The VE3DO Loop
A Compact, Easy to Build Receiving Antenna for 160M and 80M

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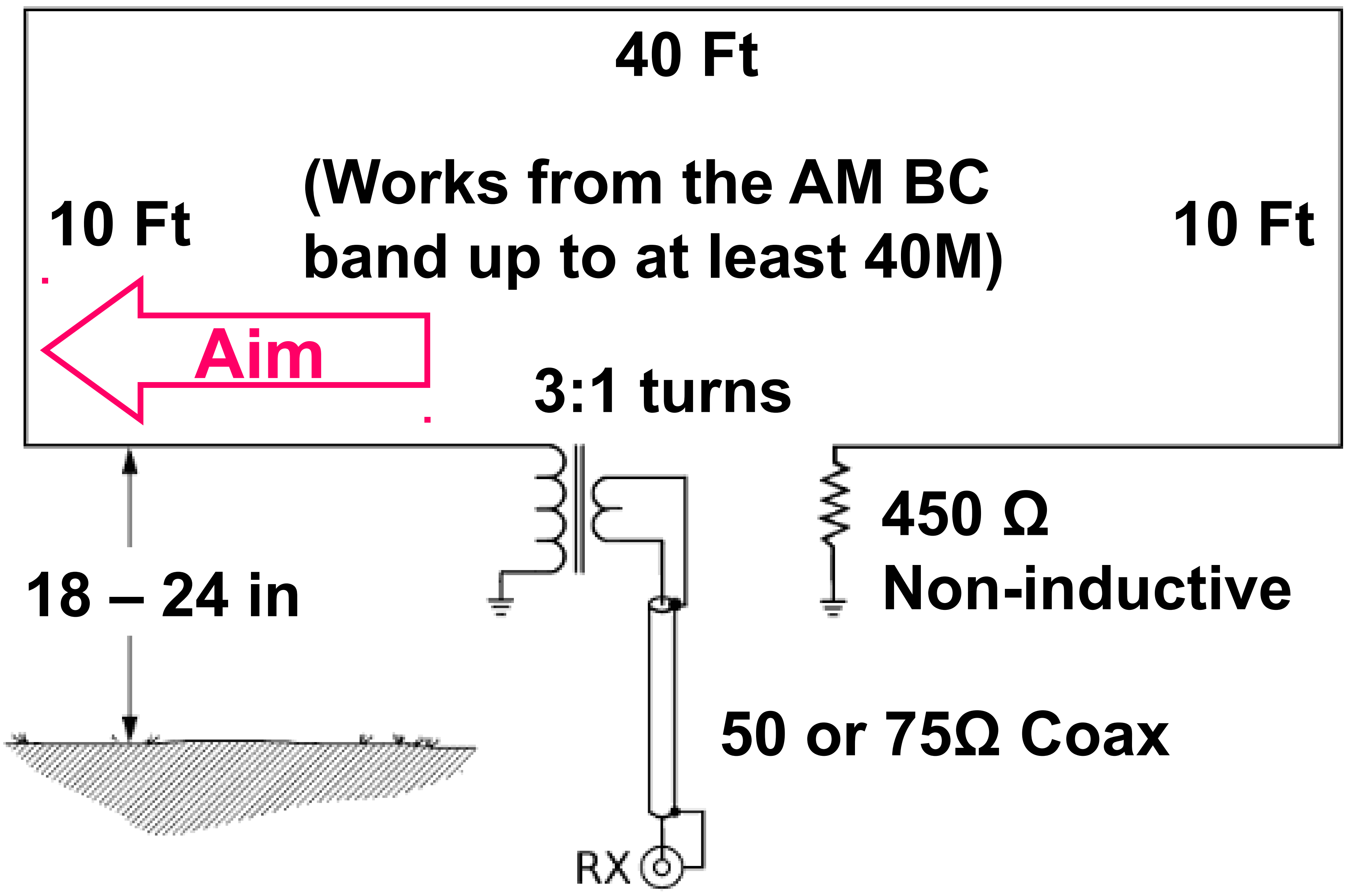
is on a fly-fishing trip to Peru

Don’t Bother Taking Notes

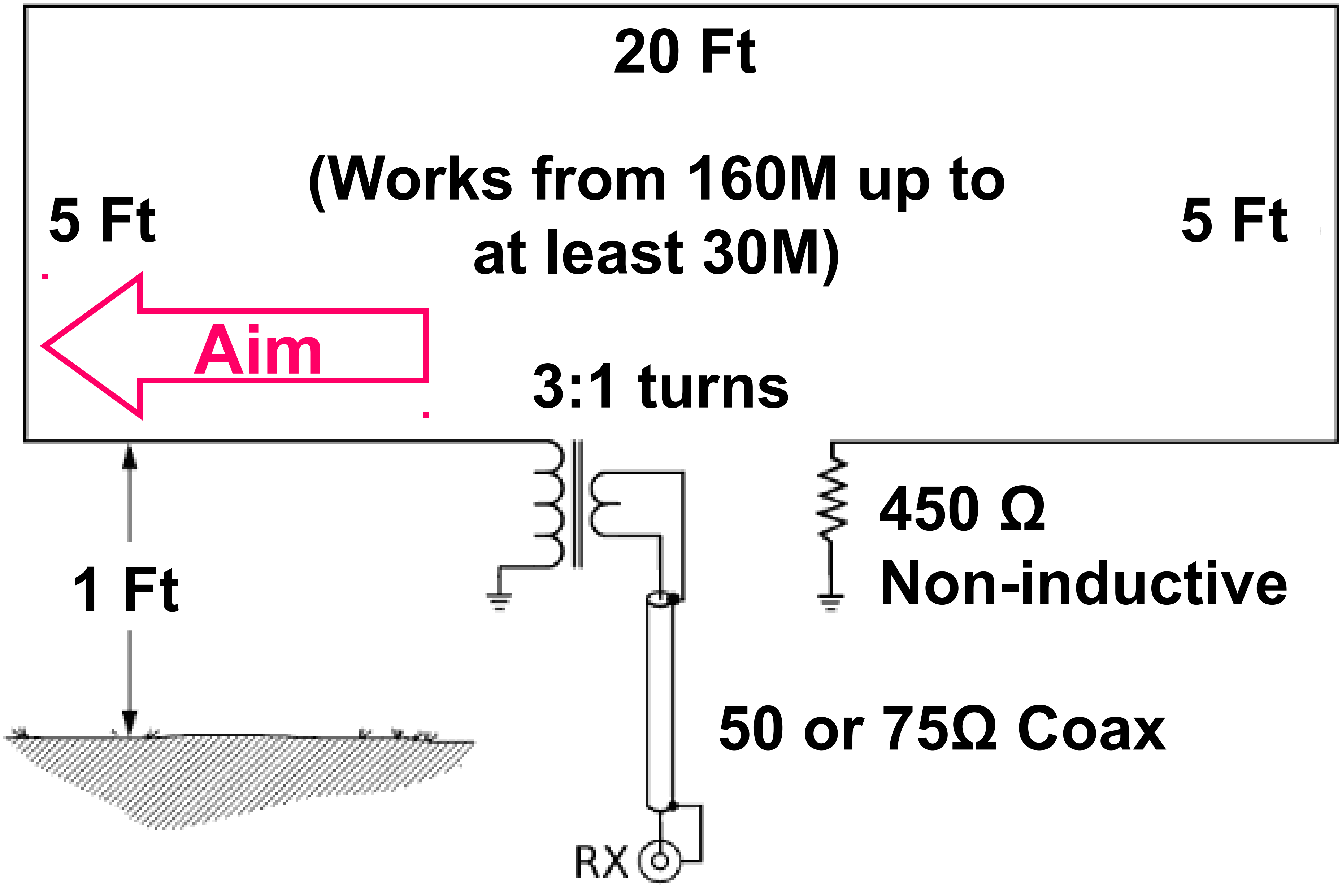
These slides are at

k9yc.com/publish.htm

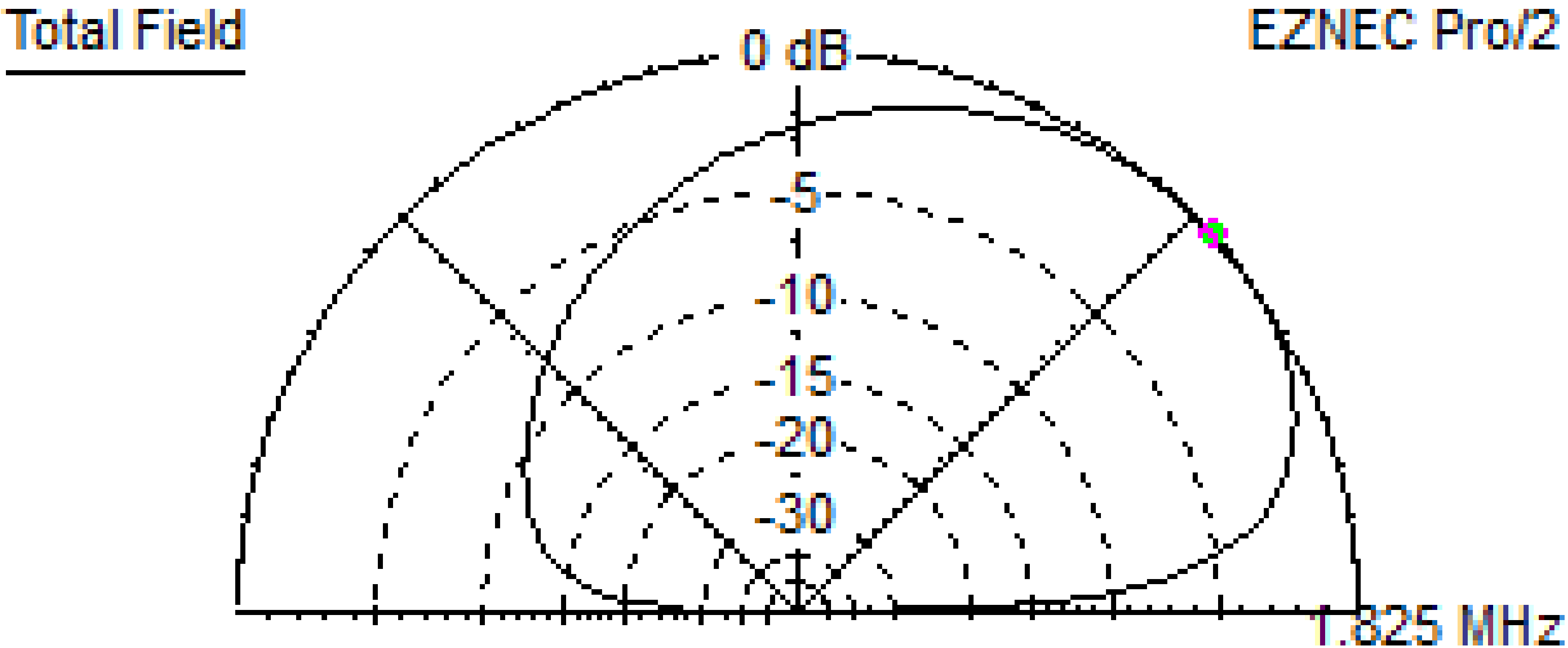
VE3DO Loop Optimized For 160M



VE3DO Loop Optimized For 80M

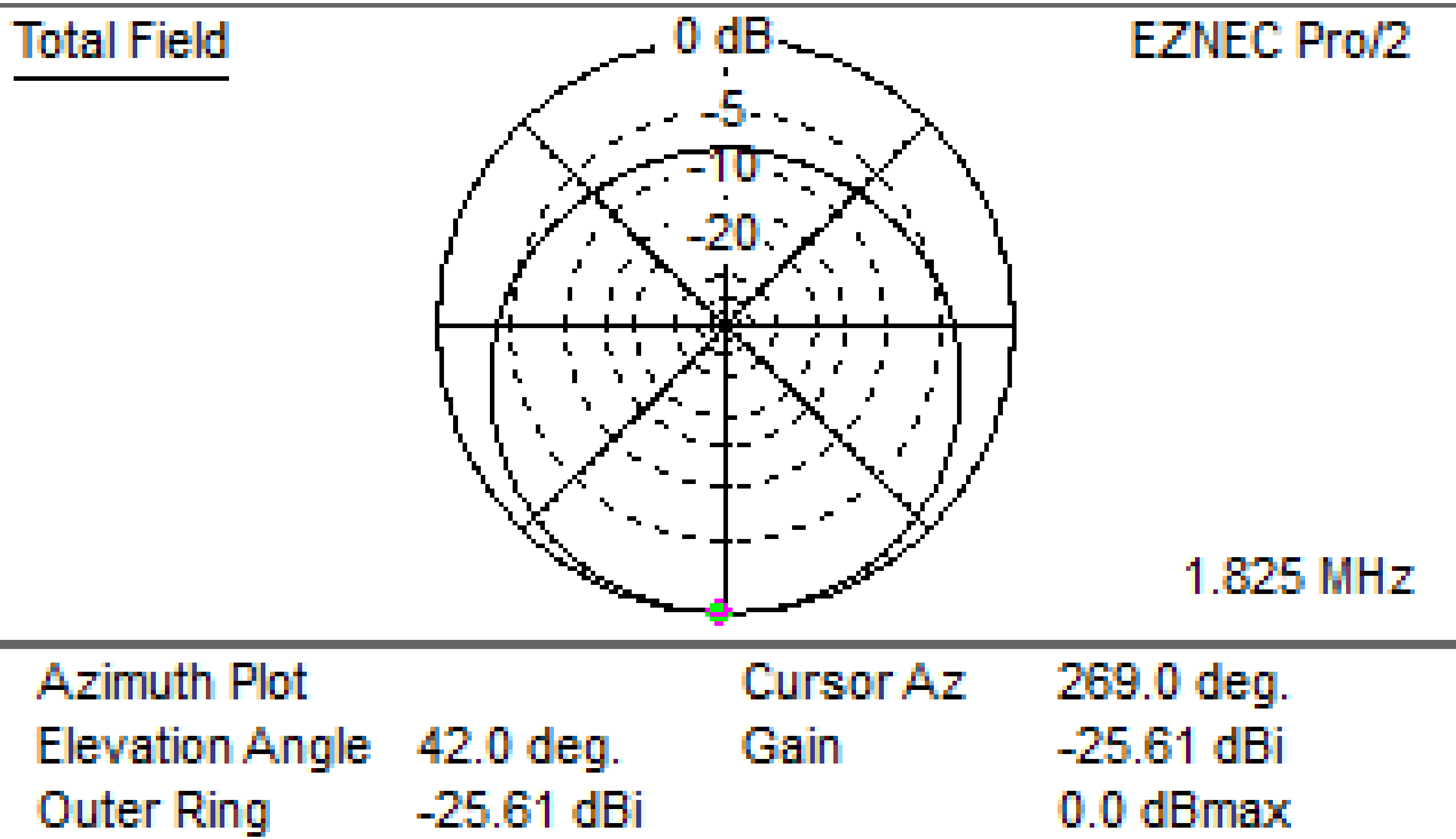


Vertical Pattern



Elevation Plot		Cursor Elev	42.0 deg.
Azimuth Angle	269.0 deg.	Gain	-25.61 dBi
Outer Ring	-25.61 dBi		0.0 dBmax

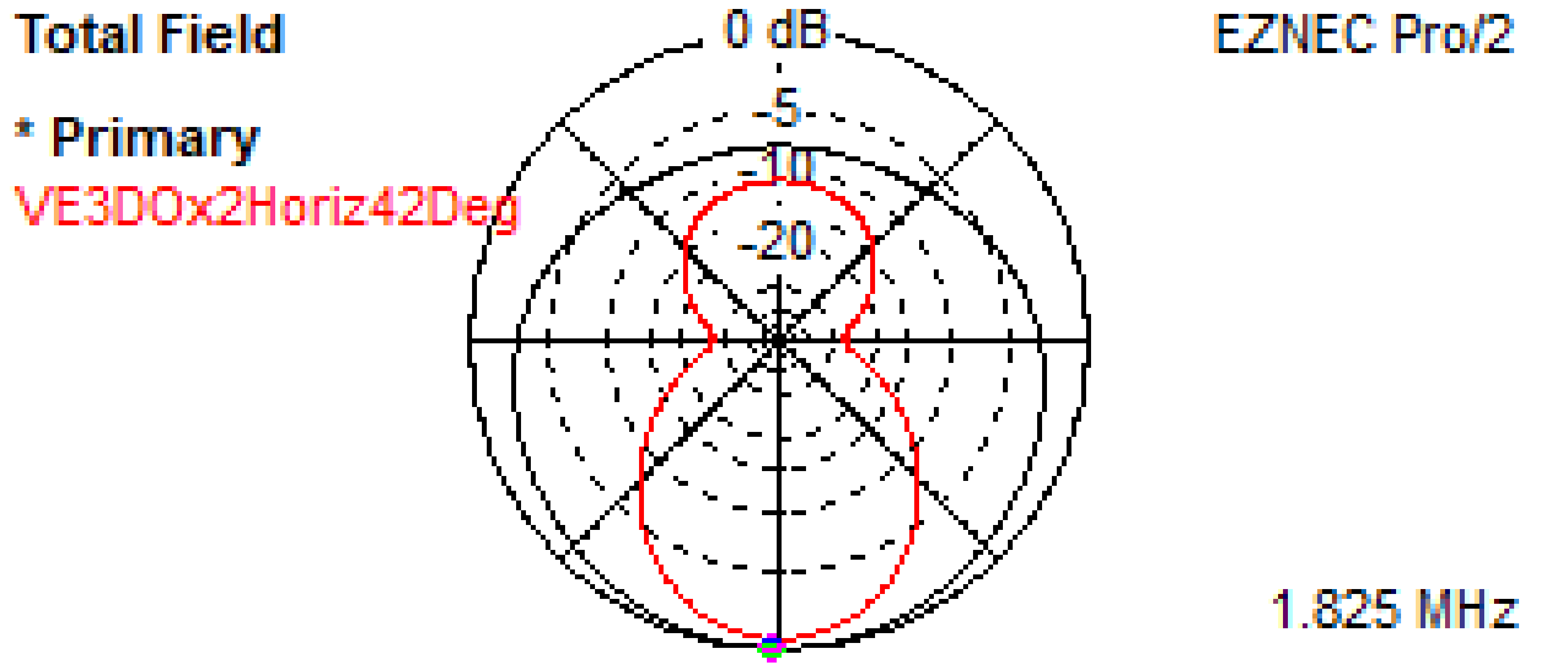
Horizontal Pattern



VE3DO 2-Loop Array

- **Two loops spaced 5/8λ (350 ft)**
- **I'm using a DX Eng NCC-1 phasing box to steer the receiving beam**
- **This could be the ultimate noise cancelling antenna system!**

Single Loop vs Dual Loops



Azimuth Plot		Cursor Bear	181.0 deg.
Elevation Angle	34.0 deg.	Gain	-23.67 dBi
Outer Ring	-23.67 dBi		0.0 dBmax
			0.0 dBmax3D

Array Spacing

- 5/8-wavelength between loops is ideal
  - 337 ft for 160M, 168 ft for 80M
  - Side-by-side, <u>not</u> "in line"
- Closer and wider spacing works, but horizontal pattern and RDF not as good
- Antennas don't have to be ideal to be useful
- Ham antennas are often a compromise

Receive Antenna Principles

- **It’s all about Noise Rejection!**
  - **Narrow pattern**
  - **Kill common mode noise on feedline**
- **Efficiency doesn’t matter**
  - **Coax loss doesn’t matter**
- **Directivity should favor desired signal and reject the noise**

Antennas Work In 3D

- Horizontal directivity = azimuth
- Vertical directivity = angle above horizon
- Horizontal pattern changes with vertical angle
  - Sometimes a little, sometimes a LOT

Vertical Angle of Arriving Signal

- Depends entirely on propagation and the other station's antenna
- Can vary from high angle to low angle as propagation changes during an opening
- Sometimes we need strong high angle RX, and sometimes strong low angle

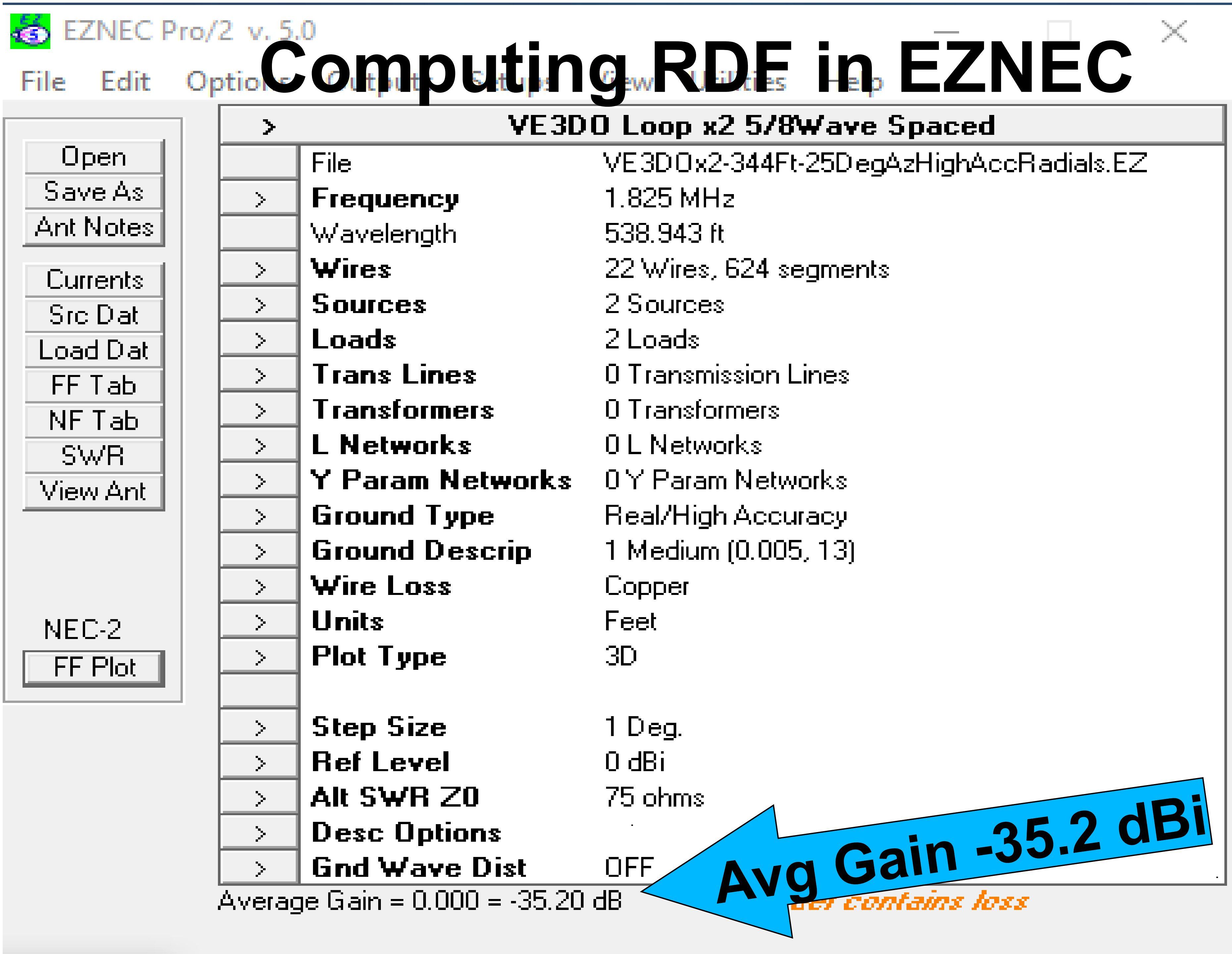
Receive Directivity Factor (RDF)

- **A single number describing the overall narrowness of the pattern**
- **Defined as the ratio of peak gain in main lobe to the average gain over the full spherical response**
- **Defines the noise rejection factor IF noise comes equally from all directions**
  - **It rarely does**

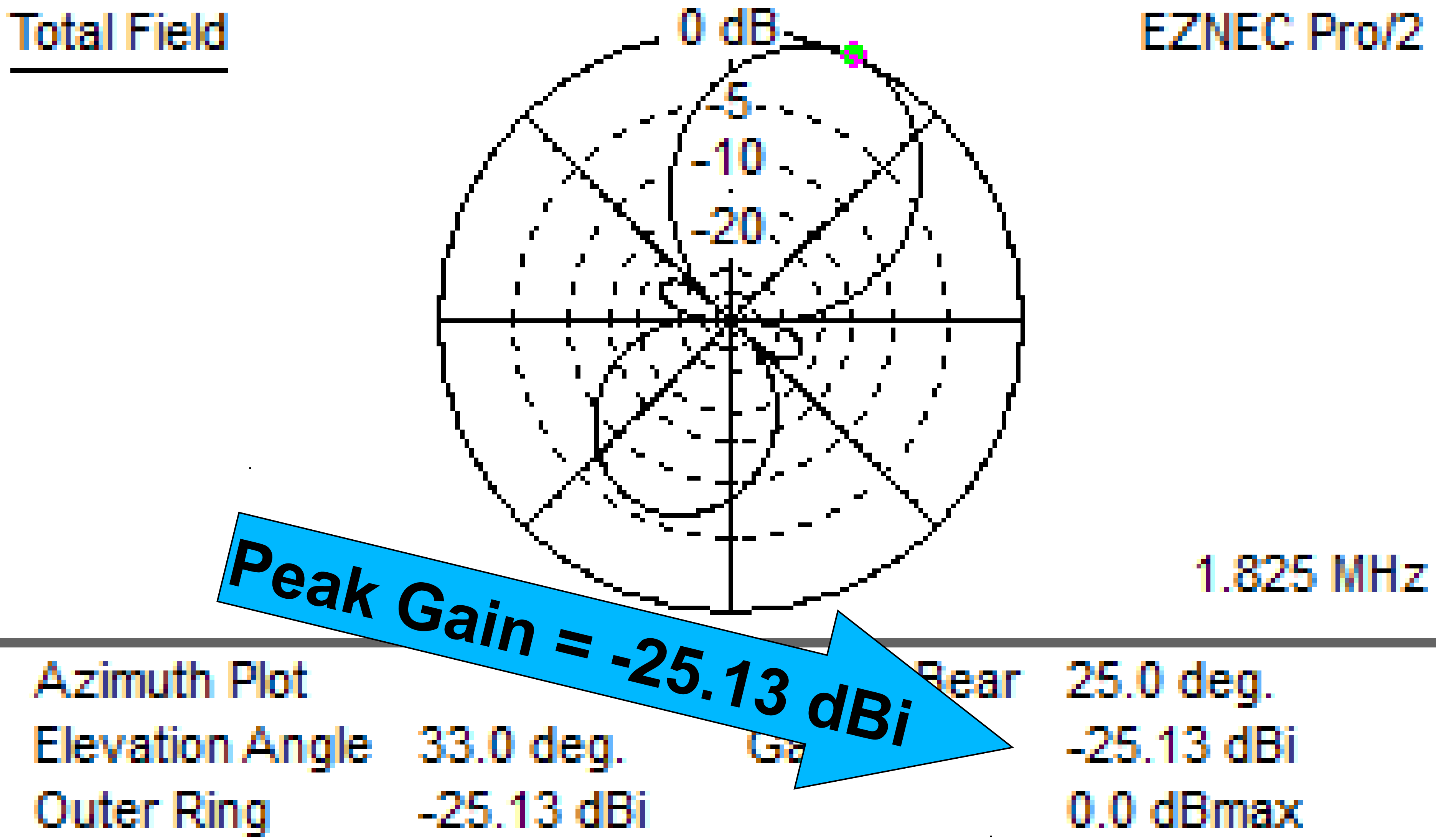
Computing RDF

- Model the antenna (NEC or other program)
- Find the Average Gain in dB
- Find the Peak Gain in dB
  - At peak elevation and peak azimuth
- RDF = [Peak Gain] – [Average Gain]
- Subtracting dB values for gain yields the dB value of their ratio

Computing RDF in EZNEC



Computing RDF in EZNEC



Computing RDF

- **RDF = [Peak Gain] – [Average Gain]**
- **For this example**
- **[-25.13 dBi] – [-35.2 dBi] = 10.07 dB**
- **It’s +10.07 dB because we’re subtracting a negative number from another negative number**

RDF Quantifies Overall Directivity

- Omni antenna picks up noise from all directions
- Directional antenna picks up noise from where it's aimed
- RDF = [Peak Gain] – [Average Gain]
- RDF tells us how much noise is reduced by narrow RX antenna if noise was equal in all directions

RDF of 160M Antennas (W8JI)

Antenna	RDF	Beam
Inv vee 120 ft apex	0.6 dB	360°
10 ft diam tuned loop	4 dB	105°
90 ft tall Tee Vertical	4.9 dB	360°
K9AY, VE3DO Loop	7.2 dB	163°
Flat dipole @ 120-250 ft	7.4 dB	
2-el TX vertical w/reflector	7.4 dB	187°
500 ft Beverage	9 dB	80°
2 - VE3DO loops spaced 340 ft	10.1 dB	50°
TX 4-square	10.7 dB	99°
Waller Flag	12.2 dB	84°

RDF Is Too Simple

- **Single quantifiers usually are**
- **Looking at the elephant through a tiny hole in the tent**

RDF Is Too Simple

- Doesn't tell the whole story
- Is blind to details of the pattern
- Is blind to where the noise is
- Is blind to polarization of the noise
  - Vertical or horizontal?
- Is blind to vertical angle
- Does beam focus vertically or horizontally or both?

RDF Is Too Simple

- **80M dipole is a good RX antenna for high angle signals, poor for low angle, so it rejects some local noise**
  - **Has typical dipole directivity at low angles, but is omni at high angles**
  - **Sometimes DX comes in at high angles!**
- **N6RO patches higher band antennas to his RX antenna setup for 160M**

RDF Is Too Simple

- 160M Tee vertical RDF 5 dB
  - Weak high angle, strong low angle
  - Most local noise is low angle
  - Local noise often vertically polarized
  - Desired signal can be high or low angle

You Can Never Have Too Many Antennas!

Polarity and Phase

- Hams need to learn the difference!
- Historically, we’ve used the word “phase” to describe what is really polarity
- This results in fuzzy thinking about how things work

Polarity

- Is the “positive-going” or “negative-going” sense of a signal path
- Has two values, “normal” and “inverted” (or “reverse”)
- Is changed by
  - Reversing the signal wiring
  - Inverting gain stage
    - Common-cathode, common-emitter, common-source amplifier
    - inverting output of a diff amp

What Is Phase?

- **Phase is a continuous variable and is measured in degrees**
- **Phase is the difference between the positive-going zero-crossings of two sine waves having <u>the same frequency</u>**
- **Phase has no meaning for signals of different frequencies**

Phase, Time, Distance

- **When phase difference is the result of travel time, phase shift is proportional to both time and frequency**
- **Applies to all signal paths – as radio wave and in transmission line**
- **Phase shift is inversely proportional to velocity factor (VF) of the medium**
  - **VF of transmission lines increases phase shift for the same physical distance as compared to a radio wave**

Polarity and Phase

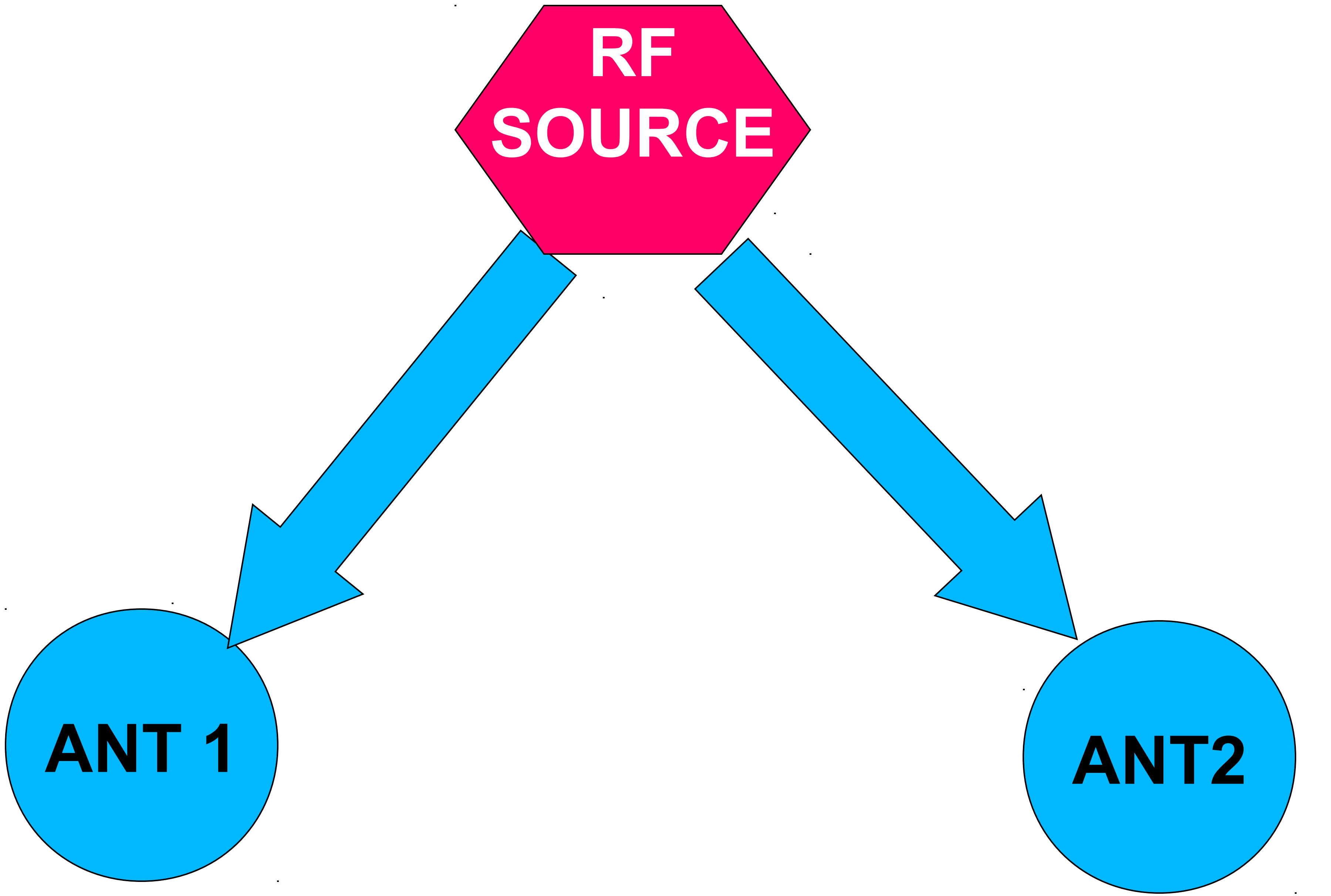
- **Polarity is independent of time and frequency**
- **Two signals that are out of polarity, in time with each other, and of equal strength will cancel at *<u>all</u>* frequencies**
- **Phase cancellation works at a single frequency**
- **The difference can be VERY important when combining (or feeding) two antennas**

Polarity and Phase

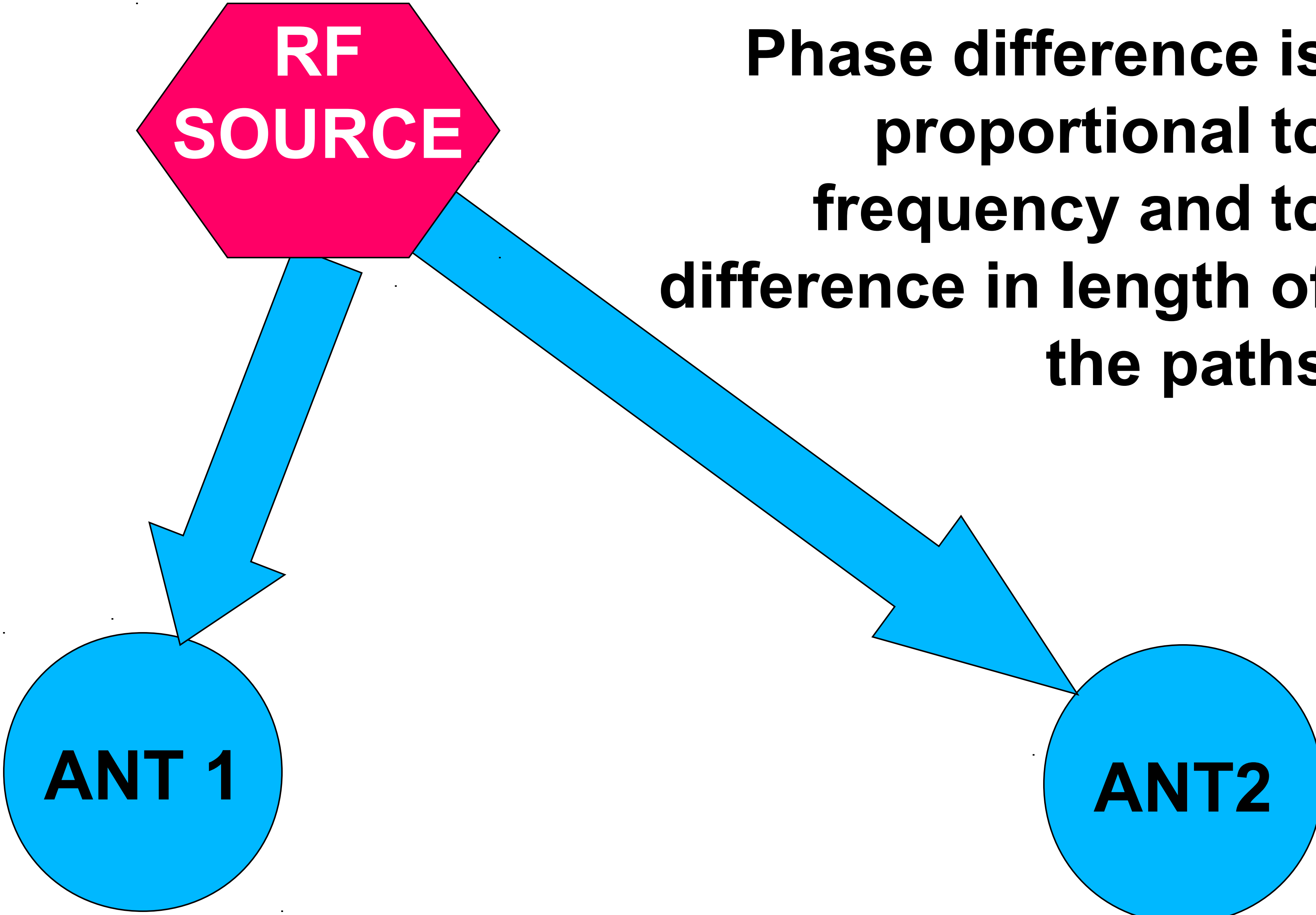
- **A “phasing line” can only provide 180º at a single frequency**
  - **Less phase shift at lower frequency**
  - **More phase shift at higher frequency**
  - **Can matter for wideband antennas**
- **Inverting polarity provides 180º at all frequencies**

How Phased Antennas Work

Equal Distance, Signals In Phase

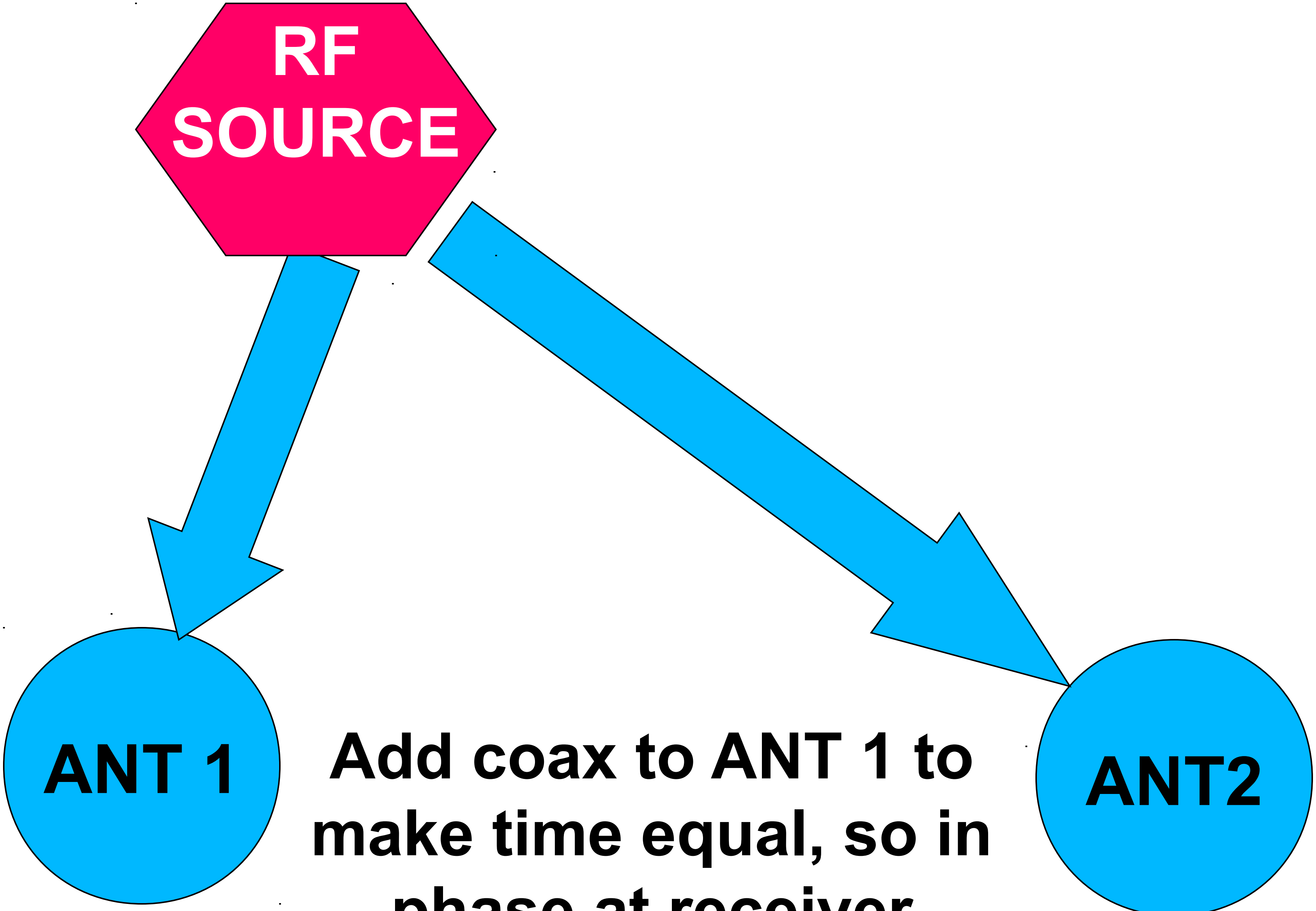


Signals Out Of Phase at Antennas



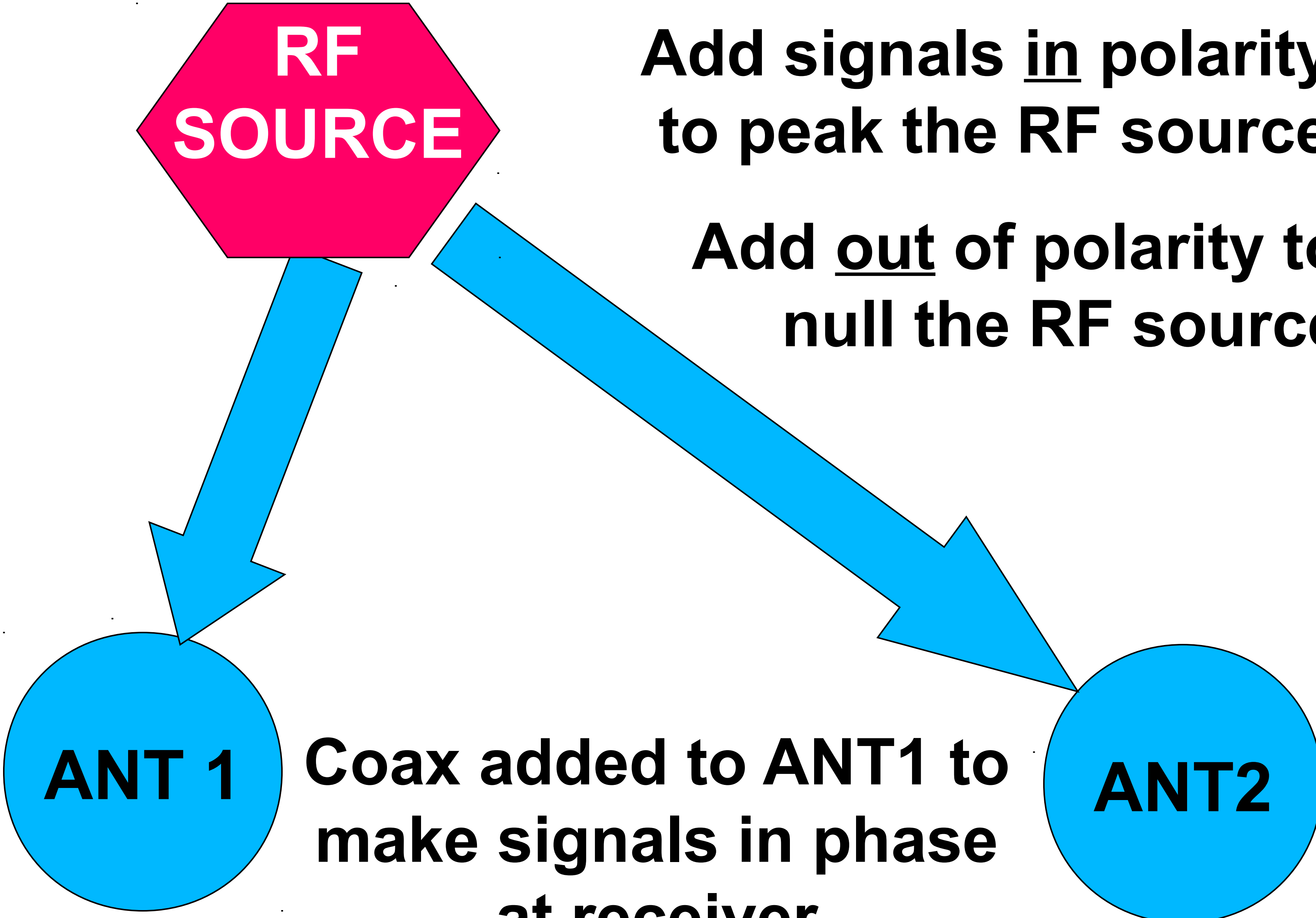
Phase difference is proportional to frequency and to difference in length of the paths

Signals Out Of Phase at Antennas



Add coax to ANT 1 to make time equal, so in phase at receiver

Signals Now In Phase at Receiver

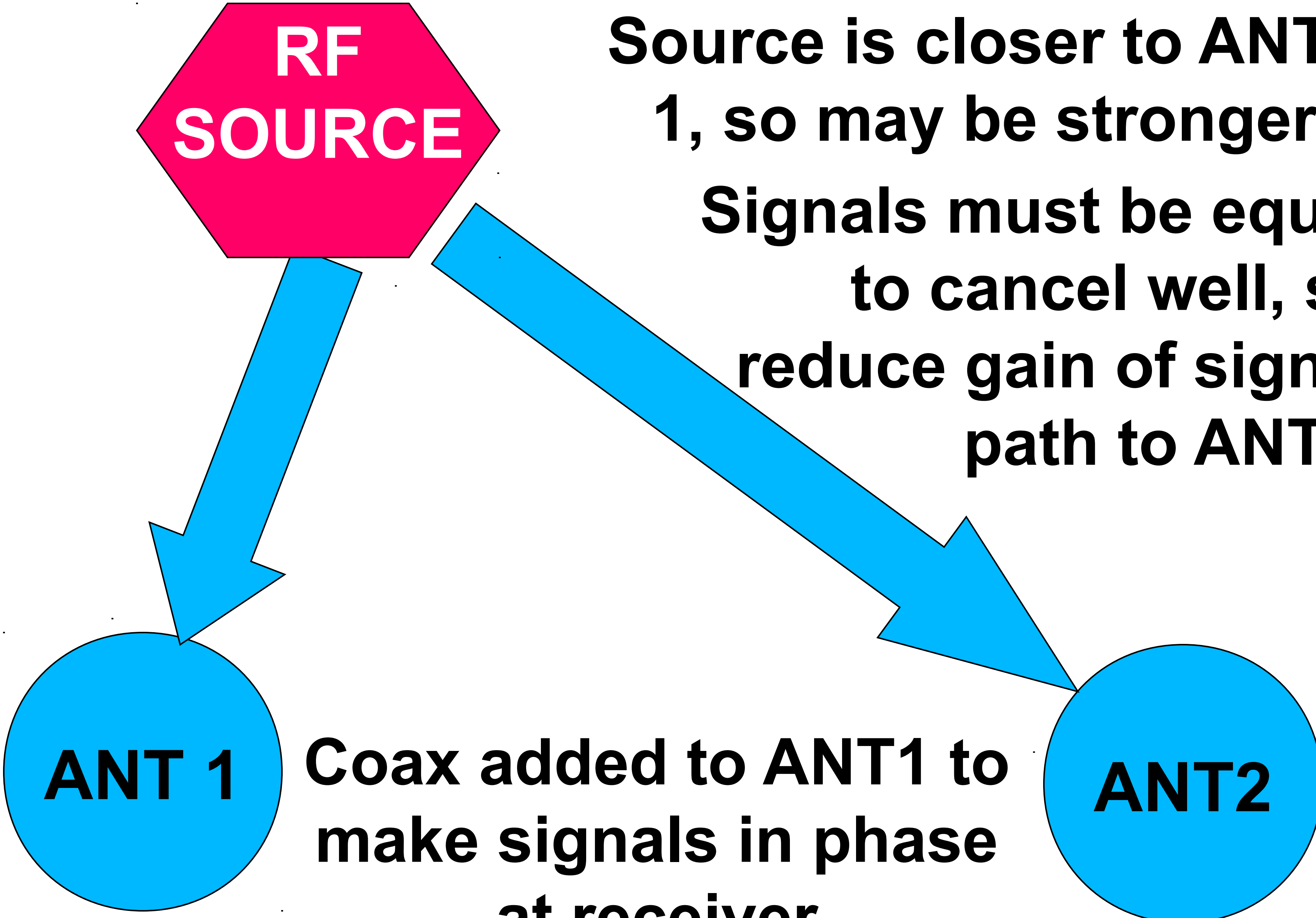


Add signals <u>in</u> polarity to peak the RF source

Add <u>out</u> of polarity to null the RF source

Coax added to ANT1 to make signals in phase at receiver

Signals Now In Phase at Receiver

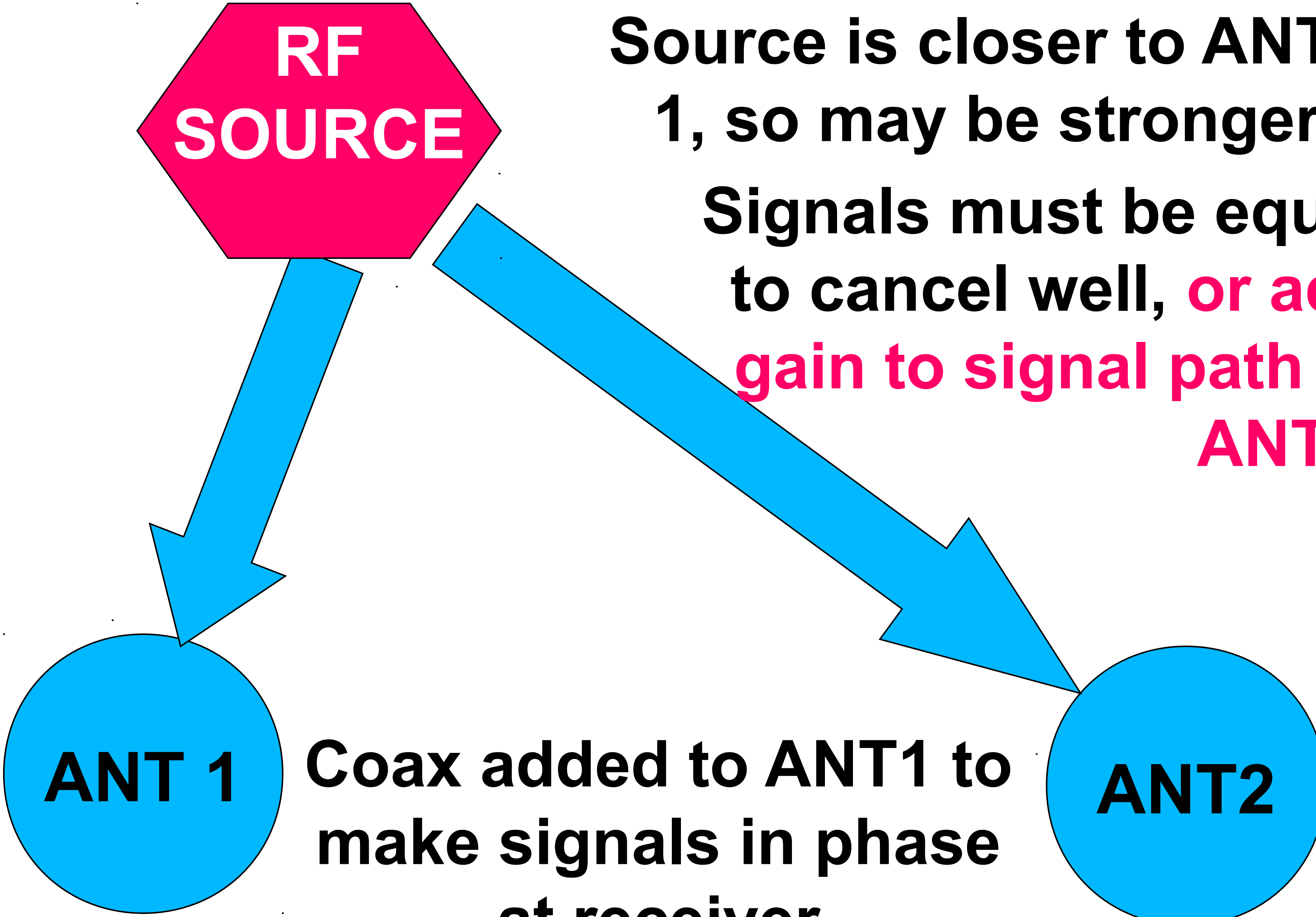


Source is closer to ANT 1, so may be stronger.

Signals must be equal to cancel well, so reduce gain of signal path to ANT 1

Coax added to ANT1 to make signals in phase at receiver

Signals Now In Phase at Receiver

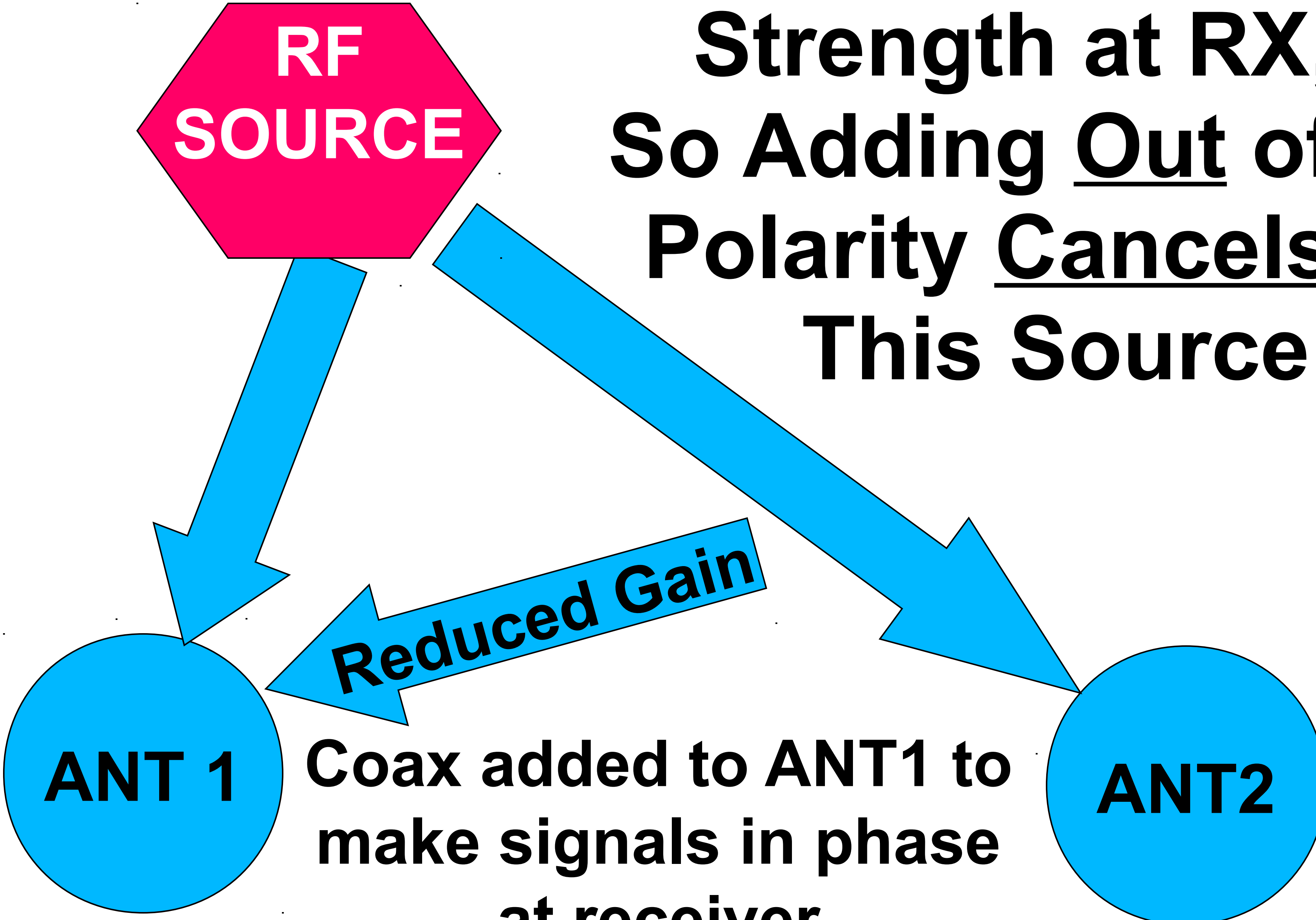


Source is closer to ANT 1, so may be stronger.

Signals must be equal to cancel well, or add gain to signal path to ANT 2

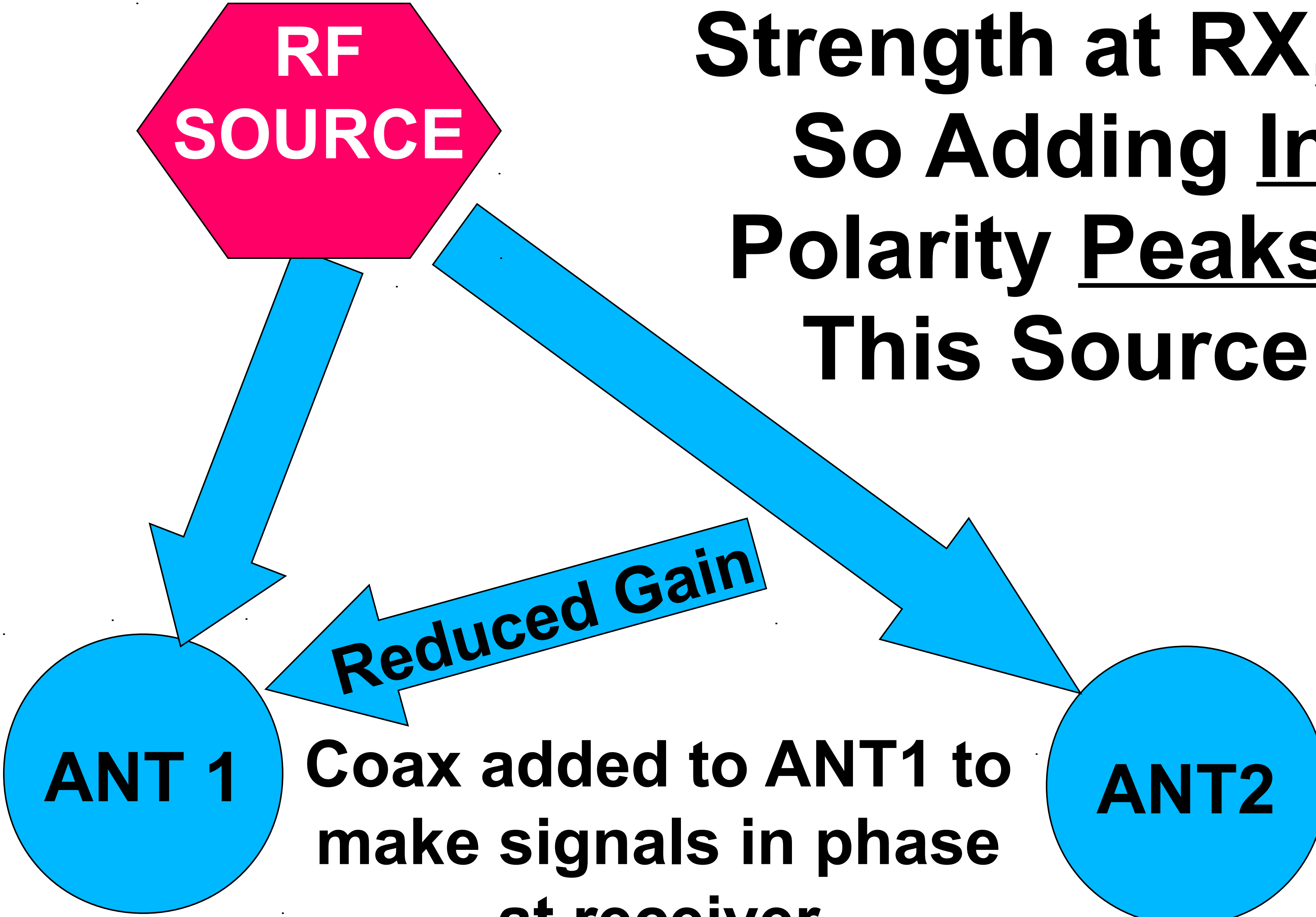
Coax added to ANT1 to make signals in phase at receiver

Signals Now In Phase and Equal Strength at RX, So Adding <u>Out</u> of Polarity <u>Cancels</u> This Source



Coax added to ANT1 to make signals in phase at receiver

Signals Now In Phase and Equal Strength at RX, So Adding In Polarity Peaks This Source



Phasing Antennas

- **The last slide shows how beam steering works**
- **The one before it shows how noise cancellation works**
- **The phase response of most real antennas varies with azimuth, or vertical wave angle, or both**
- **Modeling programs must compute it to compute antenna patterns, but most don't plot phase response**

Phasing Antennas

- It is the complex horizontal and vertical phase and amplitude response of the loops themselves, combined with the space between them, that produce the complex patterns when the loops are steered!
- Other pairs of antennas can be steered or used to cancel noise
  - Verticals are often used

Adding Signals From Two Antennas

- **The greatest addition we can achieve is 6 dB, and occurs when the signals are equal and precisely <u>in</u> phase**
  - **6 dB is twice the voltage**

Adding Signals From Two Antennas

- **If two signals were precisely equal and precisely 180 degrees <u>out</u> of phase, they cancel each other perfectly**
- **That doesn't happen in the real world, but 20-30 dB of cancellation can often be achieved**
- **20 dB is 1/10 of the voltage, 1/100 of the power**
- **30 dB is 1/31.6 of the voltage, 1/1000 of the power**

Noise Cancellation

- It’s rarely possible to cancel more than one signal at a time because phase and strength depend on
  - Direction of arrival (azimuth and elevation)
  - Distance
  - Antenna directivity
  - Antenna phase shift varies with horizontal and vertical angle

Noise Cancellation

- **For perfect cancellation, the two signals must be equal in strength, in phase, and out of polarity**
  OR
  equal in strength, in polarity, and 180º out of phase

Steer By Varying Coax Length

- Our tutorial example shows how this works
- Switch in lengths of coax to get the desired phase shift
- Two 4x1 switches and coax lengths provides four steering directions

Varying Coax Length Isn't Practical for Cancellation Because Very Fine Adjustment to Phase is Required!

Steered VE3DO Loop Patterns

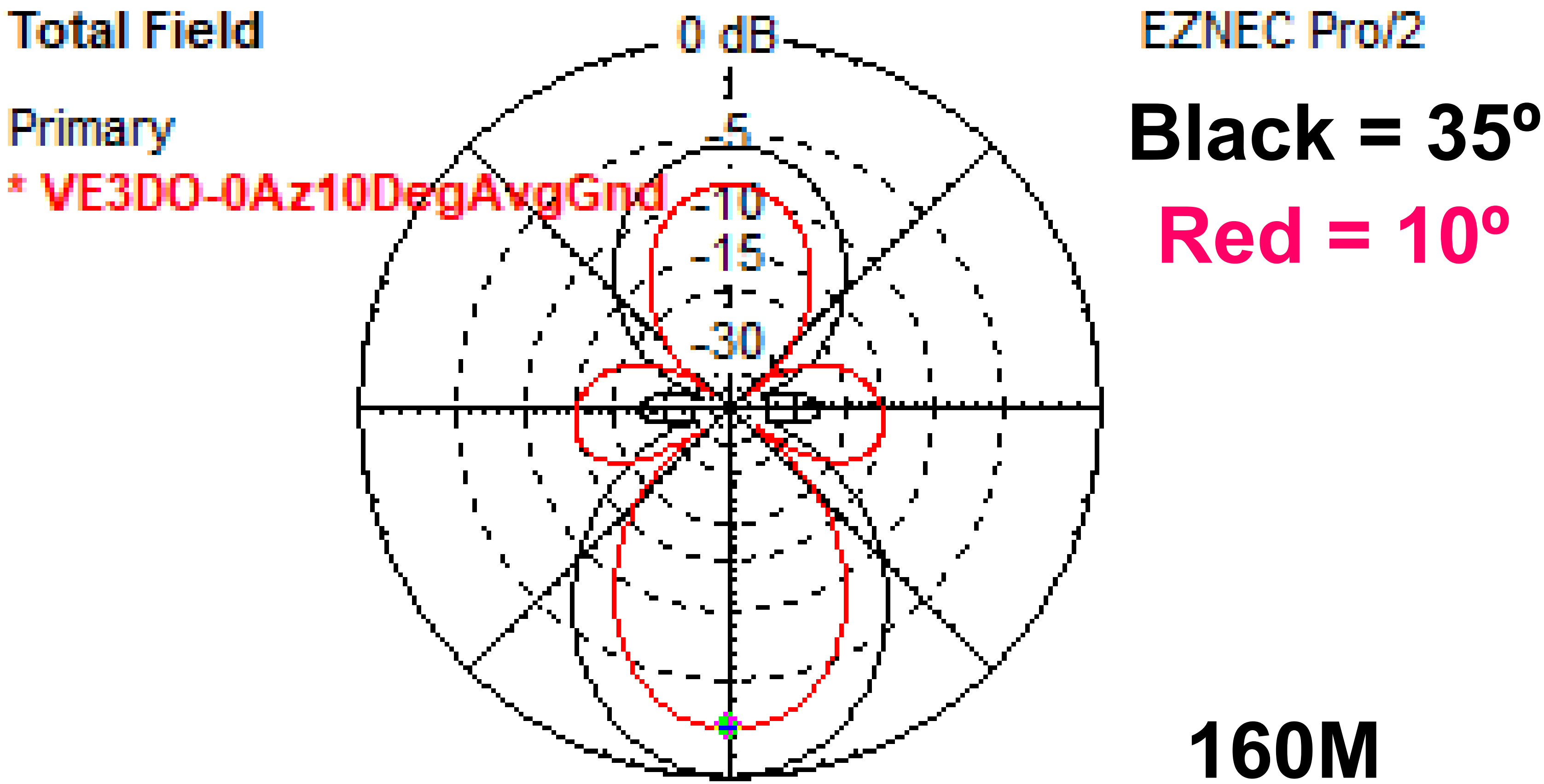
- Patterns are a bit different at low angles than at high angles
  - Black curves show peak elevation ~35º
  - Red curves show 10º elevation

Steered VE3DO Loop Patterns

- **Note that these patterns have both peaks and nulls**
- **We can**
  - **Steer peaks to desired signals**
    or:
  - **Steer nulls to kill a local noise source or QRM**
  - **If we're lucky, accomplish both with the same settings!**

Horizontal Pattern - Loops In Phase

RDF = 10.1 dB



Azimuth Plot		Cursor Az	270.0 deg.
Elevation Angle	10.0 deg.	Gain	-27.52 dBi
Outer Ring	-25.14 dBi		0.0 dBmax
			-2.38 dBPrTrc

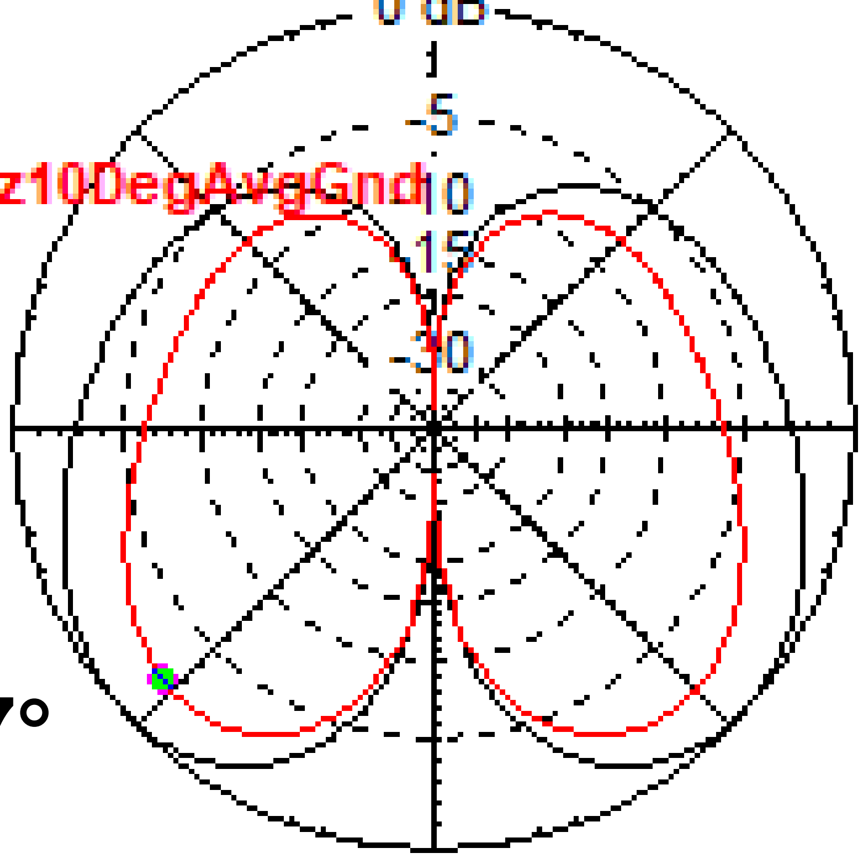
Horizontal Pattern - Loops 180º
RDF = 8 dB

Total Field

Primary

* VE3DO-180Az10DegAvgGnd

EZNEC Pro/2



Black = 29º

Red = 10º

Peaks +/- 47°

160M

Azimuth Plot		Cursor Az	223.0 deg.
Elevation Angle	10.0 deg.	Gain	-28.85 dBi
Outer Ring	-26.65 dBi		-0.07 dBmax
			-2.2 dBPrTrc

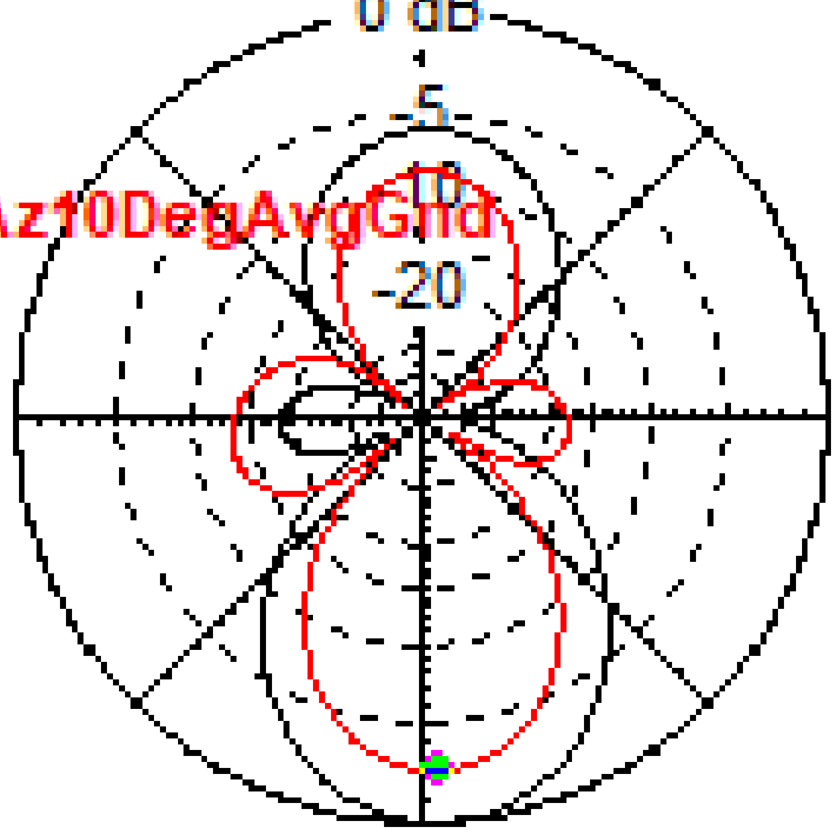
Horizontal Pattern – Steer 3º
RDF = 10.1 dB

Total Field

EZNEC Pro/2

Primary

* VE3DO-11DegAz10DegAvgGnd



Black = 34º

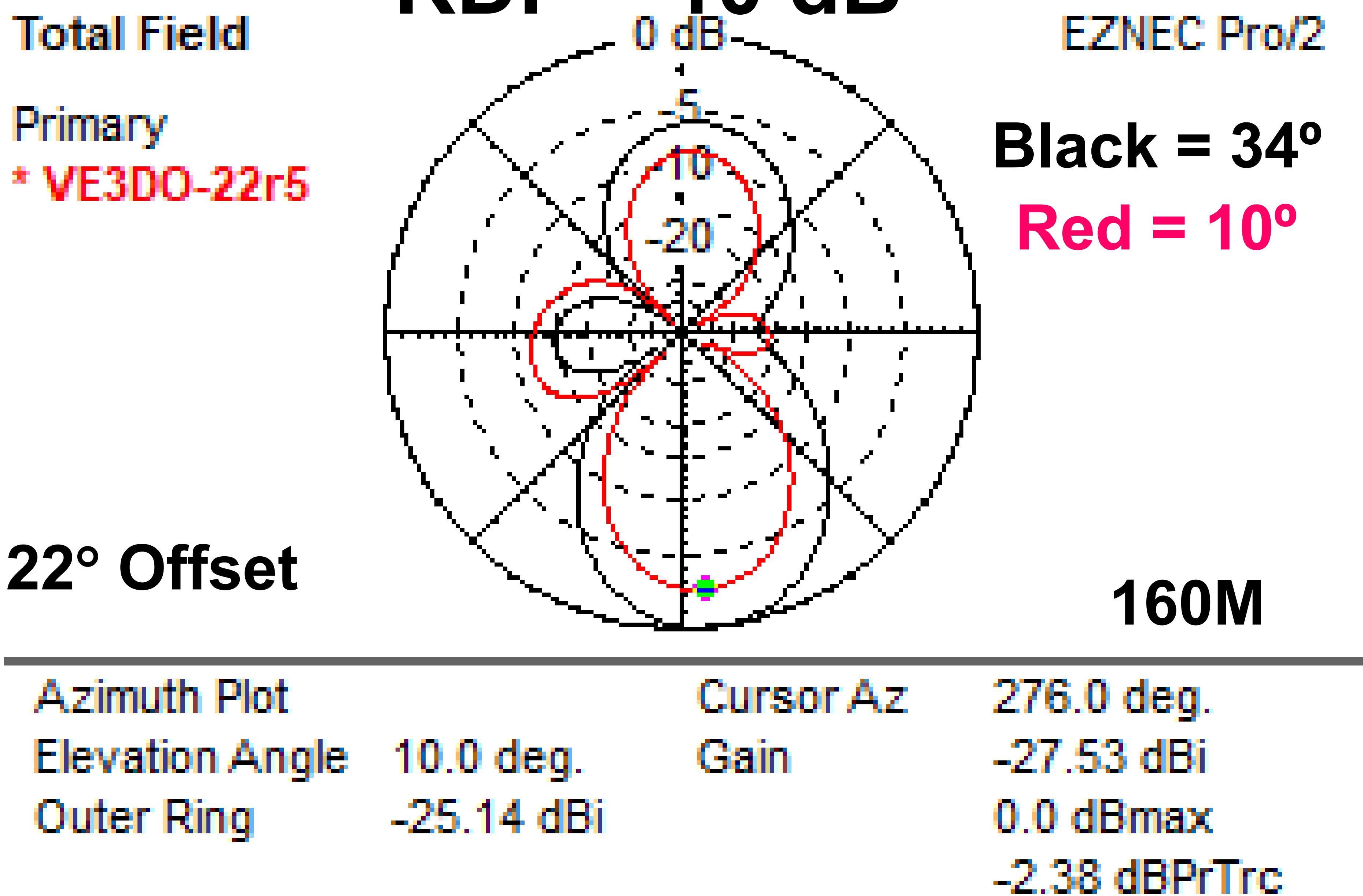
Red = 10º

11° Offset

160M

Azimuth Plot		Cursor Az	273.0 deg.
Elevation Angle	10.0 deg.	Gain	-27.52 dBi
Outer Ring	-25.13 dBi		0.0 dBmax
			-2.38 dBPrTrc

Horizontal Pattern – Steer 6º
RDF = 10 dB



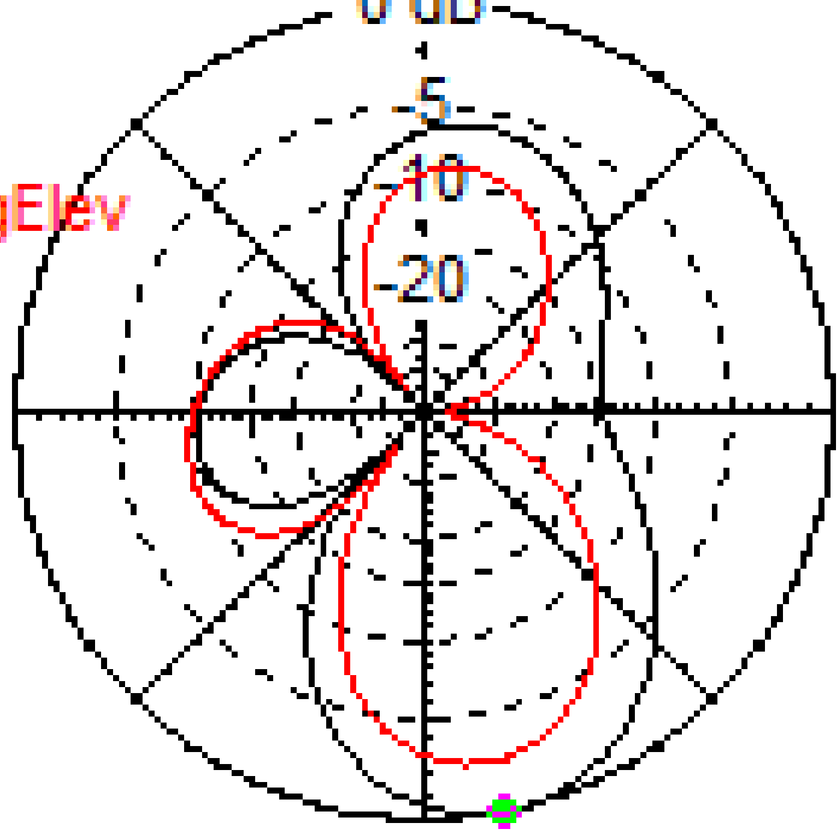
Horizontal Pattern – Steer 12º
RDF = 9.9 dB

Total Field

* Primary

VE3DO-45-10DegElev

EZNEC Pro/2



Black = 34º

Red = 10º

45° Offset

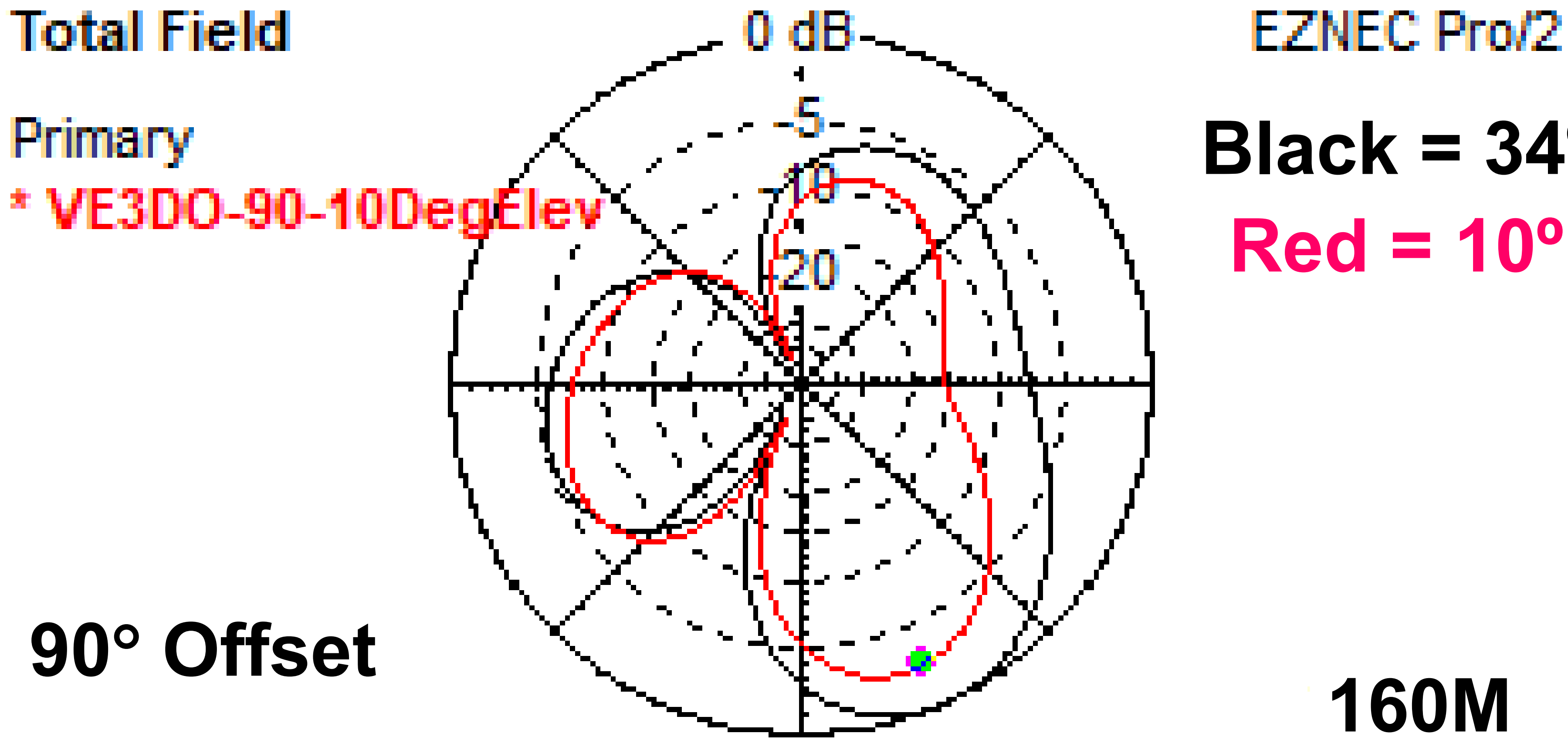
160M

Azimuth Plot		Cursor Az	282.0 deg.
Elevation Angle	34.0 deg.	Gain	-25.21 dBi
Outer Ring	-25.21 dBi		0.0 dBmax
			0.0 dBmax3D

Horizontal Pattern – Steer 24º
RDF = 9.4 dB

Black = 34º

Red = 10º

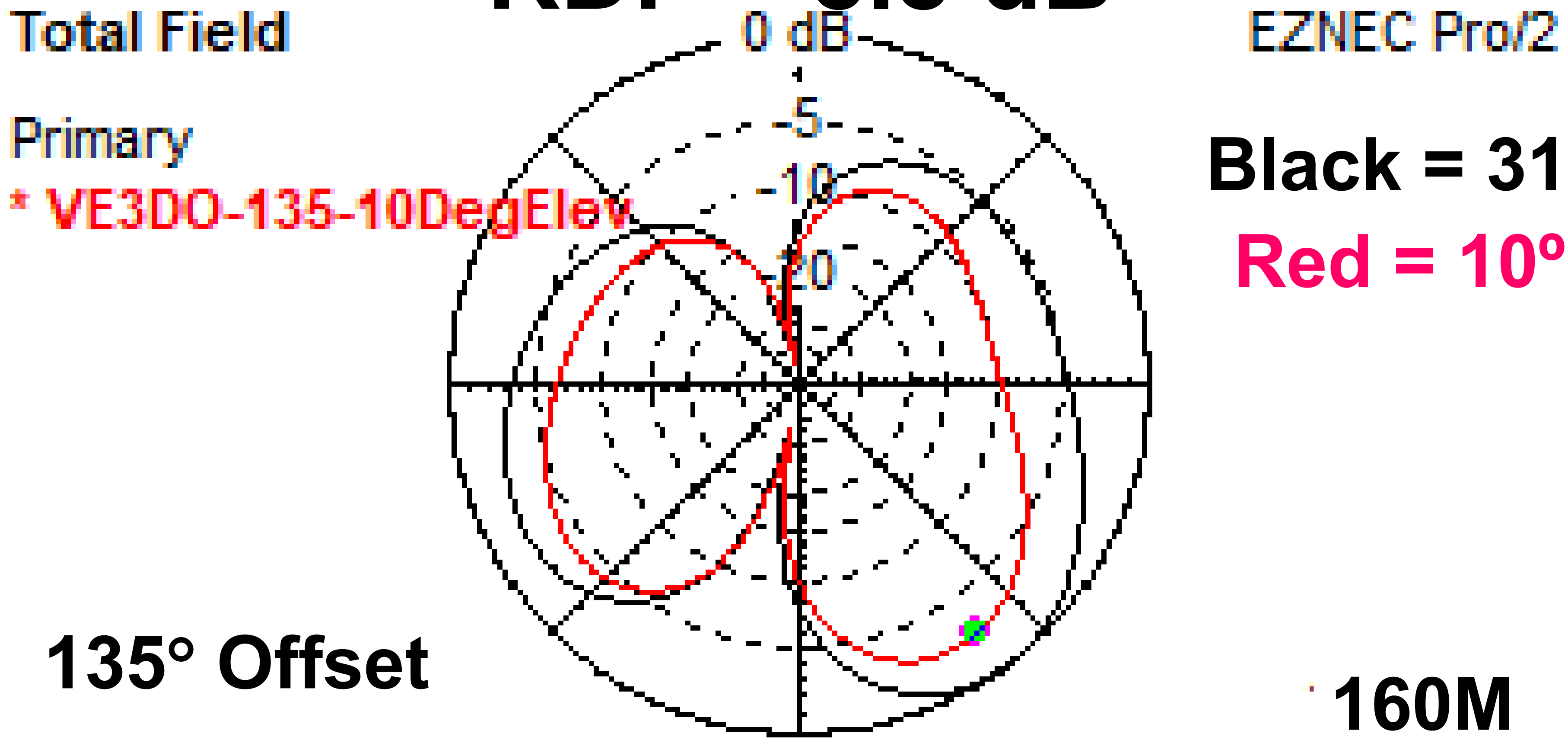


90° Offset

160M

Azimuth Plot		Cursor Az	294.0 deg.
Elevation Angle	10.0 deg.	Gain	-27.83 dBi
Outer Ring	-25.45 dBi		-0.05 dBmax
			-2.37 dBPrTrc

Horizontal Pattern – Steer 36º
RDF = 8.8 dB



Black = 31º

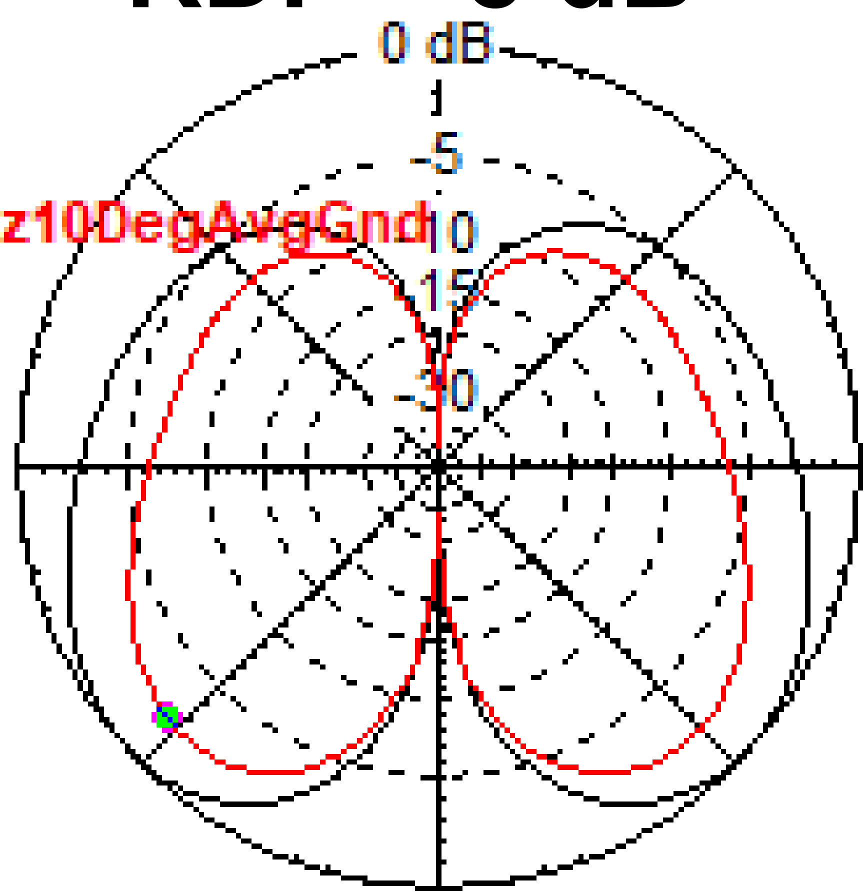
Red = 10º

135° Offset

160M

Azimuth Plot		Cursor Az	306.0 deg.
Elevation Angle	10.0 deg.	Gain	-28.24 dBi
Outer Ring	-25.9 dBi		-0.08 dBmax
			-2.34 dBPrTrc

Horizontal Pattern – Steer +/-47°
RDF = 8 dB



Black = 29º

Red = 10º

180° Offset

160M

Azimuth Plot		Cursor Az	223.0 deg.
Elevation Angle	10.0 deg.	Gain	-28.85 dBi
Outer Ring	-26.65 dBi		-0.07 dBmax
			-2.2 dBPrTrc

Directivity Summary – 160M

PhaseShift		3dB Beamwidth		RDF
	Peak Az	10° Elev	40° Elev	
0°	0°	45°	53°	10.1 dB
11°	3°	45°	53°	10.1 dB
22°	6°	45°	53°	10 dB
45°	12°	46°	54°	9.9 dB
67.5°	18°	46°	55°	9.7 dB
90°	24°	48°	58°	9.4 dB
112.5°	30°	49°	60°	9.1 dB
135°	36°	52°	63°	8.8 dB

Aim 25º to Europe – 1dB Beamwidth

PhaseShift	35° Elevation		10° Elevation		RDF dB
	North	South	North	South	
0°	10° - 40°		12° - 38°		10.1 dB
11°	7°- 37°	13°- 43°	9°- 36°	14°- 41°	10.1 dB
23°	3°- 34°	16°- 47°	6°- 33°	17°- 43°	10 dB
45°	357°- 28°	22°- 53°	1°- 28°	22°- 49°	9.9 dB
68°	350°- 22°	28°- 60°	355°- 22°	27°- 55°	9.7 dB
90°	344°- 16°	34°- 66°	350°- 17°	33°- 60°	9.4 dB
113°	337°- 10°	40°- 73°	344°- 12°	38°- 66°	9.1 dB
135°	330°- 5°	45°- 80°	337°- 7°	43°- 72°	8.8 dB
158°	323°- 359°	51°- 87°	331°- 2°	48°- 79°	8.4 dB
180°	324°- 356°	57°- 94°	324°- 356°	53°- 86°	8 dB

Observations on 160M Patterns

- **Pattern can be steered**
  - **+/- 18° with loss of only 0.4 dB RDF**
  - **+/- 24° with loss of only 0.7 dB RDF**
  - **+/- 30° with loss of only 1 dB RDF**
- **25° Az array (aimed to EU) can be steered**
  - **7° - 43° Az with loss of only 0.4 dB RDF**
  - **1° - 49° Az with loss of only 0.7 dB RDF**
  - **355° - 55° Az with loss of only 1 dB RDF**

Observations on Patterns

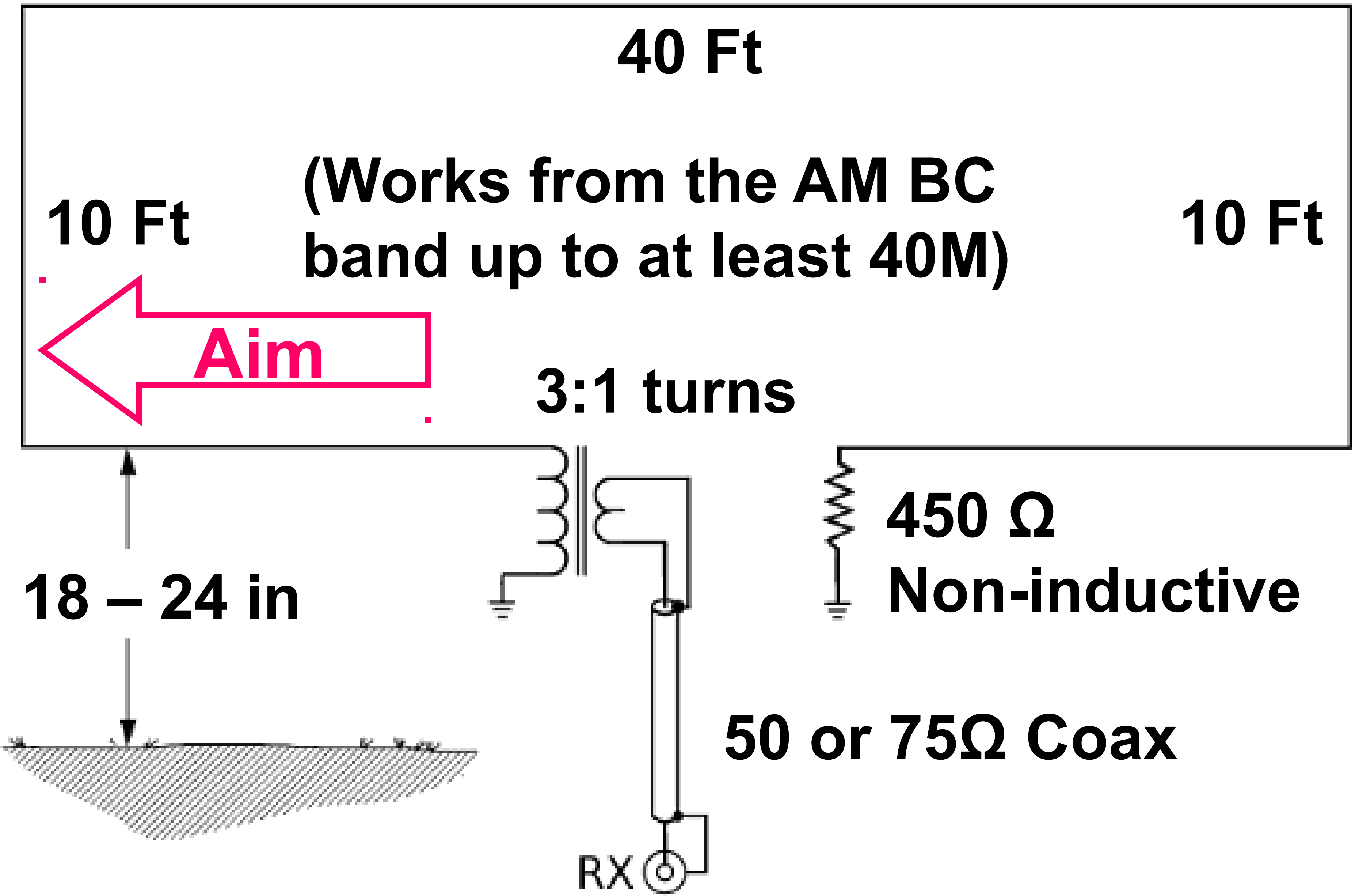
- Except for 0° and 180° phasing, null does not predict location of peaks
- For all other phasing, nulls move around with elevation, in some cases a lot
- For all other phasing, peaks move a few degrees with elevation, and are closer to centerline at low elevation
- These plots suggest that it may be possible to null many directions with little loss of a desired signal

The Importance of Nulls

- **Serious contesters who have operated from stations with antennas that can be steered report that nulls can be more important than peaking the desired signal**

Building the Antenna

VE3DO Loop Optimized For 160M



Rigging to Trees

- We used #14 solid THHN (house wire) for mechanical strength
- Place small insulators at the corners, held in place with Ty-Wraps
- I have a lot of land and a LOT trees, so it was possible to find a pair at each location with the right azimuth and spacing to support the loops
- We used 1/8-in or 3/16-in Synthetic Textiles antenna rope

Construction Notes

- **We mounted screw-in hooks in the trees at the 14 ft and 2 ft level (wire will sag a bit)**
- **A small pulley is rigged to each of the 14 ft high hooks**
- **Top rope goes through pulley to top insulator on both sides, is tied off at lower hook, tensioned to hold top wire flat**
- **Lower wire also tensioned to hold lower wire straight**

Making Your Own Supports

- Cut $^{1}/_{4}$-in – $^{1}/_{2}$-in rebar into 4 ft lengths
- Drive rebar 2-3 ft into ground
- For each loop, buy three 10 ft lengths of 1-in or larger PVC conduit
- Cut one into two 4 ft lengths
- Combine 10 ft and 4 ft pieces
- Drill two $^{1}/_{4}$-in holes near top of each pole

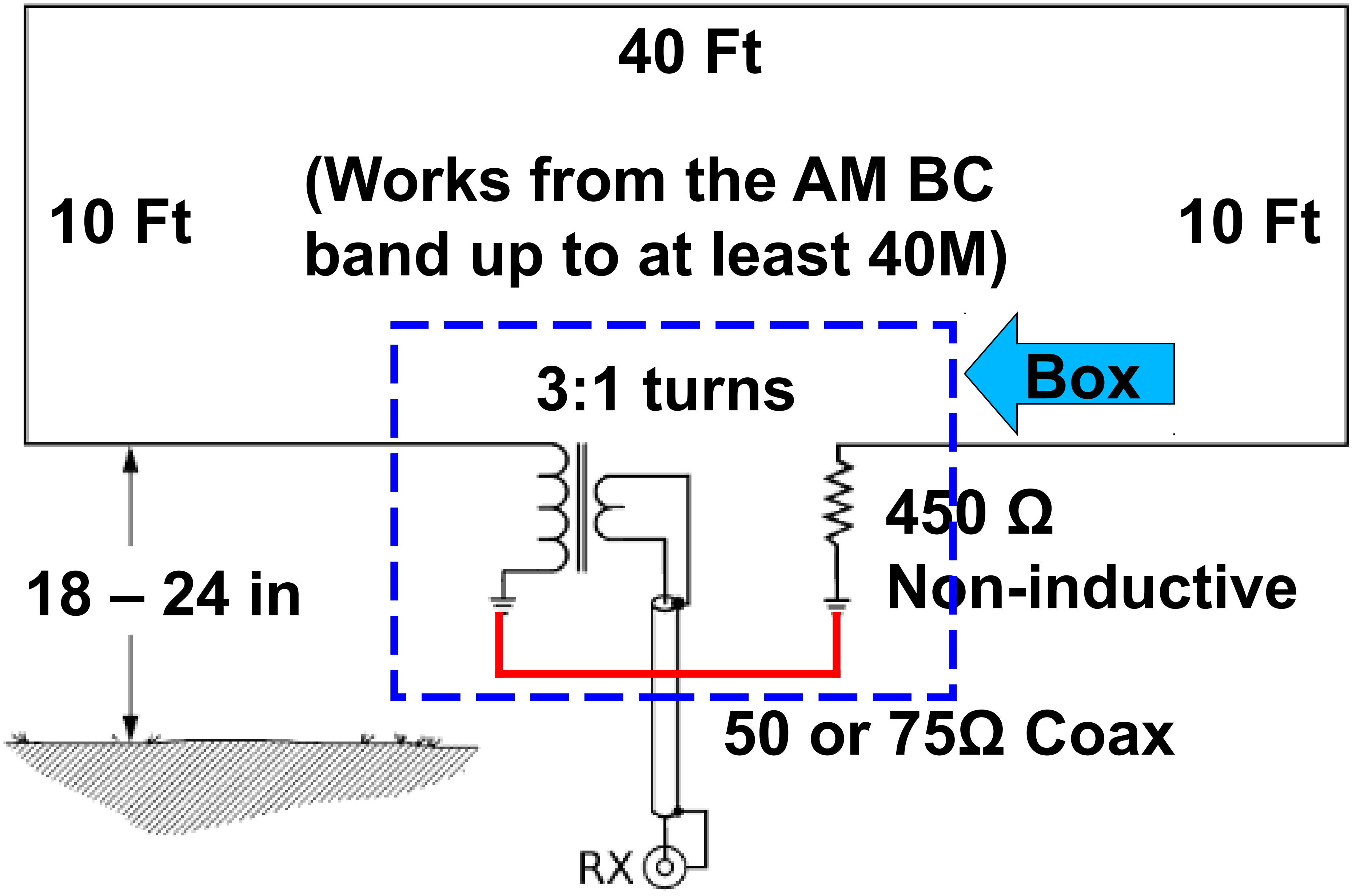
Making Your Own Supports

- Slide PVC over rebar to anchor base
- Use top hole for support rope, the other for guys to pull against antenna
- Anchor guys to suitable ground stakes or other available tie points

Feedpoint Box

- Put transformer and 450Ω resistor in a plastic weatherproof electrical box
- Coax connects only to transformer secondary, not to ground
- Tie transformer ground and resistor ground together
- Three outside connections
  - The center of the lower wires
  - Ground

VE3DO Loop Optimized For 160M



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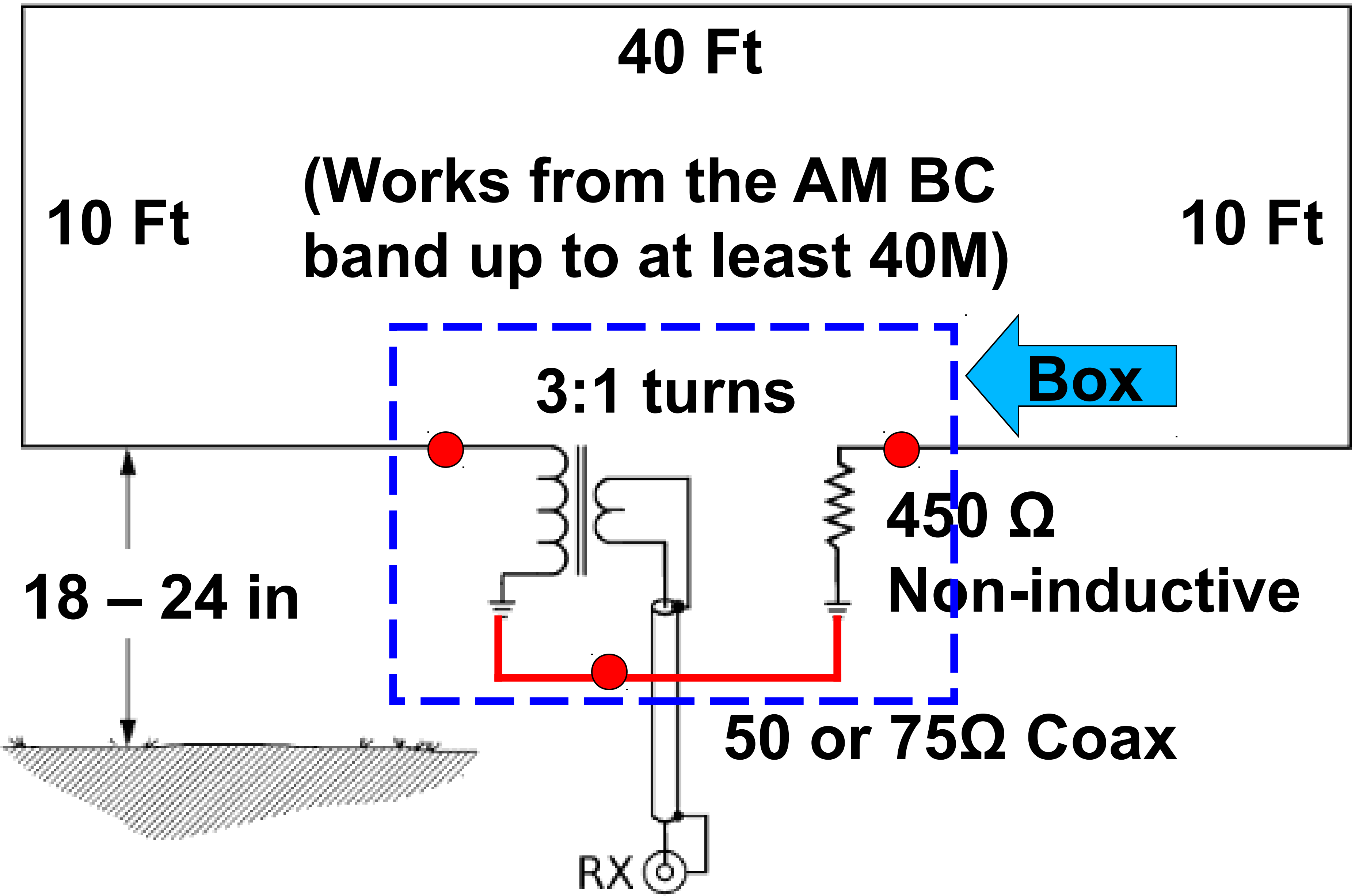
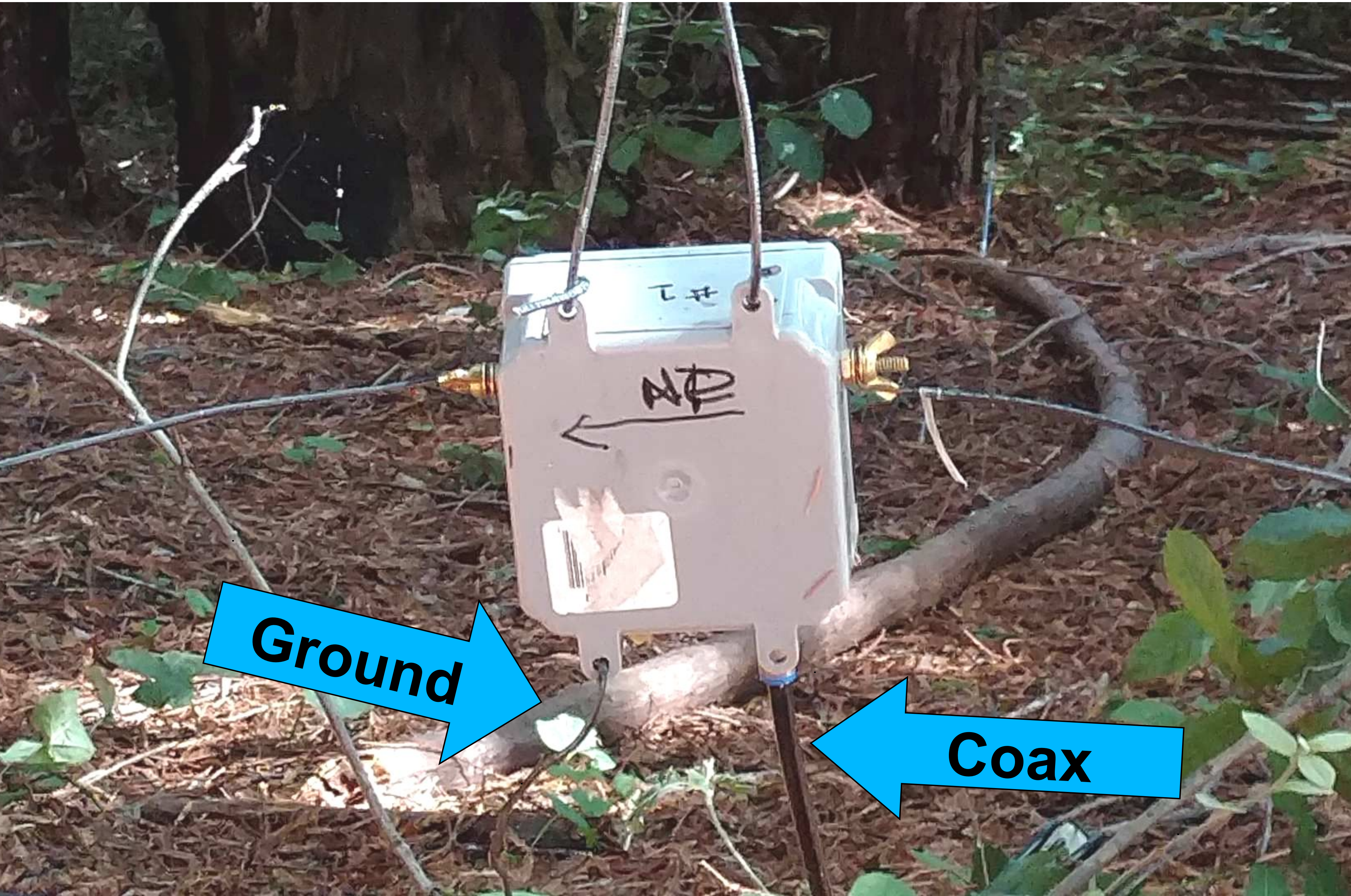
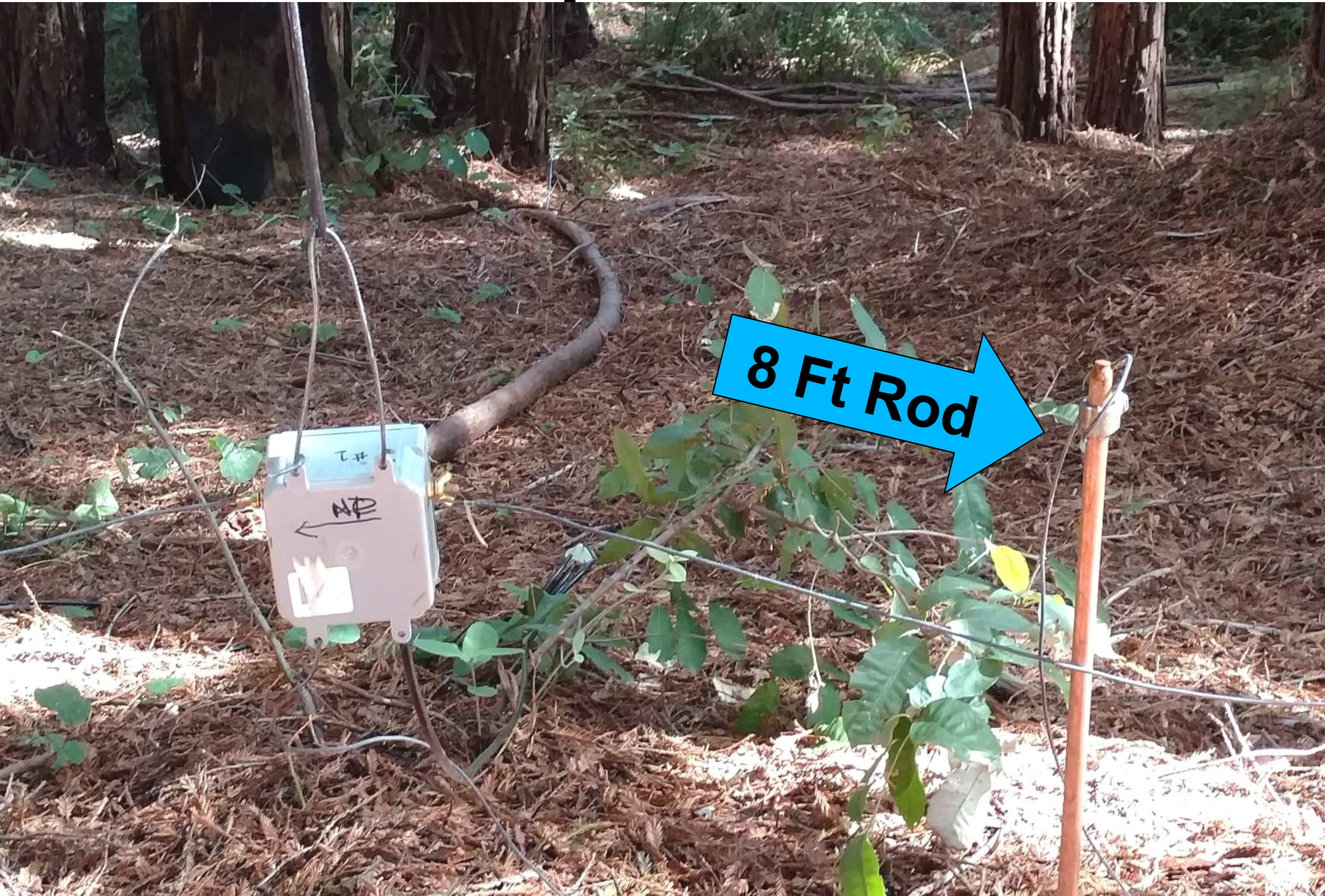


Feedpoint Box



Feedpoint Box

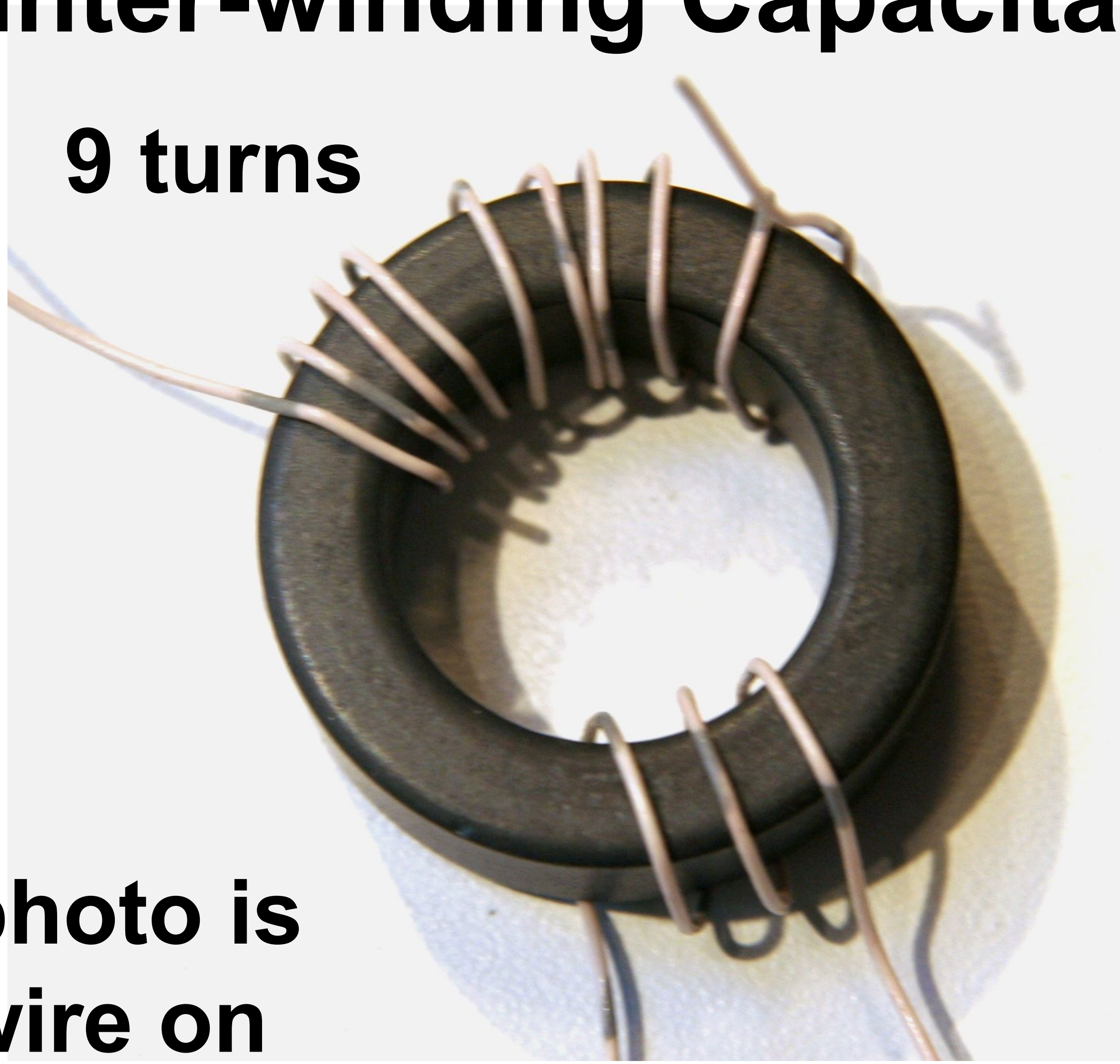


The Transformer

- Minimize inter-winding capacitance to minimize noise coupling from the coax
- Do <u>not</u> wind bifilar
- Almost any ferrite core will work
- Small diameter wire works fine
- I used 12:4 turns of one conductor of CAT5 (#24) on a #43 core
- Turns ratio is not critical

Transformer Wound To Minimize Inter-winding Capacitance

9 turns



This photo is #24 wire on 1-in o.d core

3 turns

The Resistor

- Use a non-inductive resistor
- DX Engineering sells non-inductive 470Ω 2W resistors intended for terminating Beverage antennas
- The power rating minimizes the chance of damage from nearby lightning

Preamp Likely Required

- **This output voltage from these loops is fairly low, so a preamp is likely required**
- **Preamps can be in the shack**
- **If a phasing unit is used, preamps should be between the loops and the phasing unit for best signal to noise**

Locating and Aiming The Array

- Careful aiming matters because the main lobe is pretty narrow
- A good compass helps for orientation
  - Remember to take magnetic declination into account

Locating and Aiming The Array

- **A good GPS that does averaging and saves waypoints helps set locations when terrain or foliage makes visual sighting or measurement with a tape difficult**
- **I use a 2004 vintage Garmin 60CX GPS**

A Very Good GPS Option

- Has waypoints, averaging
- High sensitivity, so works in dense foliage
- Uses 2-AA batteries
- Discontinued, reviews say newer models not as good
- Special cell phone apps may be good enough

Locating Loops for the Array

- Google Earth can be a good start
- Find a promising location on your property for one loop, then use the Ruler to draw a 5/8λ line (or whatever spacing you can fit) at 90º from the aim azimuth
- Set Google Earth lat/lon unit format for one your GPS can also use
- Save the line, record lat/lon coordinates of both ends

Locating Loops in the Field

- **Go to one location with GPS and compass, look for supports**
- **When a location looks good, average the GPS reading for high precision and save it as a waypoint**
- **Leave a marker at that point, then go to the second location**
- **Set the GPS to navigate to the first location**

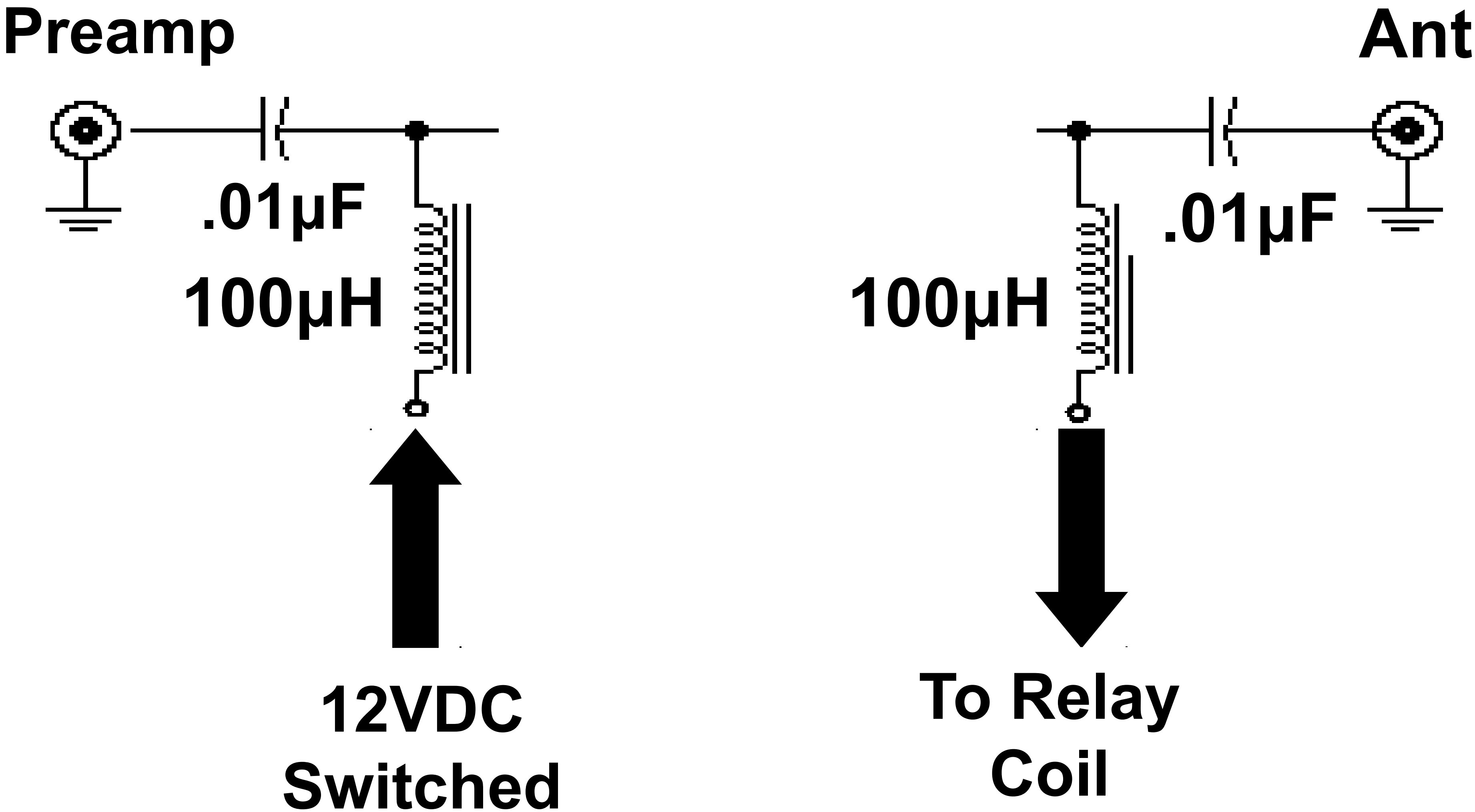
Locating Loops in the Field

- Verify that you’re in the right place by observing distance and azimuth to the first point, then look for supports
- Average the GPS reading at the second location for good accuracy and save it as a waypoint
- Be prepared to move either loop to find supports for both, to avoid obstacles, and to avoid long conductors near either loop (fences, long wires)

Reversing the Pattern

- It’s easy to reverse the loops so that they can steer to ZL and VK
- Add a 12V DPDT relay to exchange the two bottom wires inside the box
- Power the relay with a simple injection circuit that puts 12VDC on the coax through a suitable inductor
- Connect the relay coil through an inductor
- Add caps to DC-block antenna and pre-amp

Powering The Relay



Coax For Receive Antennas

- Commscope F660BEF Flooded RG6
  - $95/1,000 ft at Phat Satellite
    - eBay, Amazon
- Be careful with bending radius
  - Tight bends can short center to shield
- This cable seems to resist varmints
  - My coax mostly runs on the ground
- Very smooth outer jacket, long runs pull smoothly

Coax For Receive Antennas

- **Pull extra length so you can wind common mode chokes at both ends**
- **Wind at least 7-8 1-ft diameter turns through a "largest #31 clamp-on" (Fair-Rite 0431177081) and tape turns together**
- **This minimizes center to shield shorts and lowers the resonant frequency of the choke**

Beam Steering

- **Start with equal lengths of coax to the two antennas**
  - **If coax to one antenna is shorter, add enough coax to make them equal**
- **Vary the phase between antennas**
- **Vary coax length**
- **Introduce phase shift electronically (noise cancellers)**
  - **DX Engineering NCC-1, NCC-2 (great!)**
  - **MFJ 1026 (OK)**
  - **TimeWave ANC-4 (better than nothing)**

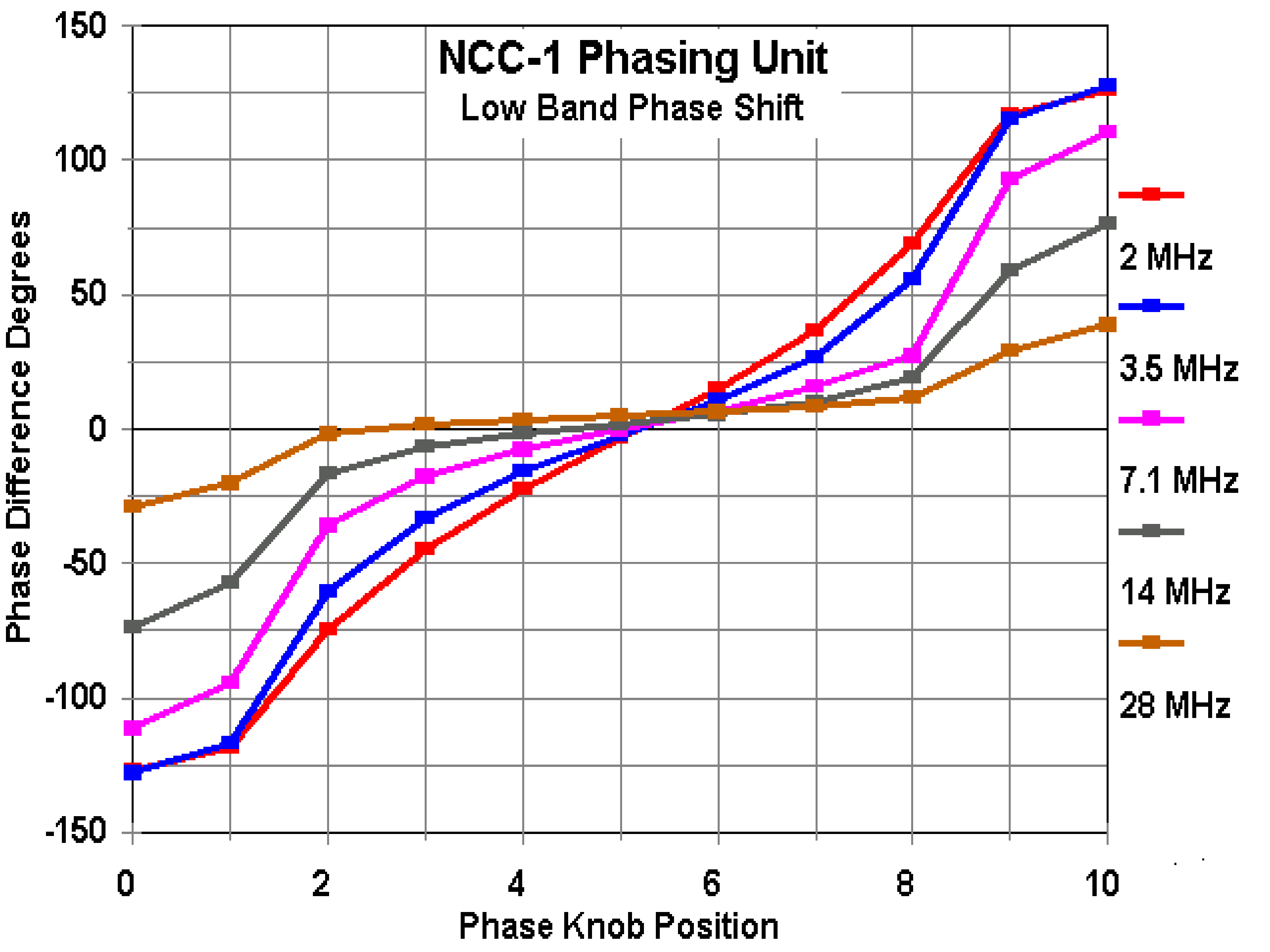
Noise Cancellation

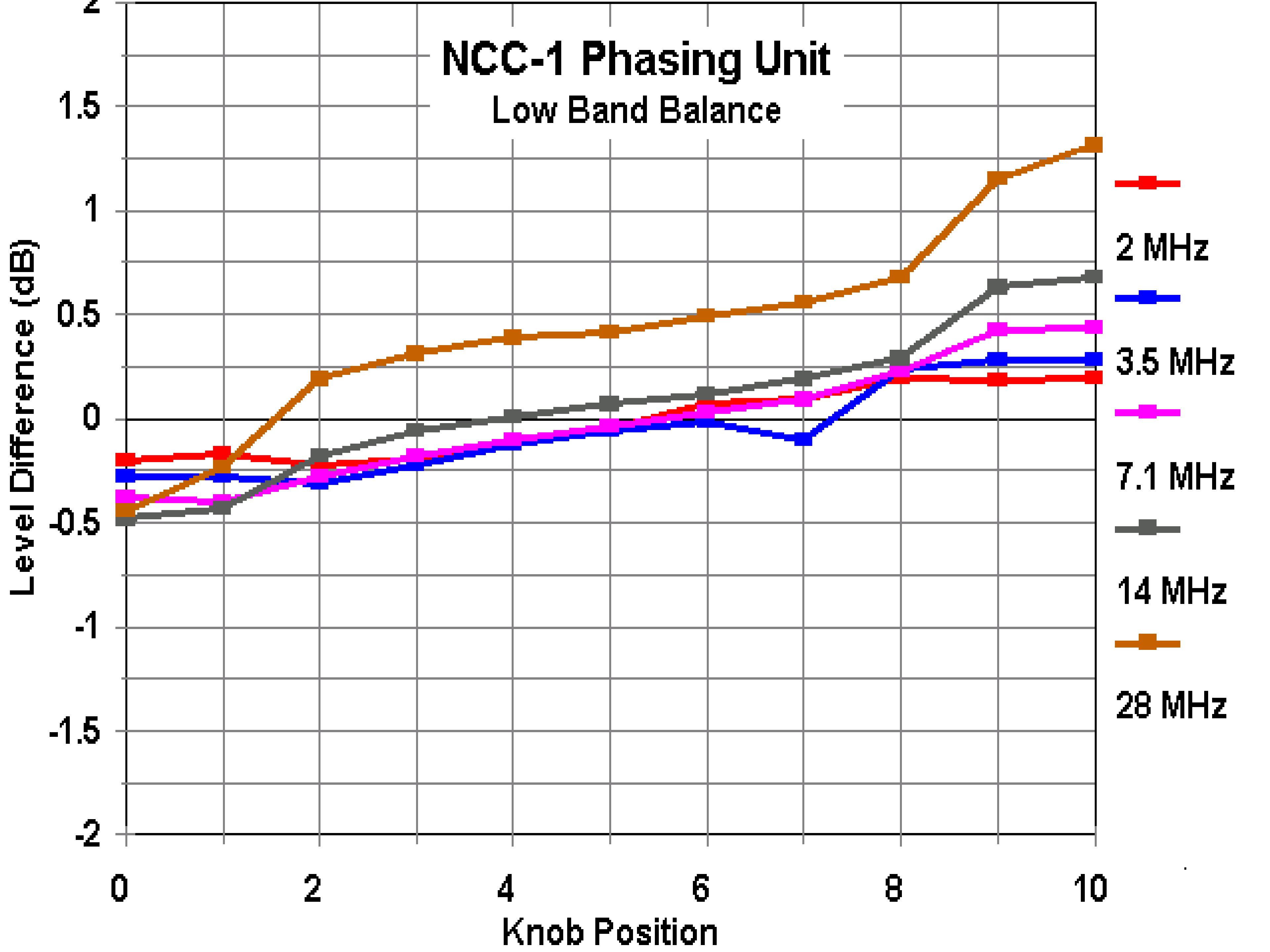
- **Cheap** noise cancellers vary the strength while varying the phase, making them difficult to tune
  - TimeWave ANC-4 (better than nothing)
  - MFJ 1026 (Reviews say OK)
- **Great** noise cancellers hold strength constant while varying the phase
- You get what you pay for!
  - DX Engineering NCC-1, NCC-2 (great!)
  - Not cheap ($750)

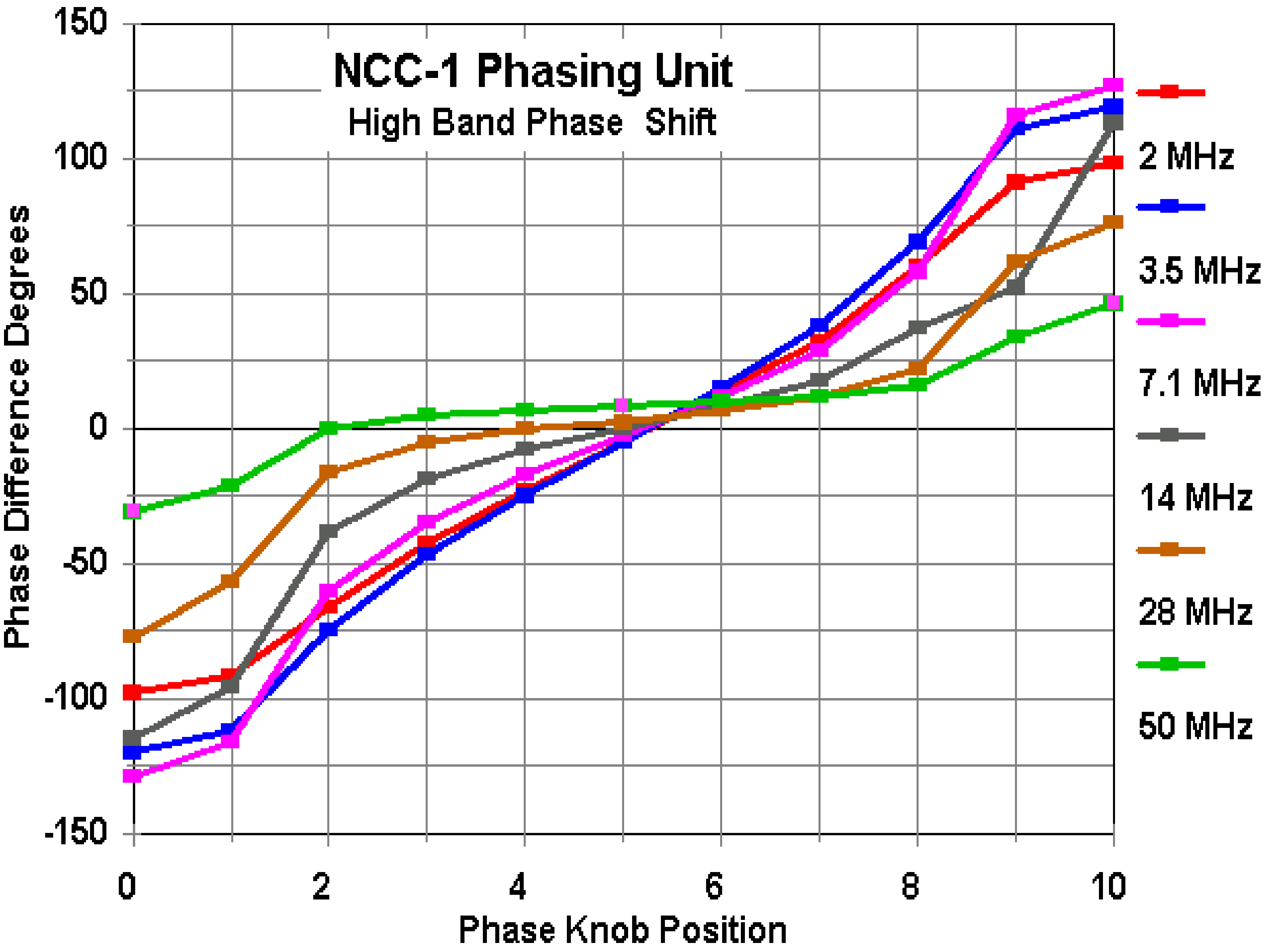
NCC-1 Phasing Unit

NCC-1 Phasing Unit

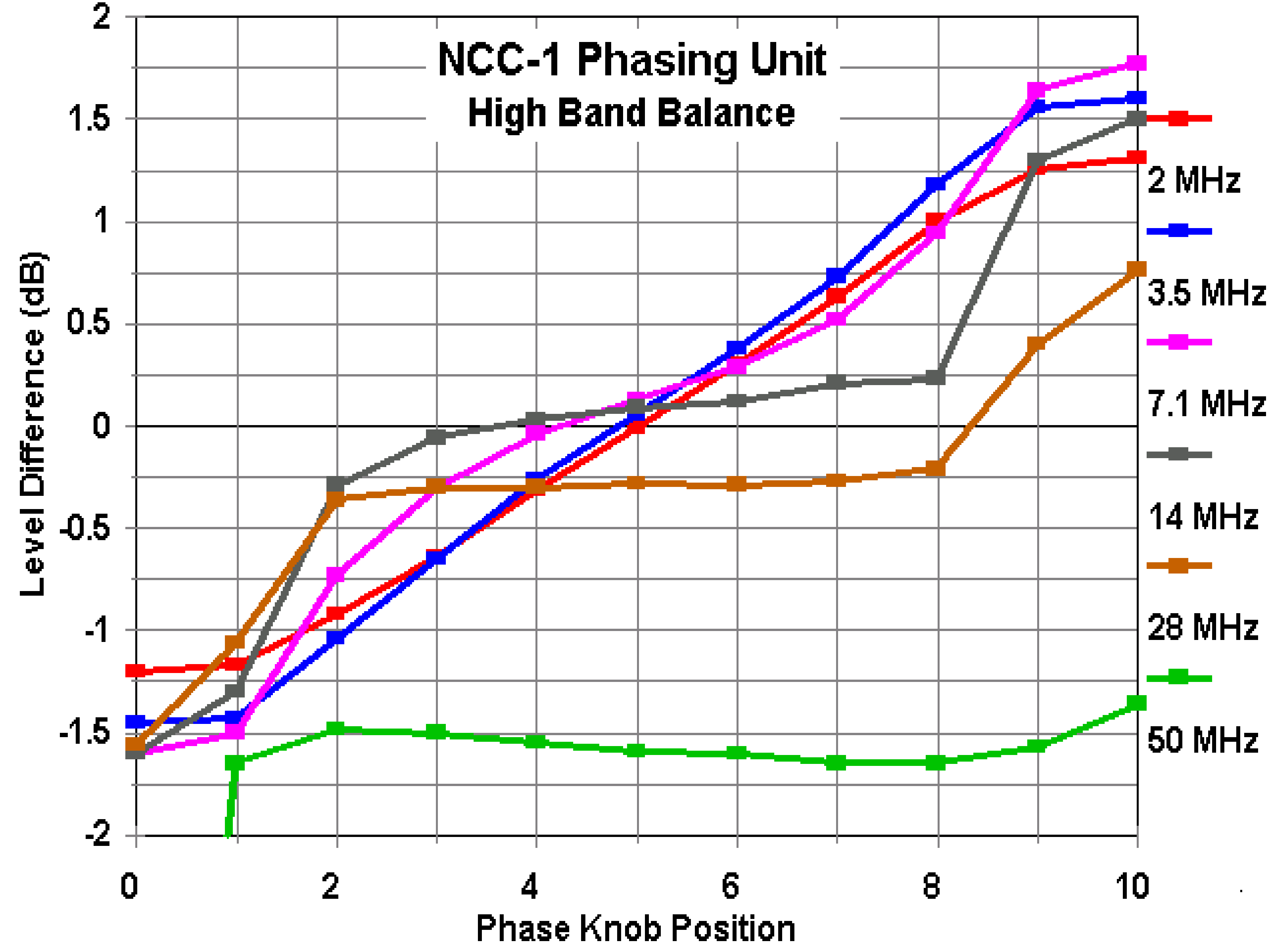
- Phase continuously adjustable +/- 125º
- Balance continuously adjustable
- Polarity reverse switch
- Input step attenuators 10, 20, 30 dB
- Makes steering and nulling easy and fast
- Replaced by NCC-2
  - Includes T-R relay so TX antenna can be one of the phased antennas
  - Same price and features


NCC-1 Phasing Unit
Low Band Phase Shift
Phase Difference Degrees
Phase Knob Position
150
100
50
0
-50
-100
-150
0
2
4
6
8
10
2 MHz
3.5 MHz
7.1 MHz
14 MHz
28 MHz


NCC-1 Phasing Unit
Low Band Balance
Level Difference (dB)
Knob Position
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
0
2
4
6
8
10
2 MHz
3.5 MHz
7.1 MHz
14 MHz
28 MHz



NCC-1 Phasing Unit
High Band Phase Shift
Phase Difference Degrees
150
100
50
0
-50
-100
-150
0
2
4
6
8
10
Phase Knob Position
2 MHz
3.5 MHz
7.1 MHz
14 MHz
28 MHz
50 MHz


NCC-1 Phasing Unit
High Band Balance
Level Difference (dB)
Phase Knob Position
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
0
2
4
6
8
10
2 MHz
3.5 MHz
7.1 MHz
14 MHz
28 MHz
50 MHz

NCC-1 on the Lower Bands

- **Very well behaved 160M – 40M**
  - **Level match +/- 0.2 dB on 160 over full range of Phase control, +/- 0.3 dB on 80M, +/- 0.4 dB on 40M**
  - **Phase adjustment +/- 125° on 160 and 80M, +/- 112° on 40M, slope of curve is well behaved**
  - **Should be used with the Low band setting on these bands**
- **Nearly constant level match makes nulling much easier than cheap units**

NCC-1 Above 40M

- **<u>Much</u> <u>less</u> well behaved**
- **Most of the phase shift occurs near limits of the phase knob**
- **Variation in level match makes nulling much more difficult**
- **I haven't tried or studied it on 30M**
- **I don't recommend it above 30M**

Array Optimized for 80M

- 5/8λ spacing is about 173 ft on 80M
- 80M patterns will look like the 160M spacing on 160M
- 40M patterns will look like the 160M spacing on 80M

Using the 160M Array on 80M

- The following polar plots and table are for the 160M design
  - Built with 5/8λ spacing for 160M (337 ft)
  - Aimed to Europe (25º)
- I chose 25º because EU is my most difficult direction
- Note differences in patterns between 10º (red curve) and 44º (black curve)

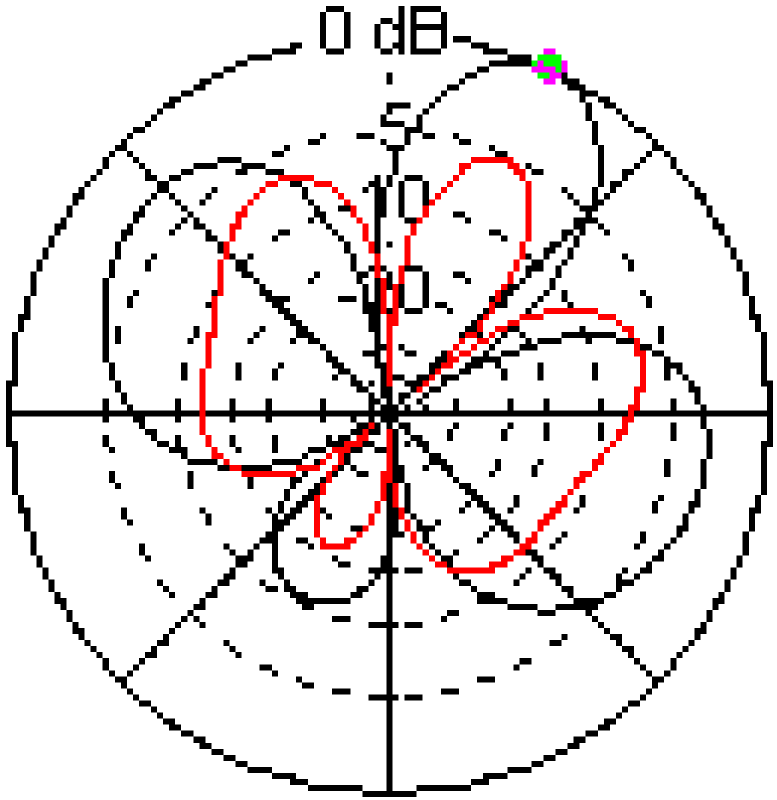
80M Horizontal Pattern – Aim 25° Az

Total Field

EZNEC Pro/2

* **Primary**

VE3DO-80-0-10



44° Elev

10° Elev

No Phase Shift

Azimuth Plot		Cursor Az	65.0 deg.
Elevation Angle	44.0 deg.	Gain	-13.81 dBi
Outer Ring	-13.81 dBi		0.0 dBmax
			-0.01 dBmax3D

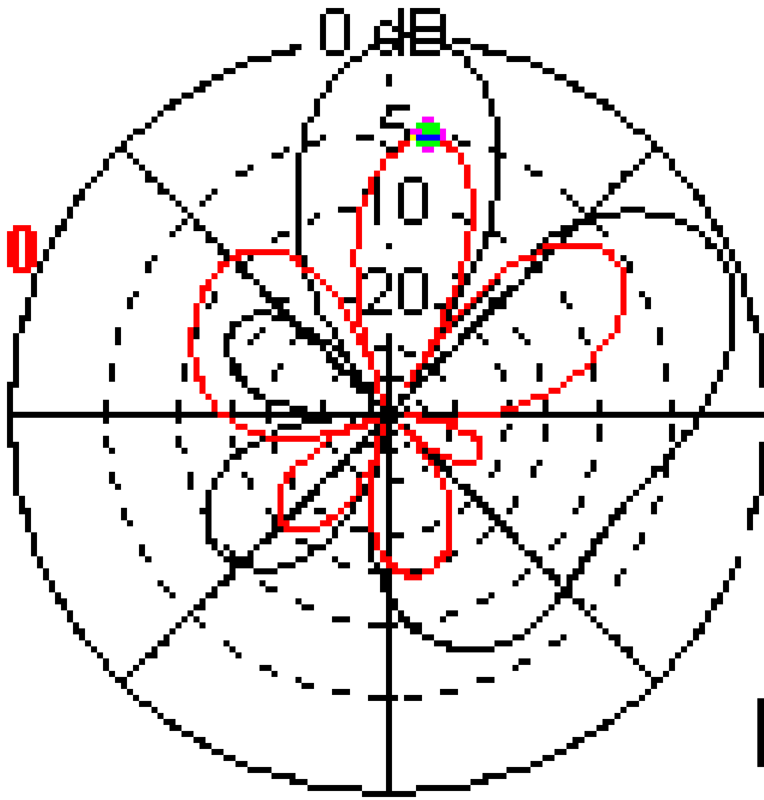
80M Horizontal Pattern – Aim 9° Az

Total Field

EZNEC Pro/2

Primary

* VE3DO-80+125-10



44° Elev

10° Elev

+ 125° Phase Shift

Azimuth Plot		Cursor Az	
Elevation Angle	10.0 deg.	Gain	-19.19 dBi
Outer Ring	-14.03 dBi		0.0 dBmax
			-4.91 dBPrTrc

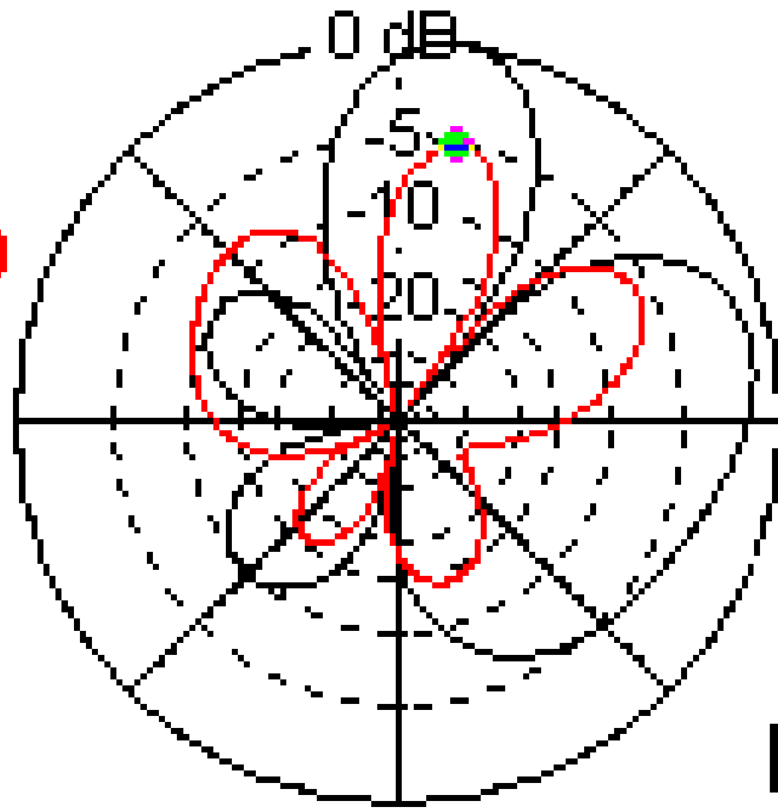
80M Horizontal Pattern – Aim 13° Az

Total Field

EZNEC Pro/2

Primary

* VE3DO-80+90-10



44° Elev

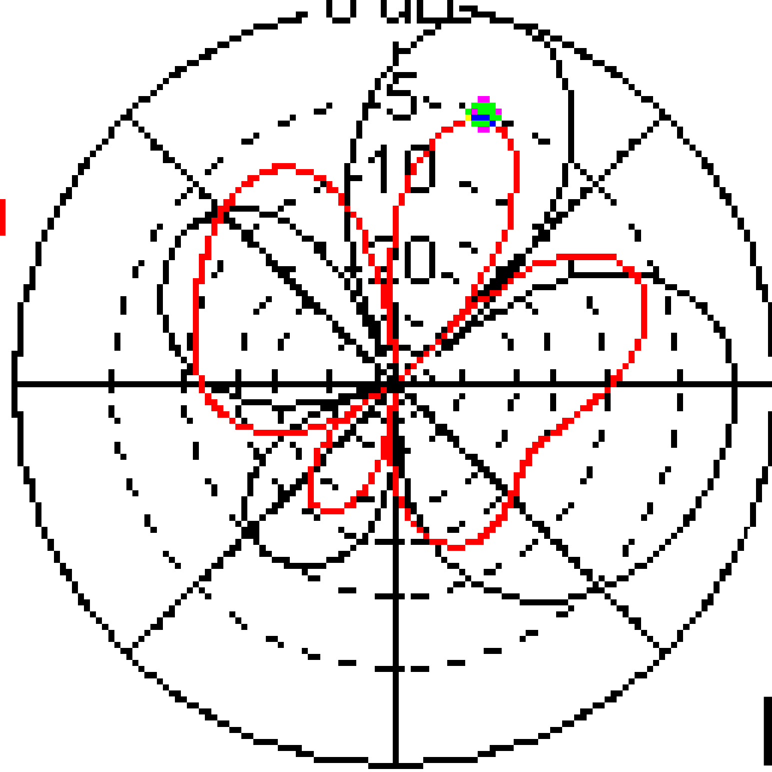
10° Elev

+ 90° Phase Shift

Azimuth Plot		Cursor Az	
Elevation Angle	10.0 deg.	Gain	-19.14 dBi
Outer Ring	-13.9 dBi		0.0 dBmax
			-5.1 dBPrTrc

80M Horizontal Pattern – Aim 19° Az

Total Field



EZNEC Pro/2

Primary

* VE3DO-80+45-10

44° Elev

10° Elev

+ 45° Phase Shift

Azimuth Plot		Cursor Az	–
Elevation Angle	10.0 deg.	Gain	-19.09 dBi
Outer Ring	-13.83 dBi		0.0 dBmax
			-5.22 dBPrTrc

80M Horizontal Pattern – Aim 25° Az

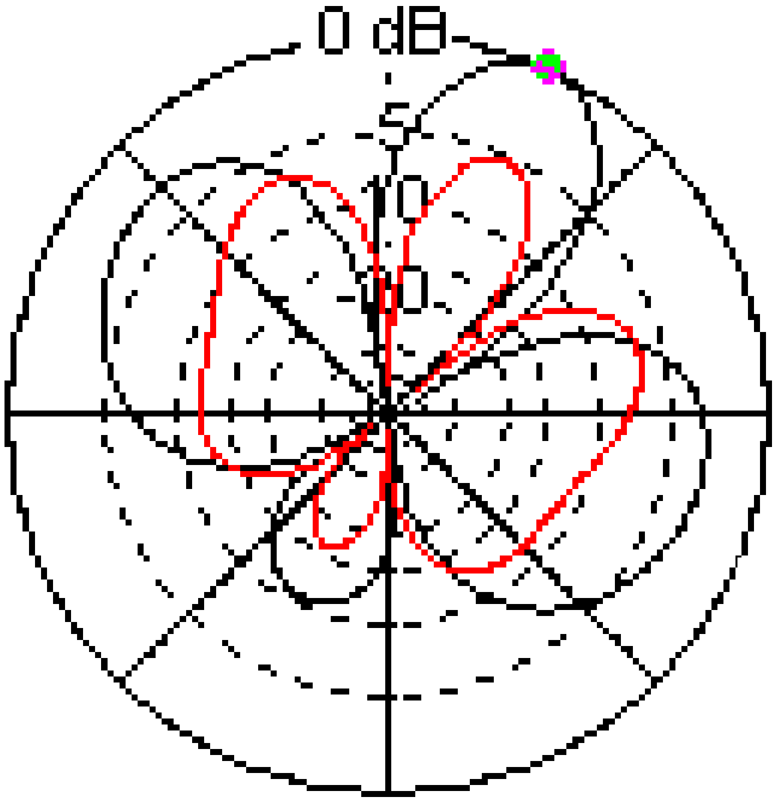
Total Field

*** Primary**

VE3DO-80-0-10

44° Elev

10° Elev



No Phase Shift

Azimuth Plot		Cursor Az	65.0 deg.
Elevation Angle	44.0 deg.	Gain	-13.81 dBi
Outer Ring	-13.81 dBi		0.0 dBmax
			-0.01 dBmax3D

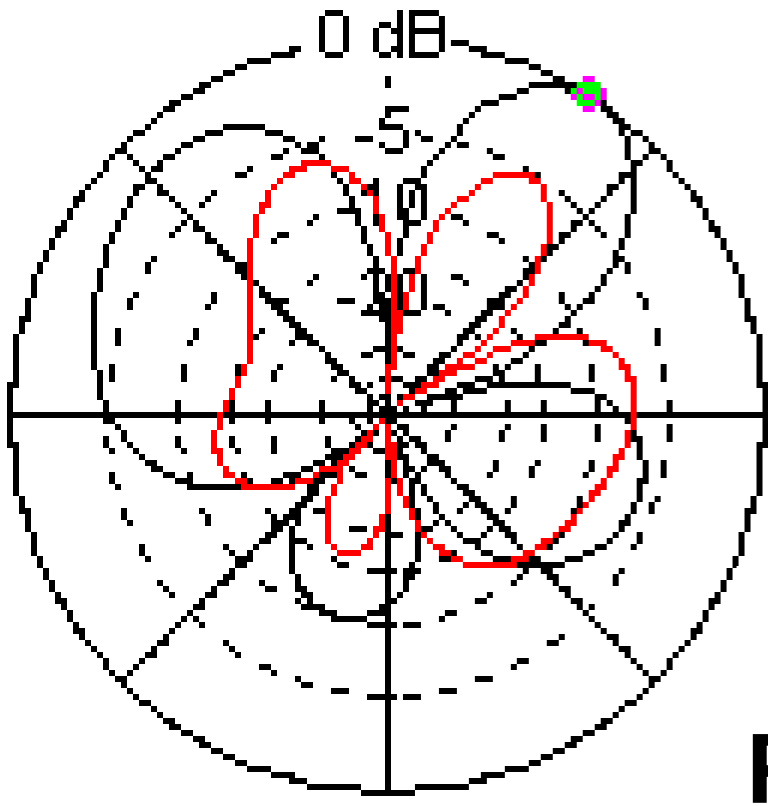
80M Horizontal Pattern – Aim 29° Az

Total Field

EZNEC Pro/2

*** Primary**

VE3DO-80--45-10



44° Elev

10° Elev

- 45° Phase Shift

Azimuth Plot		Cursor Az	
Elevation Angle	46.0 deg.	Gain	-13.83 dBi
Outer Ring	-13.83 dBi		0.0 dBmax
			0.0 dBmax3D

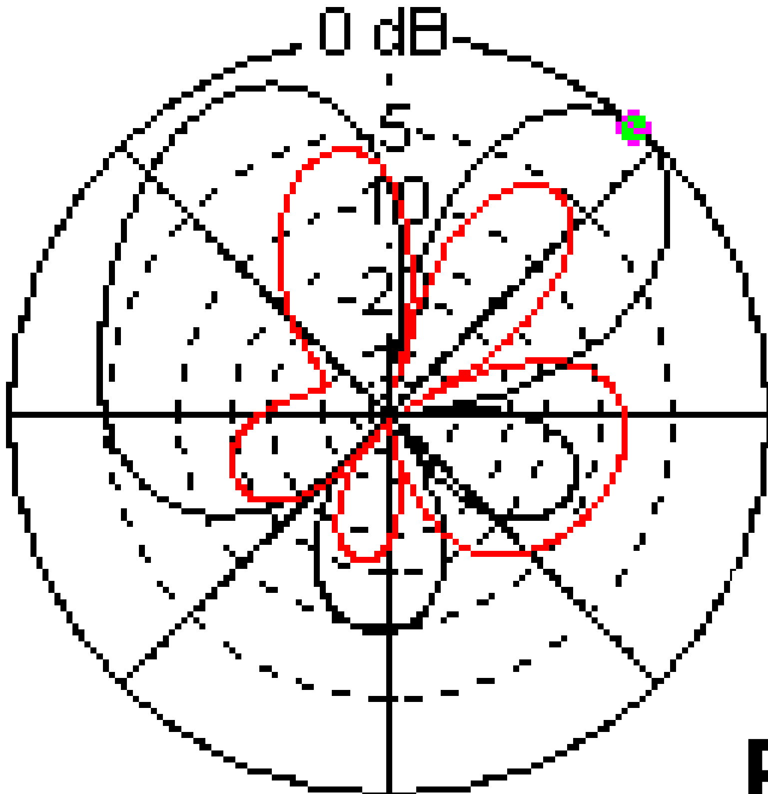
80M Horizontal Pattern – Aim 37° Az

Total Field

EZNEC Pro/2

*** Primary**

VE3DO-80--90-10



44° Elev

10° Elev

- 90° Phase Shift

Azimuth Plot		Cursor Az	
Elevation Angle	45.0 deg.	Gain	-13.89 dBi
Outer Ring	-13.89 dBi		0.0 dBmax
			0.0 dBmax3D

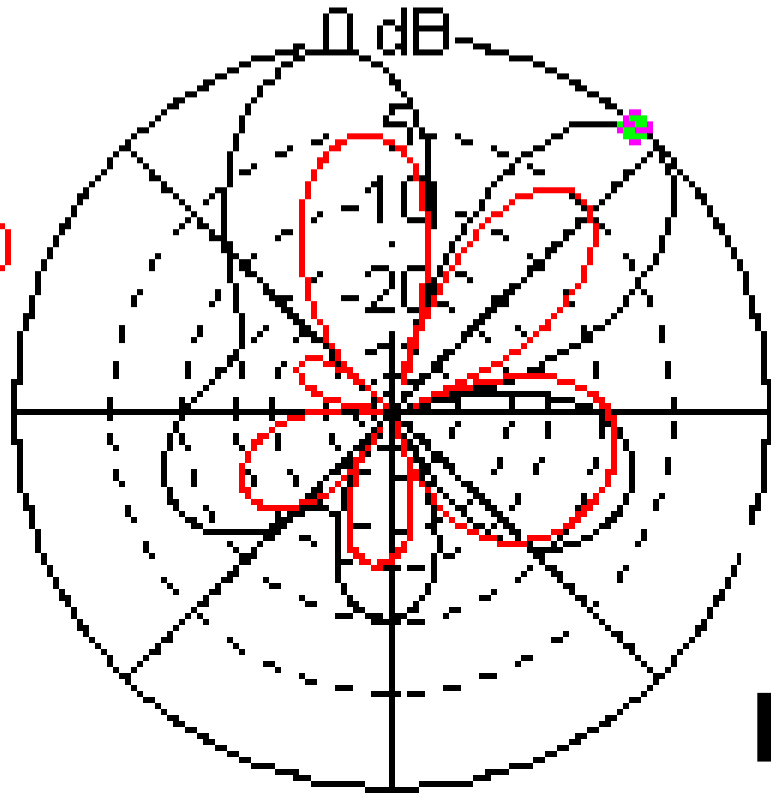
80M Horizontal Pattern – Aim 41° Az

Total Field

EZNEC Pro/2

* Primary

VE3DO-80--125-10



44° Elev

10° Elev

- 125° Phase Shift

Azimuth Plot		Cursor Az	
Elevation Angle	31.0 deg.	Gain	-14.54 dBi
Outer Ring	-14.44 dBi		-0.1 dBmax
			-0.56 dBmax3D

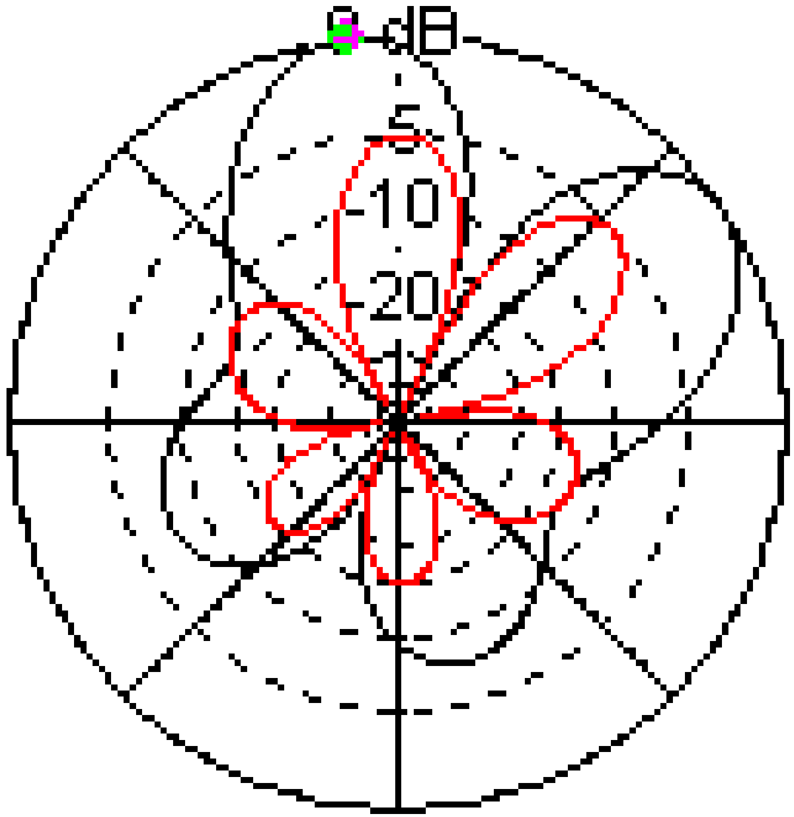
80M Pattern – Aim 0° Az and 47° Az

Total Field

EZNEC Pro/2

*** Primary**

VE3DO-80-180-10



44° Elev

10° Elev

180° Phase Shift

Azimuth Plot		Cursor Az	
Elevation Angle	43.0 deg.	Gain	-14.18 dBi
Outer Ring	-14.18 dBi		0.0 dBmax
			0.0 dBmax3D

Directivity – 160M Array on 80M

PhaseShift	Peak Azimuth @ 10° Elevation		1 dB Beamwidth @ 10° Elevation		RDF@ 40°
			Northward	Southward	
0°	25°	25°	12° - 37°		10.86 dB
45°	15°	35°	1° - 28°	22° - 49°	10.7 dB
90°	5°	45°	350° - 17°	33° - 60°	10.2 dB
125°	354°	56°	337° - 7°	43° - 73°	9.2 dB
180°	343°	67°	324° - 356°	54° - 86°	8.6 dB

Pretty Wild Patterns!

- But we can tune them by ear to peak the signal(s) we want and sometimes null noise or QRM
- Listening to a 160M pileup on 3C0L Wednesday night, I could null a strong station calling him and hear another weaker station underneath the stronger one

How I Measured NCC-1

- **VNWA 3e Vector Network Analyzer**
  - **Both Phase switches Normal**
  - **Balance knob centered visually**
  - **Sweep 2 – 50 MHz, set markers for each band**
  - **Swept both inputs for each setting of the Phase Knob**
  - **Put data in spreadsheet, plotted differences in amplitude and phase for each knob setting and each band**

The VE3DO Loop
A Compact, Easy to Build Receiving Antenna for 160M and 80M

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