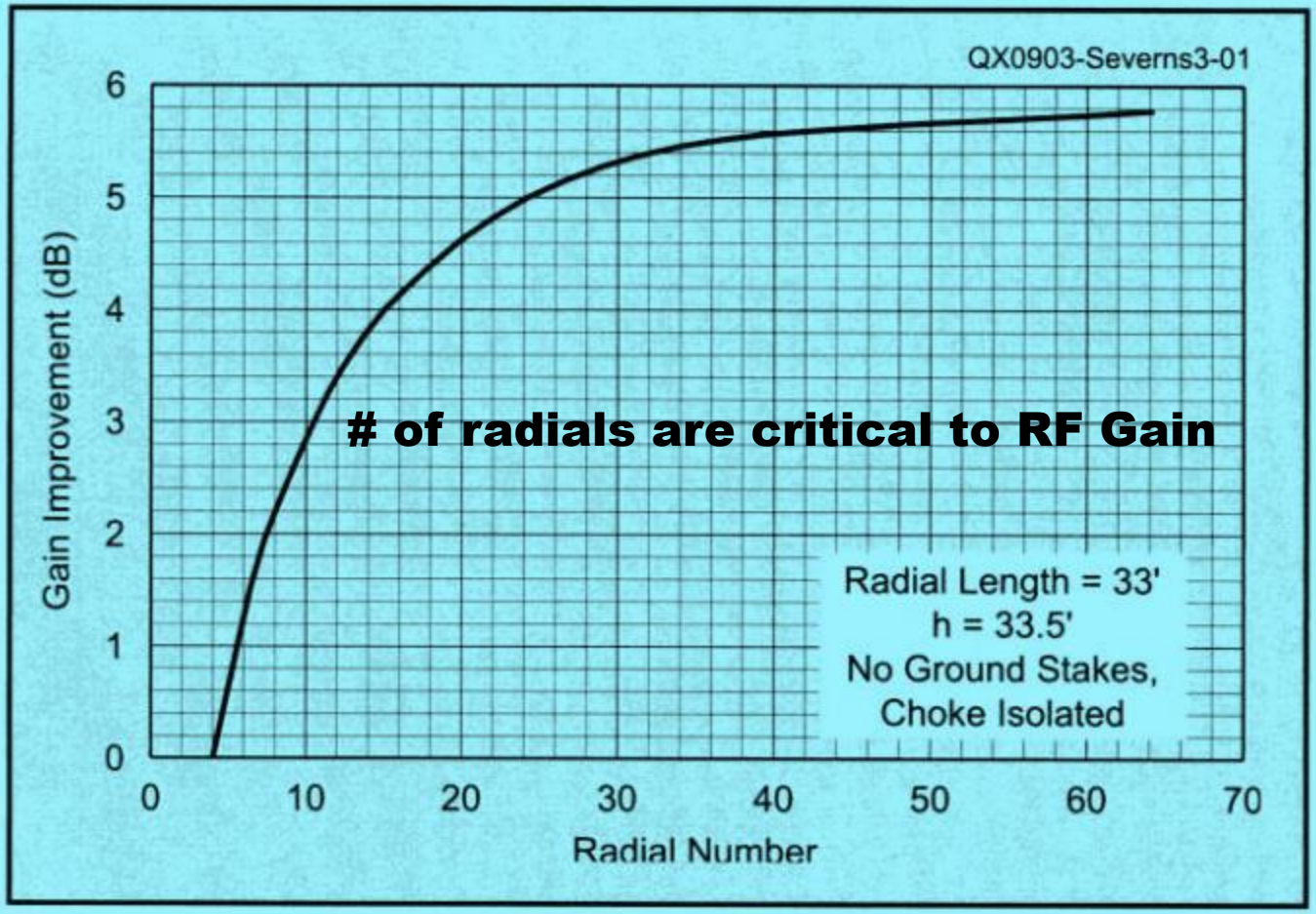


Figure 4 — Signal improvement as a function of radial number. All radials lying on the ground surface, F = 7.2 MHz.

Verticals vs Ground Radials

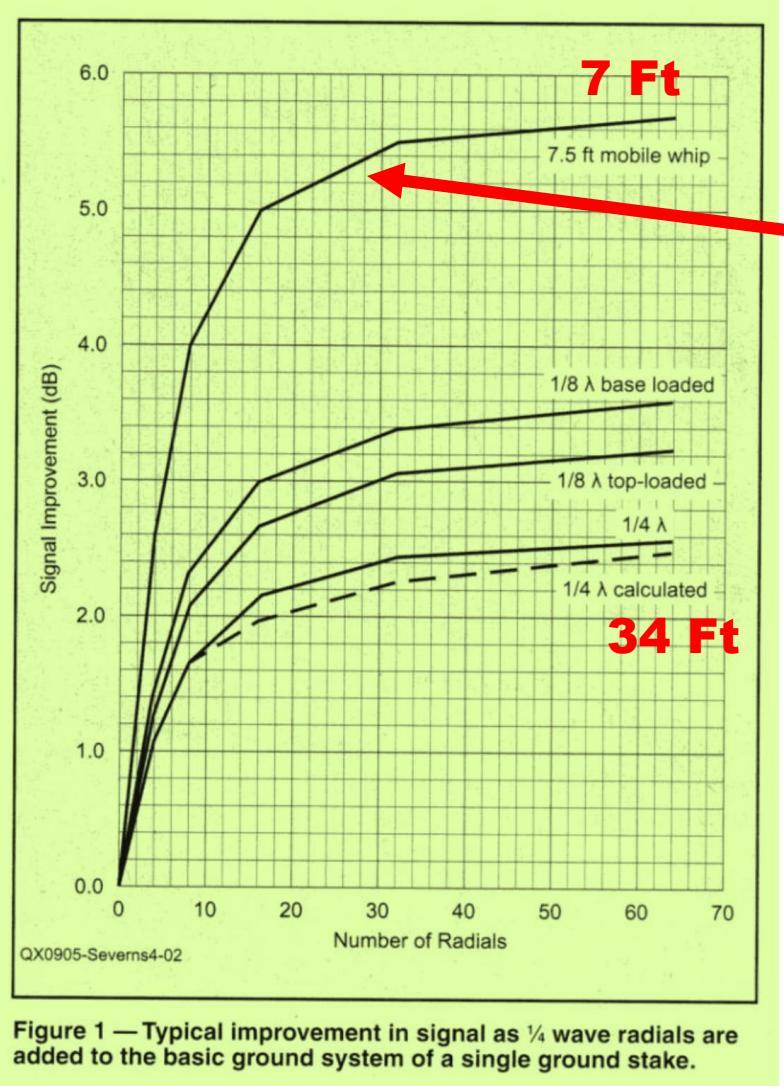


Figure 1 — Typical improvement in signal as ¼ wave radials are added to the basic ground system of a single ground stake.

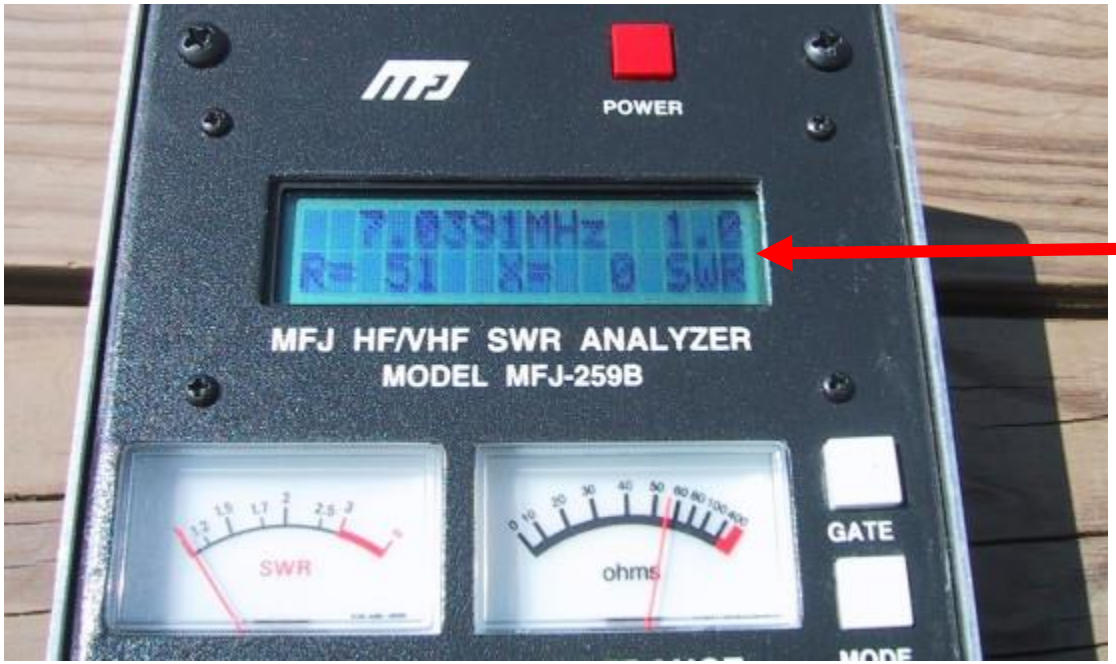
Short Antennas suffer twice as much from fewer radials

Verticals vs Ground Radials

Number of radials	16	24	36	60	90	120
Power loss relative to “perfect” ground plane	50%	37%	29%	21%	6%	1%
Feedpoint impedance in ohms	52	46	43	40	37	35

Why not use a Vertical?

(Conclusion)



What does this measurement mean with respect to radials?

Lots of work to install all those radials,

but you can get a better result with a Vertical Delta Loop

How to make a Vertical Delta Loop

Vertical Delta Loop Materials

- **Pole**
  - **Crappie Poles are cheap and telescope for storage**
  - **Crappie Poles 15 to 20 Feet ($10 - $25)**
  - **PVC pipe will work too**
  - **Trees are even better, except for storage**
- **Wire**
  - **Any wire will do, just need a size that doesn't break**
  - **#20 AWG (bell wire) is plenty strong and cheap**
  - **Stranded is better for handling and strength**
  - **Insulated is readily available**
- **BALUN**
  - **4:1**
  - **Balanced to Unbalanced**
  - **Current type (Guanella is best)**
- **Miscellaneous**
  - **Wood or plastic stake for fishing pole**
  - **Stake, milk bottle or rock to hold one corner**
  - **Plastic Shower Rings or Nylon Cable Ties for fishing pole apex**

Round, Square, Rectangular, Triangular and Delta Loop

Wire Length

Band	Bare Copper
160 (1.83 MHz)	549 ft
80 (3.6 MHz)	279 ft
75 (3.9 MHz)	257 ft
40 (7.1 MHz)	141 ft
30 (10.1 MHz)	99 ft
20 (14.2 MHz)	70 ft
17 (18.1 MHz)	55 ft
15 (21.2 MHz)	47 ft
12 (24.9 MHz)	40 ft
10 (28.7 MHz)	35 ft

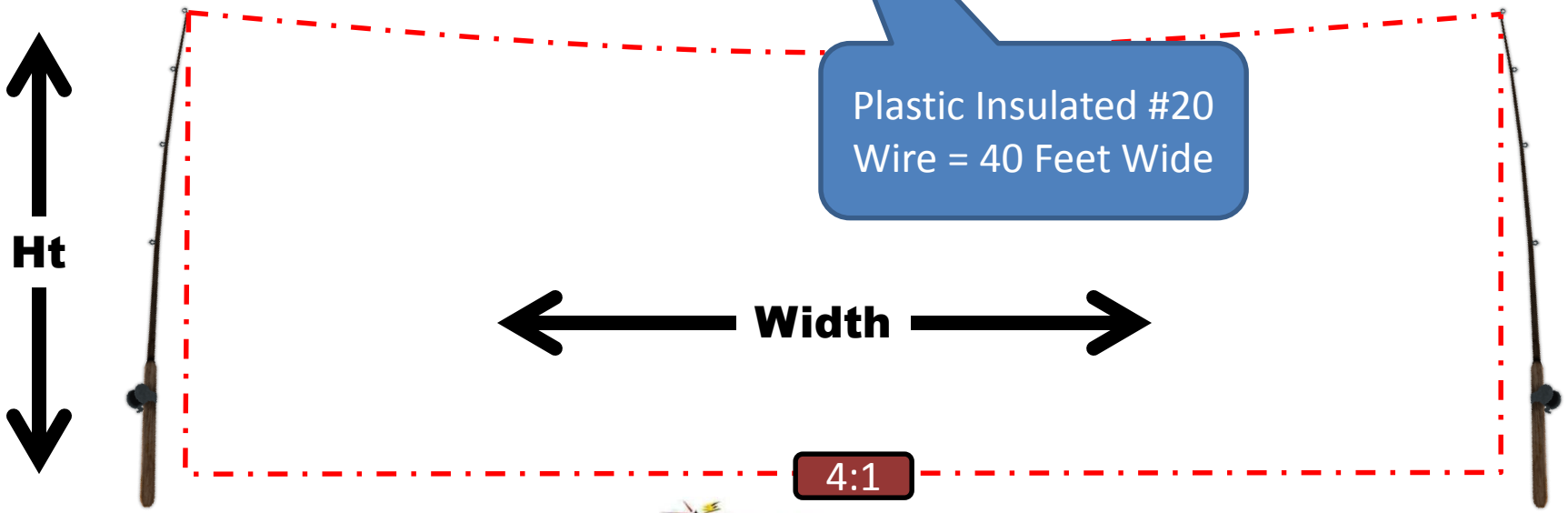
Plastic Insulated #20 Wire = 64 Feet

Shorter if insulated

What can you do with 2 fishing poles?

Two 20 Foot poles, 20 AWG bell wire and a 4:1 Current BALUN

Band	160M	80M	60M	40M	30M	20M	17M	15M	12M	10M
MHz	1.8	3.6	5.3	7.0	10.1	14.0	18.1	21.0	24.9	28.0
Units	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet	Feet
Circumference =	520.0	260.0	176.6	133.7	92.7	66.9	51.7	44.6	37.6	33.4
Height =	20.0	20.0	20.0	20.0	20.0					
Width =	240.0	110.0	68.3	46.9	26.3					
Area =	4,800.0	2,200.0	1,366.0	937.1	526.7					
Max Area Ratio %	22.3%	40.9%	55.0%	65.8%	7.0%	77.0%	77.0%	77.0%	77.0%	77.0%



Putting up a Vertical Loop

Vertically oriented loops may be erected with one or more supports

Circumference = ~135 feet trim tune to 40M and Harmonics

Feed Point = 130 R + 0 j at 40, 20, 10, 6 M (measured)

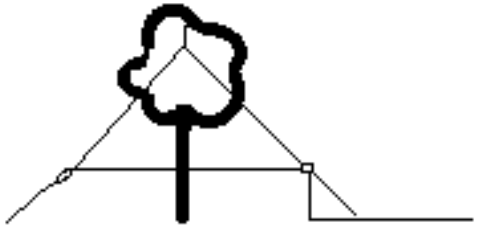
Current BALUN 4:1 on ground at Pergola (33 R + 0 j)

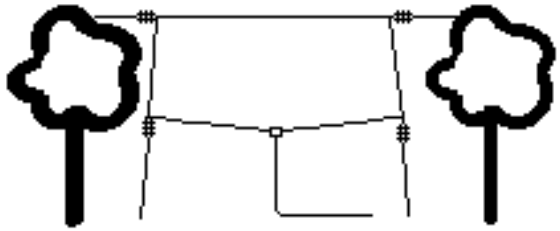
Tuner at T/R in Bandstand for 30, 17, 12M

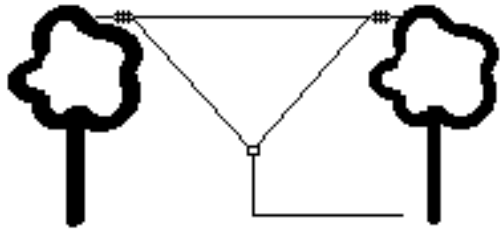
1:1.4 VSWR No tuner required for 40, 20, 10, 6 M

Wire #22 AWG Bell Wire

Not pulled just placed in trees with fishing pole



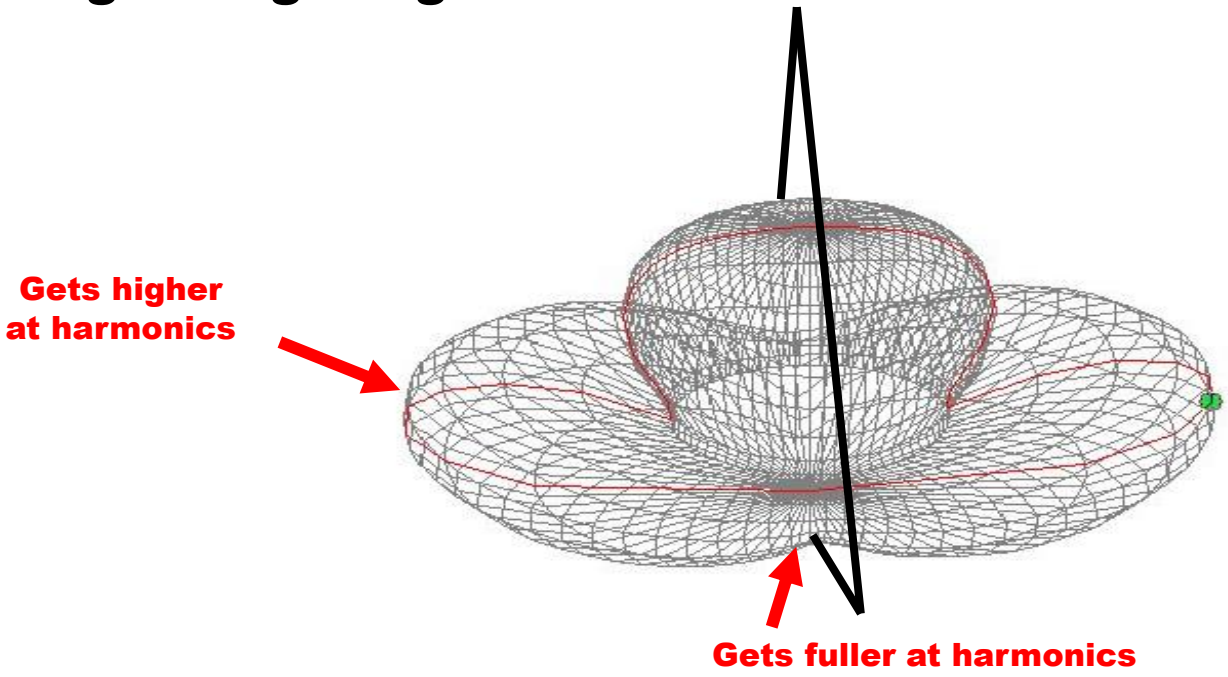




Harmonic Operation of Loops

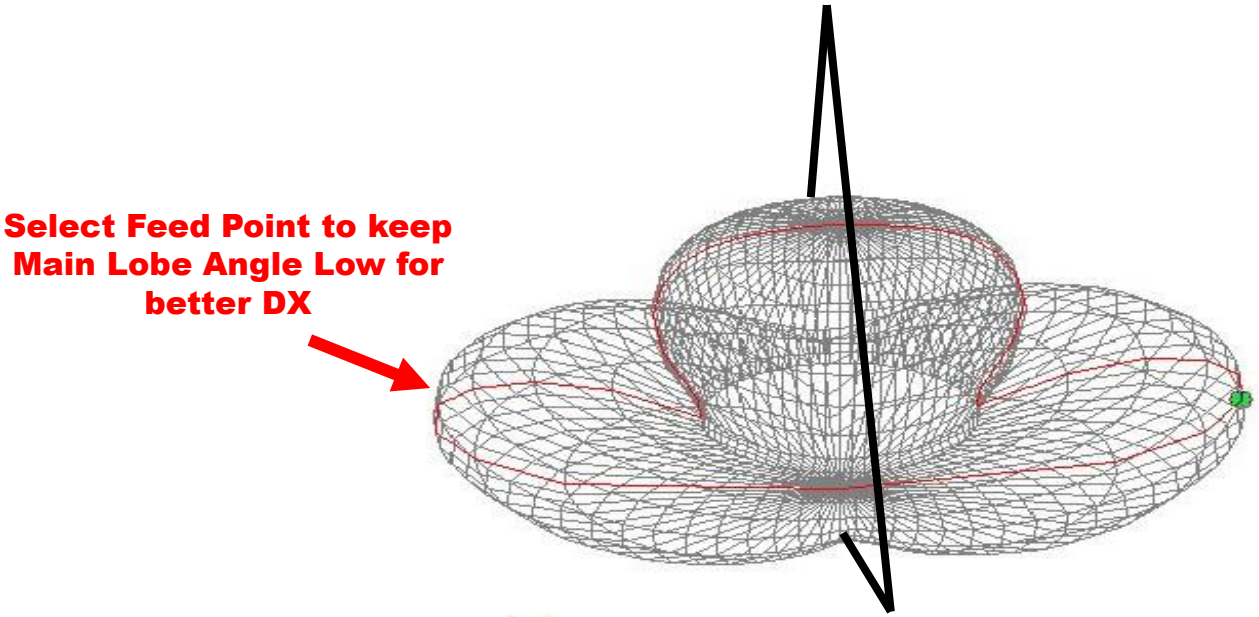
40M, 20M, 15M, 10M bands without needing a tuner
40M through 6M with a tuner

- A loop antenna is resonant at integral multiples
- Harmonics 200 - 300 ohms (50-75 after 4:1 BALUN) lower in real life
- Less directivity at harmonics
- Higher high angles of radiation on harmonic frequencies.



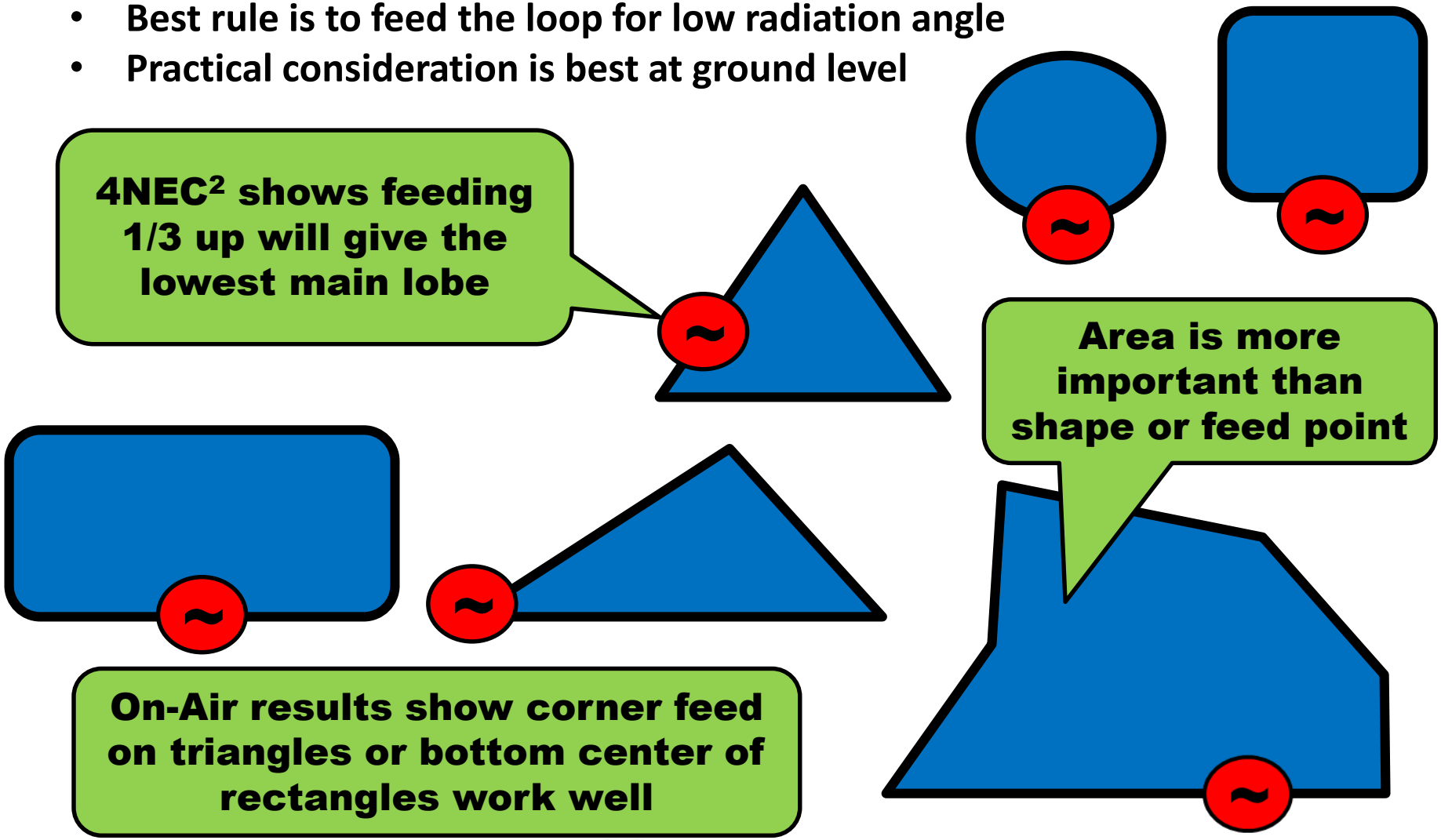
Polarization of Loop Antennas

- HF DX signals are constantly changing in polarization
- The loop may be vertical or horizontal depending on feed point
- Vertical polarization is preferred when antenna is low
- DX rule is to feed the loop for low radiation angle
- Practical consideration is feed at ground level



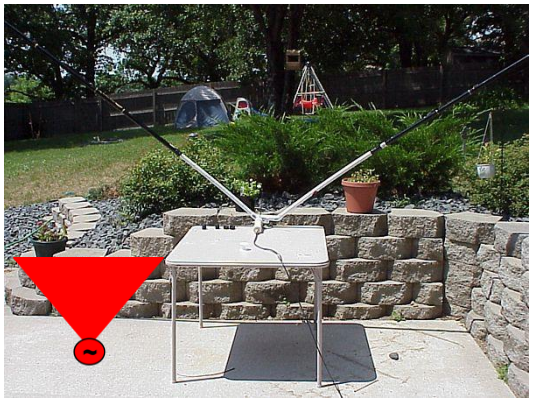
Feed Point for Loop Antennas

- Best rule is to feed the loop for low radiation angle
- Practical consideration is best at ground level



Conclusion

Vertical Delta Loops are good performers, cheap, simple, portable and one more option to get on the air



ANTENNA	Pros	Cons
Vertical Delta Loop	Portable	Very large on low bands
Dipoles	No Radials	Need altitude for DX
Monopole	Good on low Bands	Many radials required