A Portable Lightweight *Three* Band Antenna for Hill Topping, Portable, or Small Space Use

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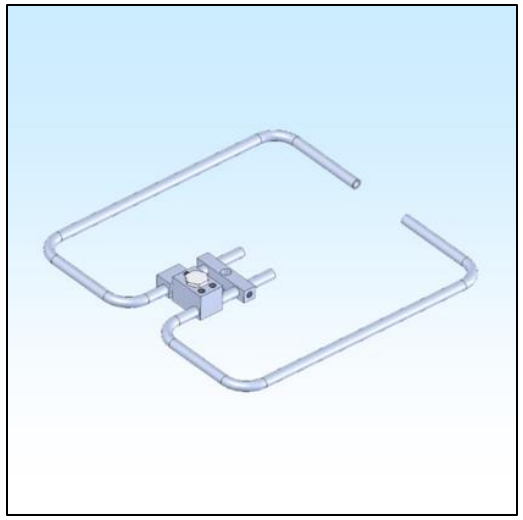
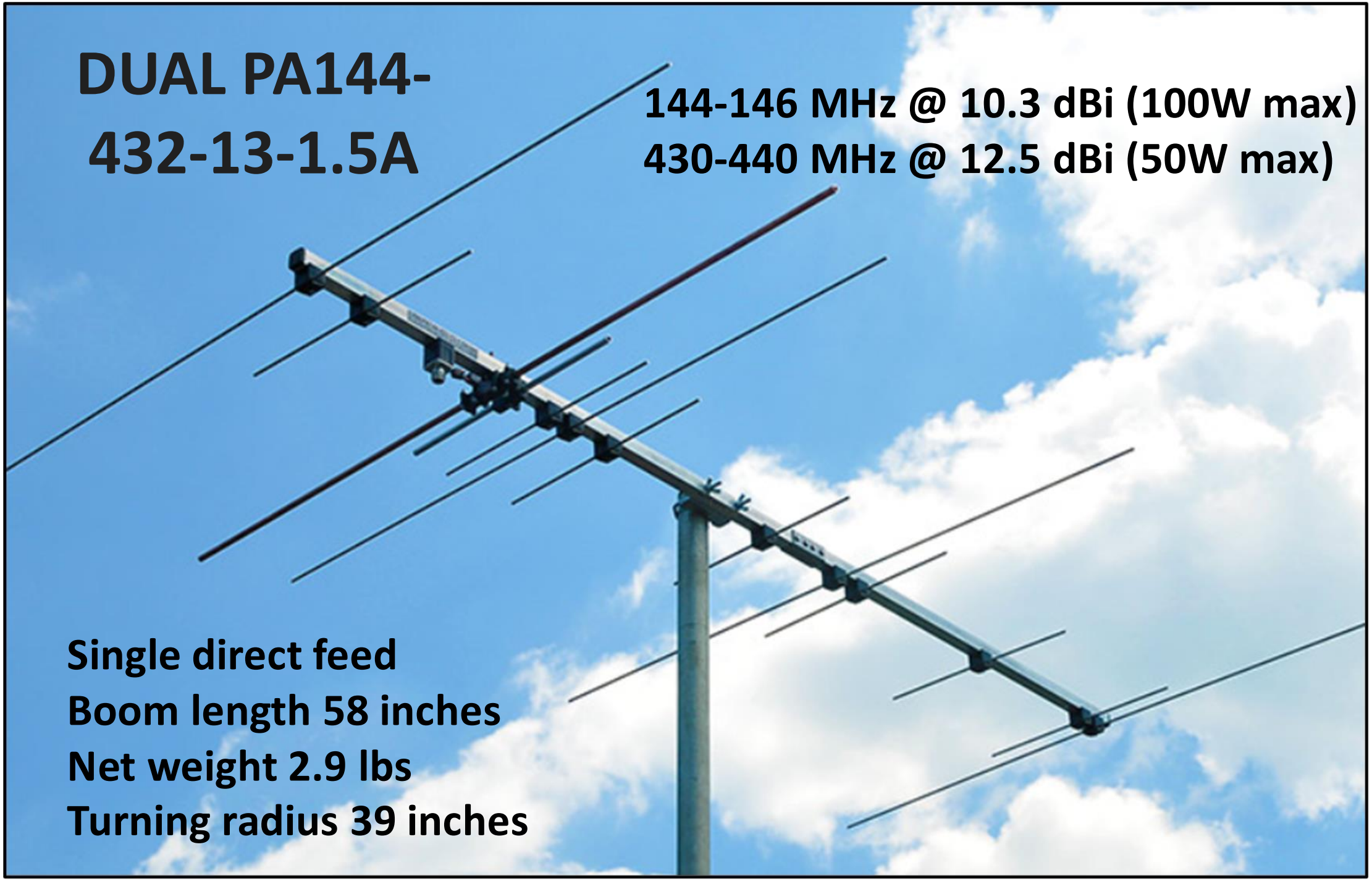
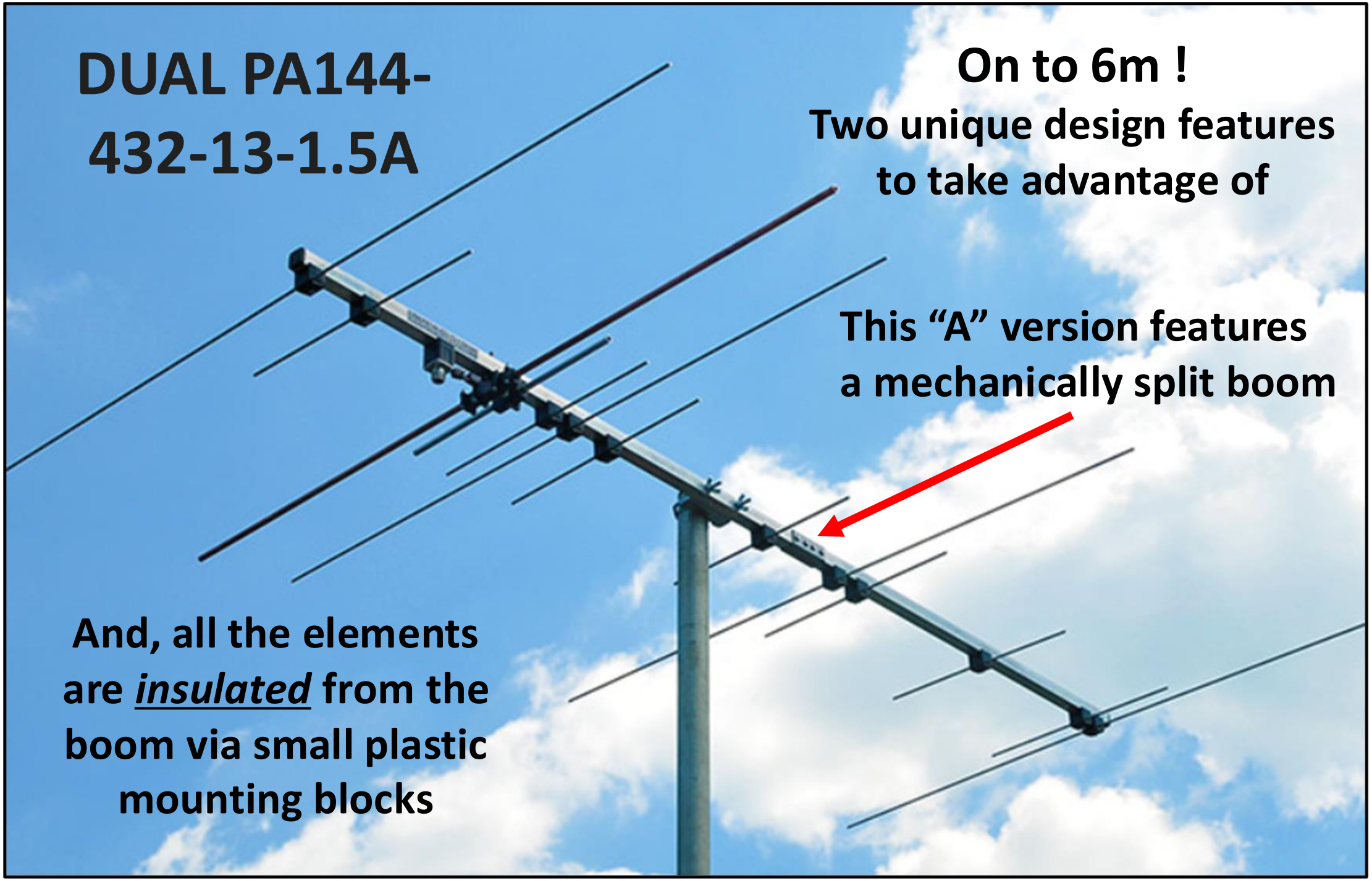
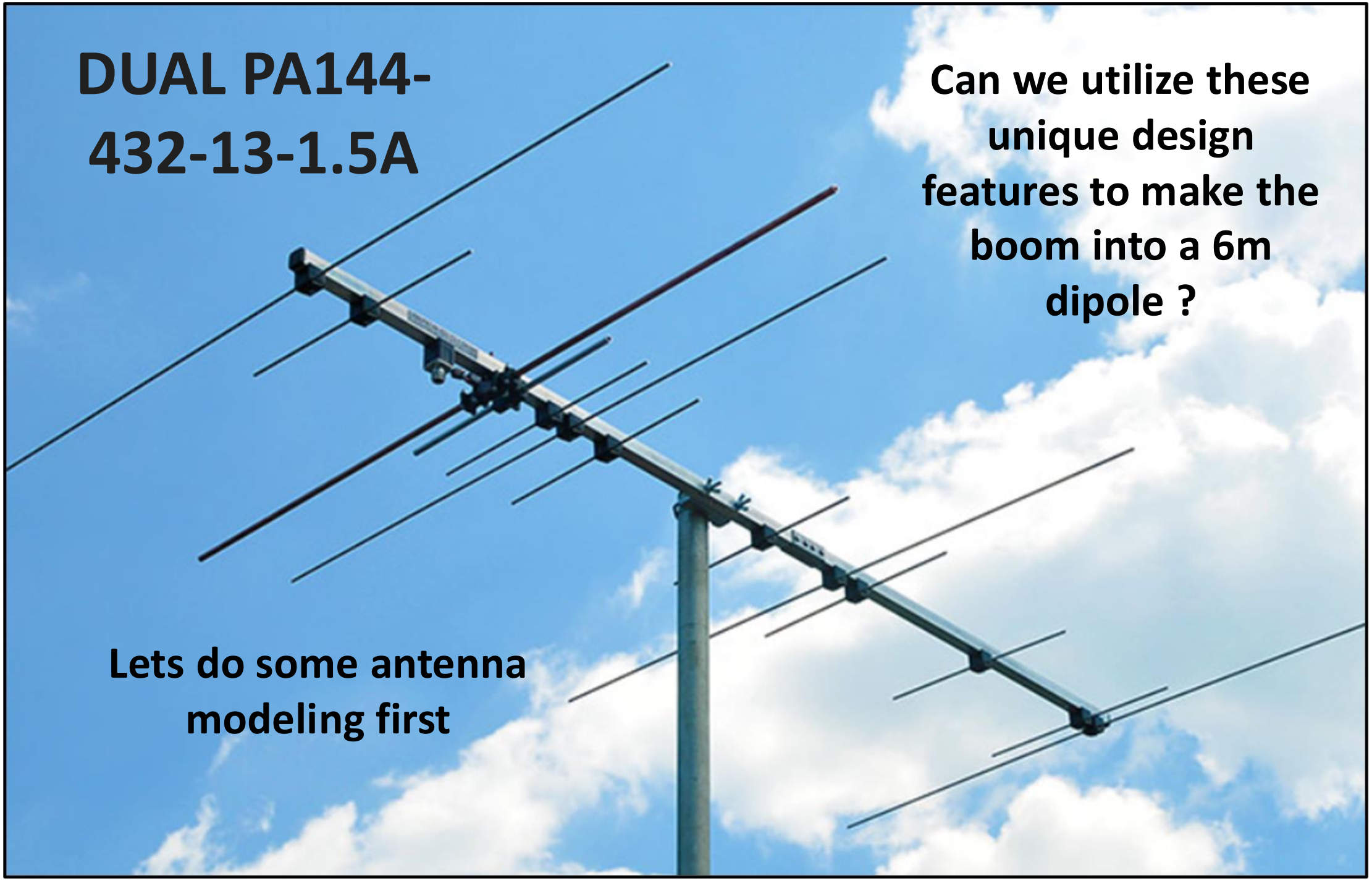
The availability of small portable HF radios with 6m, 2m and 432 MHz capability has enabled portable, Hill Topping, and rover activity. However the challenge remains to find small lightweight *effective* antennas to take with you for all three bands. Also, living in an HOA community brings antenna challenges.

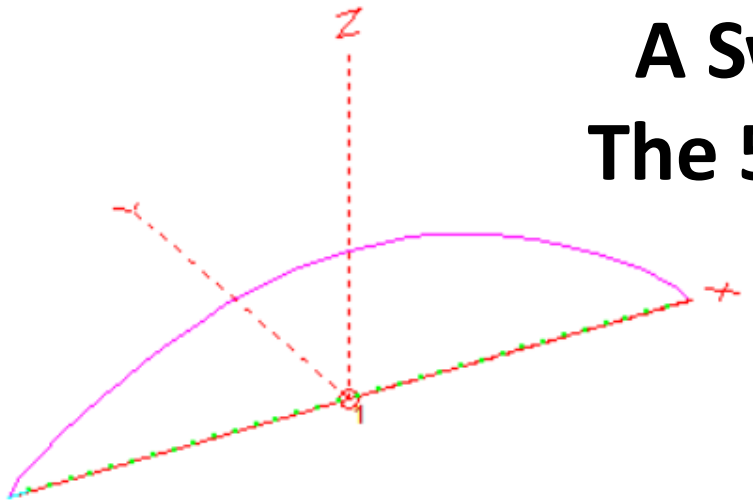



DUAL PA144-
432-13-1.5A
144-146 MHz @ 10.3 dBi (100W max)
430-440 MHz @ 12.5 dBi (50W max)
Single direct feed
Boom length 58 inches
Net weight 2.9 lbs
Turning radius 39 inches

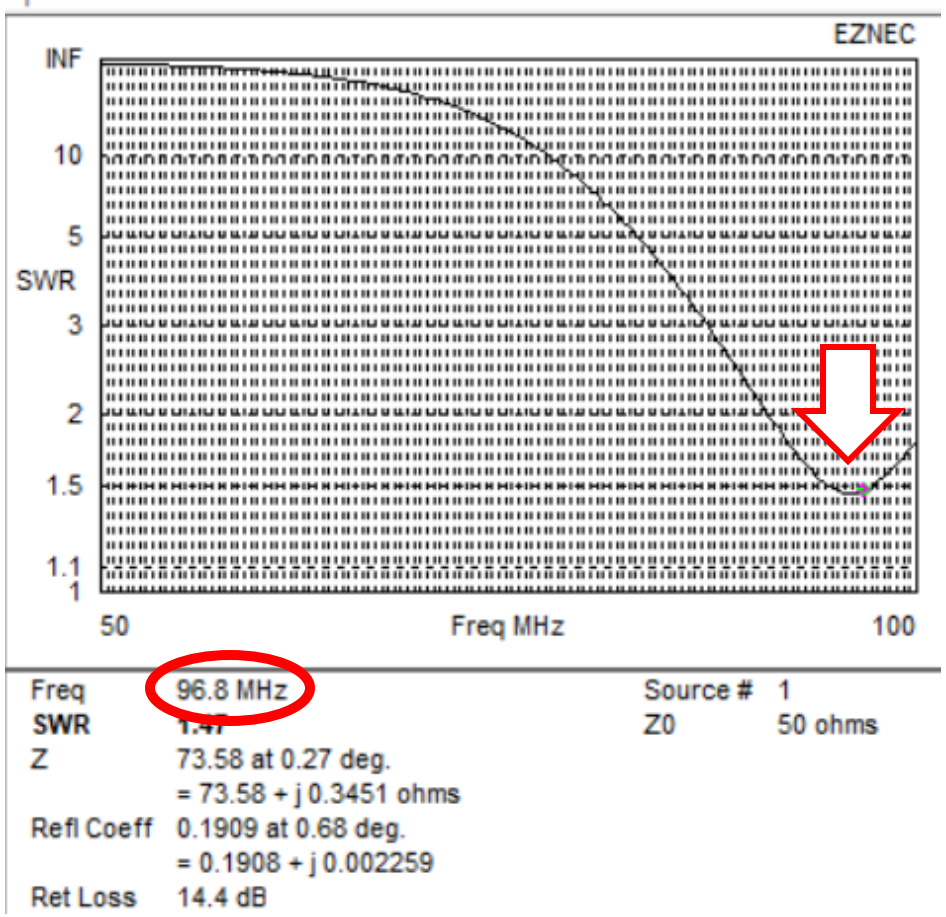

DUAL PA144-
432-13-1.5A
On to 6m !
Two unique design features
to take advantage of
This “A” version features
a mechanically split boom
And, all the elements
are *insulated* from the
boom via small plastic
mounting blocks


DUAL PA144-
432-13-1.5A
Can we utilize these unique design features to make the boom into a 6m dipole ?
Lets do some antenna modeling first

EZNEC



A Sweep Of The 57” Boom



Freq	96.8 MHz	Source #	1
SWR	1.47	Z0	50 ohms
Z	73.58 at 0.27 deg.		
	= 73.58 + j 0.3451 ohms		
Refl Coeff	0.1909 at 0.68 deg.		
	= 0.1908 + j 0.002259		
Ret Loss	14.4 dB		

How do we move the resonate frequency down from 96.8 MHz to 50.2 MHz ?

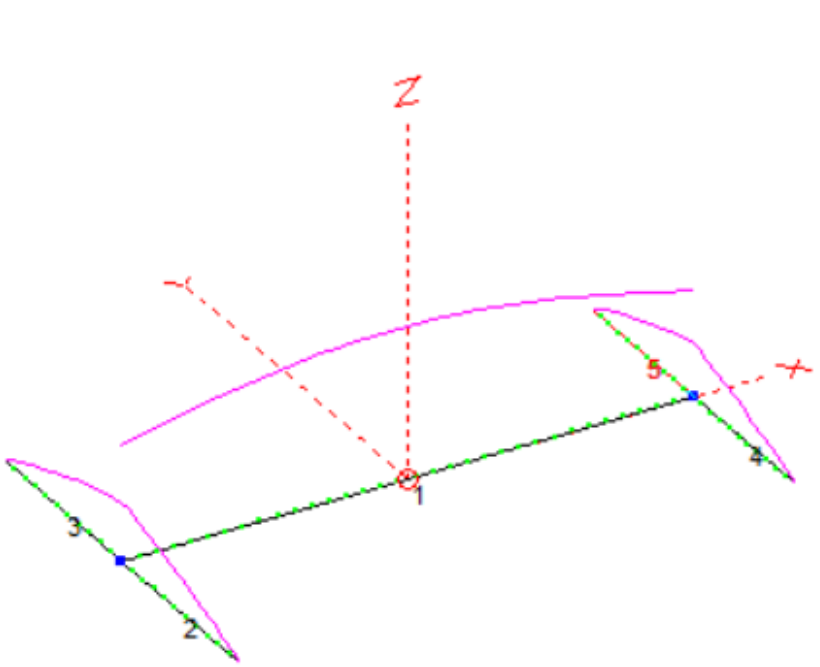
Wires

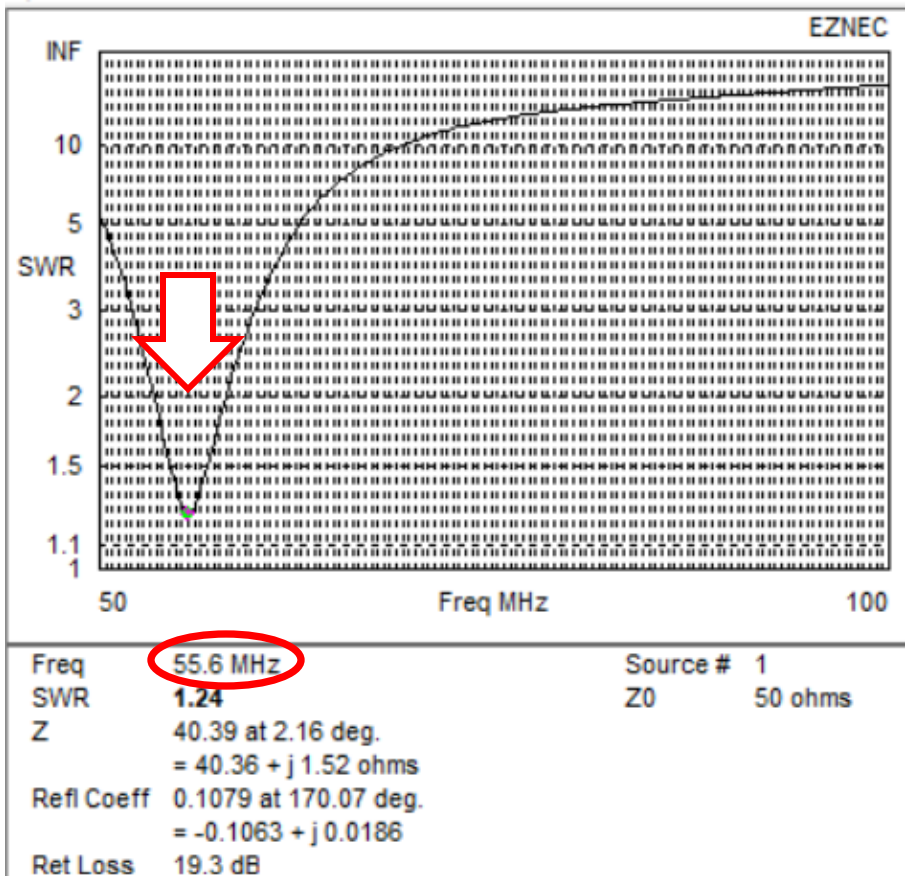
Wire Create Edit Other

☐ Coord Entry Mode ☐ Preserve Connections ☑ Show Wire Insulation

Wires

	No.	End 1				End 2				Diameter	Segs	Insulation	
		X (in)	Y (in)	Z (in)	Conn	X (in)	Y (in)	Z (in)	Conn	(in)		Diel C	Thk (in)
▶	1	0	0	120		57	0	120		0.866	33	1	0
*													





Freq	55.6 MHz	Source #	1
SWR	**1.24**	Z0	50 ohms
Z	40.39 at 2.16 deg.		
	= 40.36 + j 1.52 ohms		
Refl Coeff	0.1079 at 170.07 deg.		
	= -0.1063 + j 0.0186		
Ret Loss	19.3 dB		

Answer: Connect the 2m reflector and 3rd director to the boom

Wires

Wire Create Edit Other

☐ Coord Entry Mode ☐ Preserve Connections ☑ Show Wire Insulation

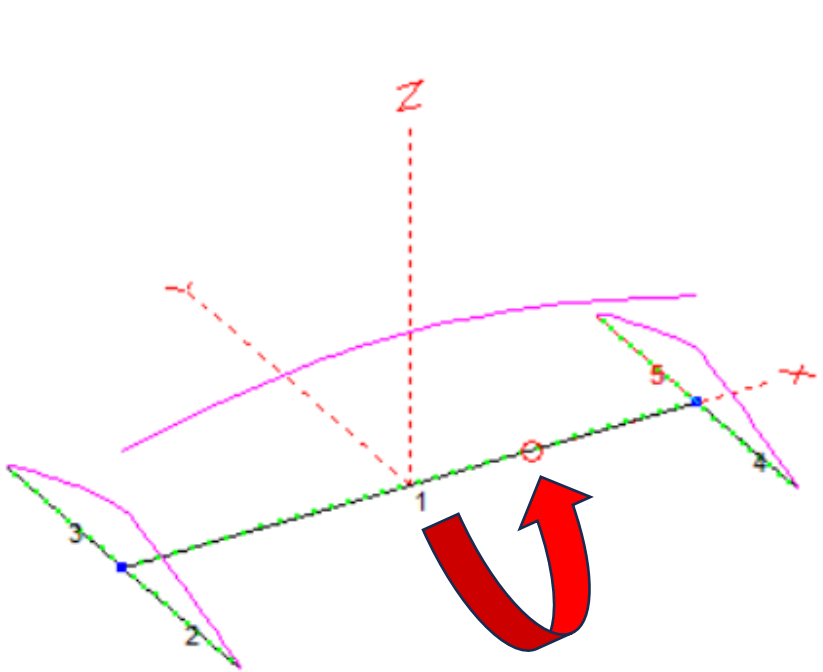
Wires

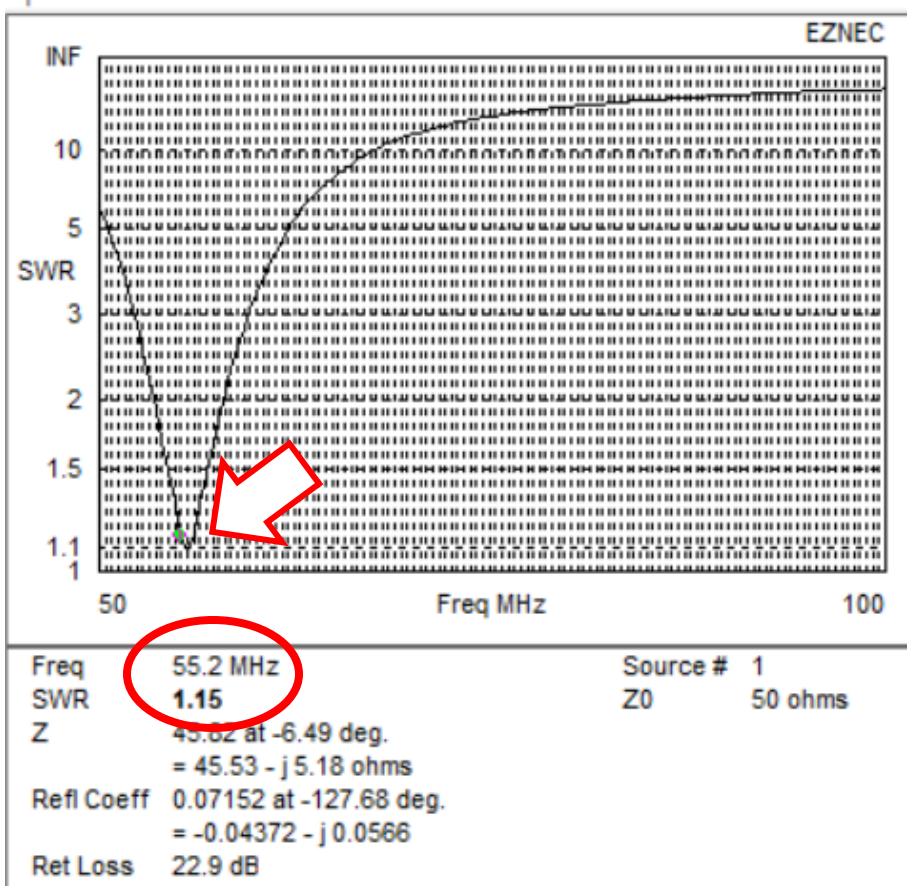
No.	End 1				End 2				Diameter	Segs	Insulation	
	X (in)	Y (in)	Z (in)	Conn	X (in)	Y (in)	Z (in)	Conn	(in)		Diel C	Thk (in)
1	0	0	120	W2E1	57	0	120	W4E1	0.866	33	1	0
2	0	0	120	W3E1	0	-20.375	120		0.157	11	1	0
3	0	0	120	W1E1	0	20.375	120		0.157	11	1	0
4	57	0	120	W5E1	57	-17.59	120		0.157	11	1	0
▶ 5	57	0	120	W1E2	57	17.59	120		0.157	11	1	0

Modifications to the 2m reflector and last 2m director elements to electrically connect them to the metal boom.

3M copper tape attached to the exact middle of the element

Copper tape captured under the elements mounting screw





Move the feedpoint over to the mechanically split boom location

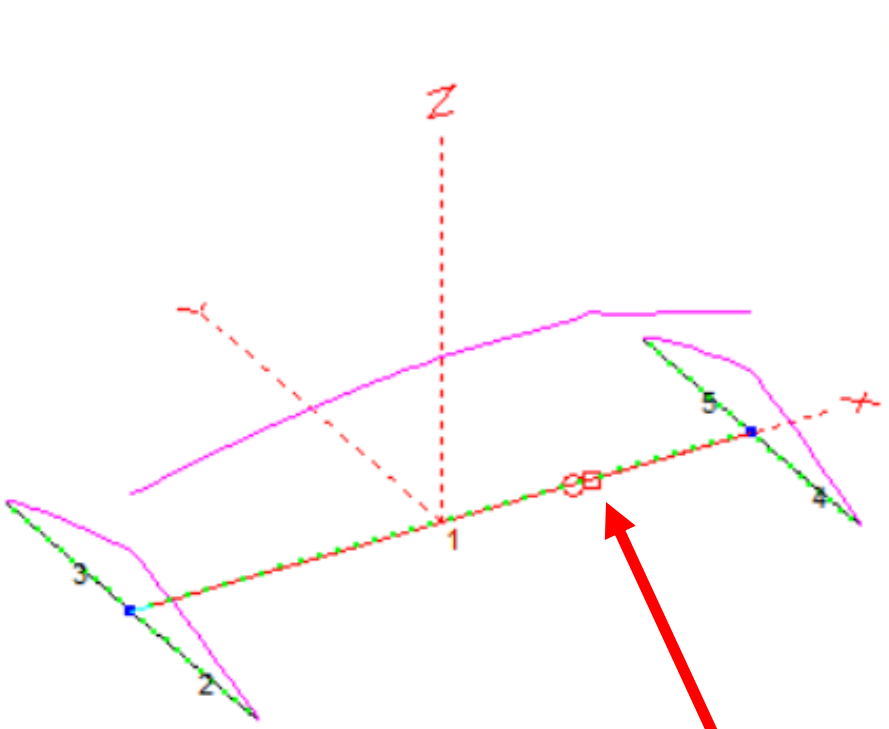
Wires

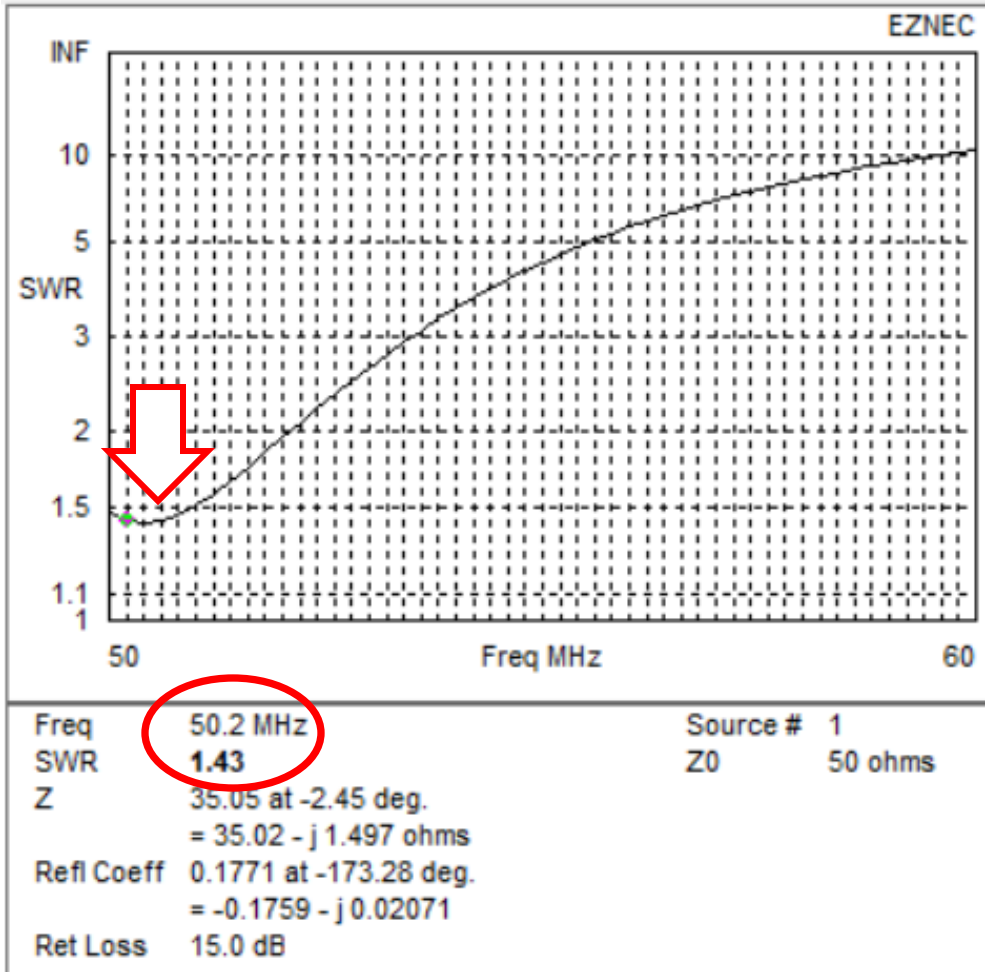
Wire Create Edit Other

☐ Coord Entry Mode ☐ Preserve Connections ☑ Show Wire Insulation

Wires

No.	End 1				End 2				Diameter	Segs	Insulation	
	X (in)	Y (in)	Z (in)	Conn	X (in)	Y (in)	Z (in)	Conn	(in)		Diel C	Thk (in)
1	0	0	120	W2E1	57	0	120	W4E1	0.866	33	1	0
2	0	0	120	W3E1	0	-20.375	120		0.157	11	1	0
3	0	0	120	W1E1	0	20.375	120		0.157	11	1	0
4	57	0	120	W5E1	57	-17.59	120		0.157	11	1	0
▶ 5	57	0	120	W1E2	57	17.59	120		0.157	11	1	0





Freq	50.2 MHz	Source #	1
SWR	**1.43**	Z0	50 ohms
Z	35.05 at -2.45 deg.		
	= 35.02 - j 1.497 ohms		
Refl Coeff	0.1771 at -173.28 deg.		
	= -0.1759 - j 0.02071		
Ret Loss	15.0 dB		

Add a little (inductive) loading

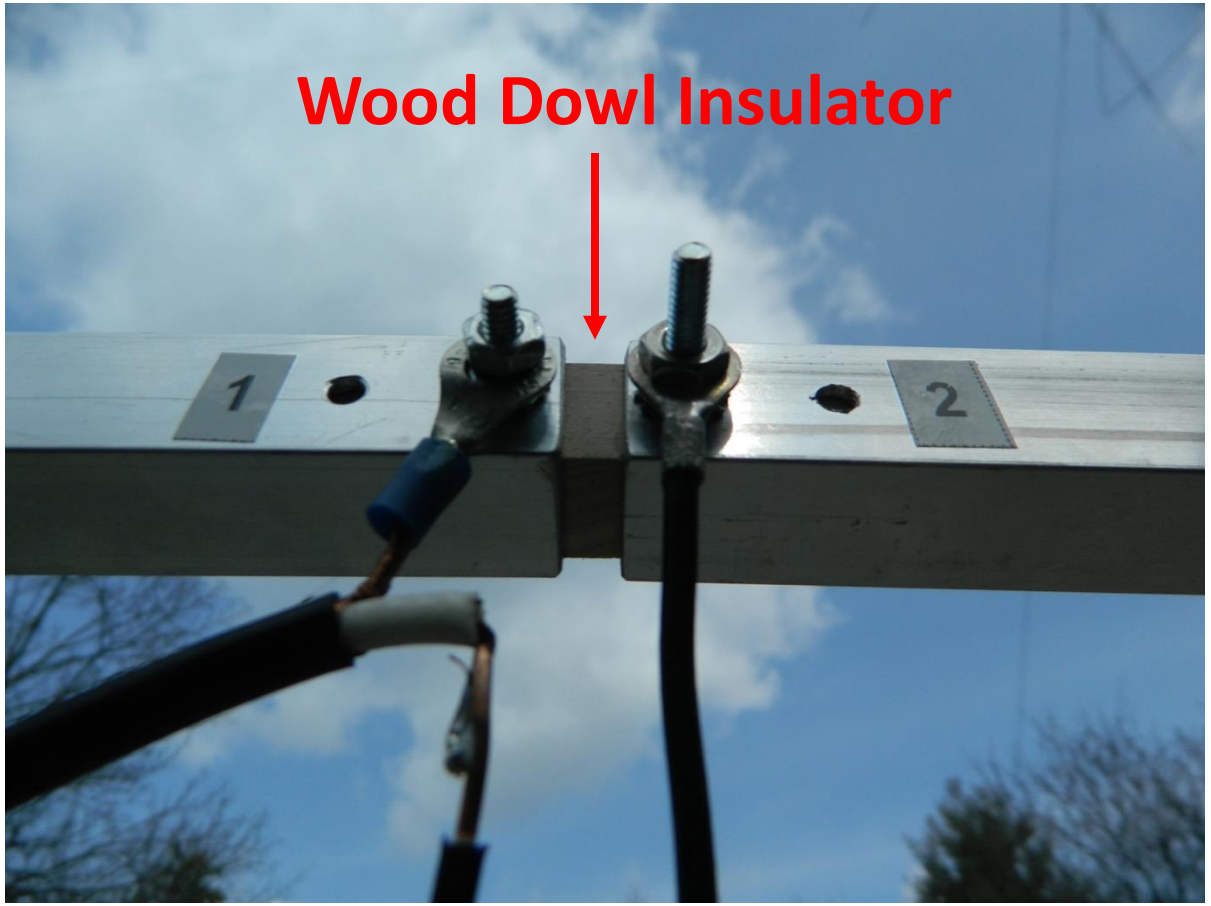
Loads (RLC)

Load Edit Other

Loads

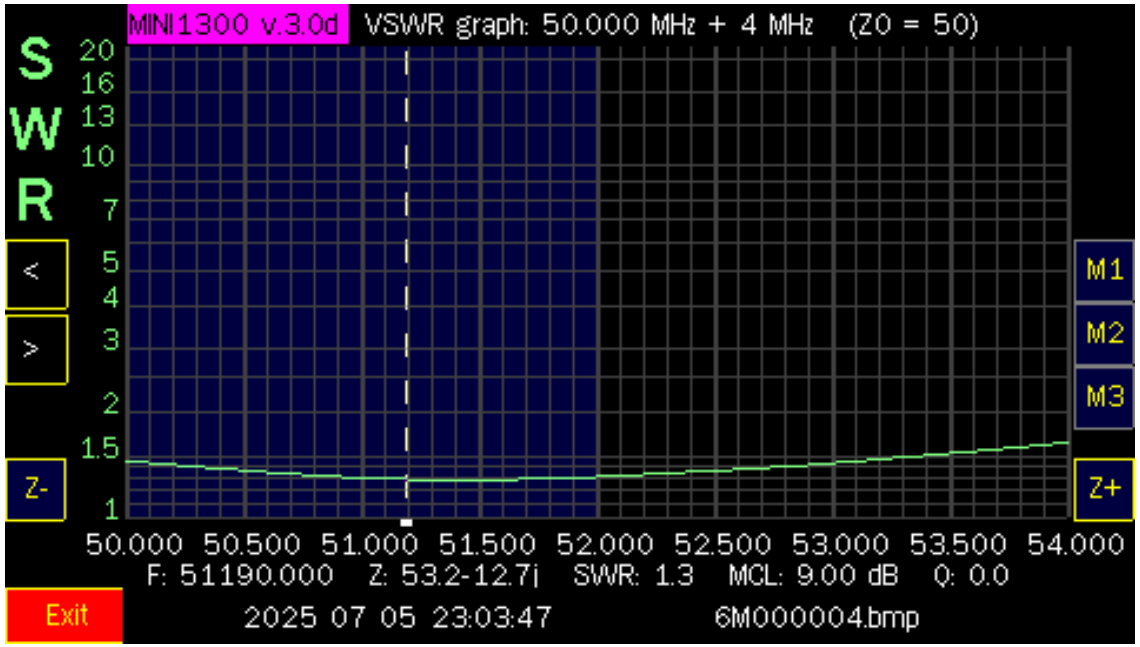
	No.	Specified Pos.		Actual Pos.		R	L	C	R Freq	Config	Ext Conn
		Wire #	% From E1	% From E1	Seg	(ohms)	(uH)	(pF)	(MHz)		
▶	1	1	75	74.2424	25	Short	0.25	Short	0	Ser	Ser
*											

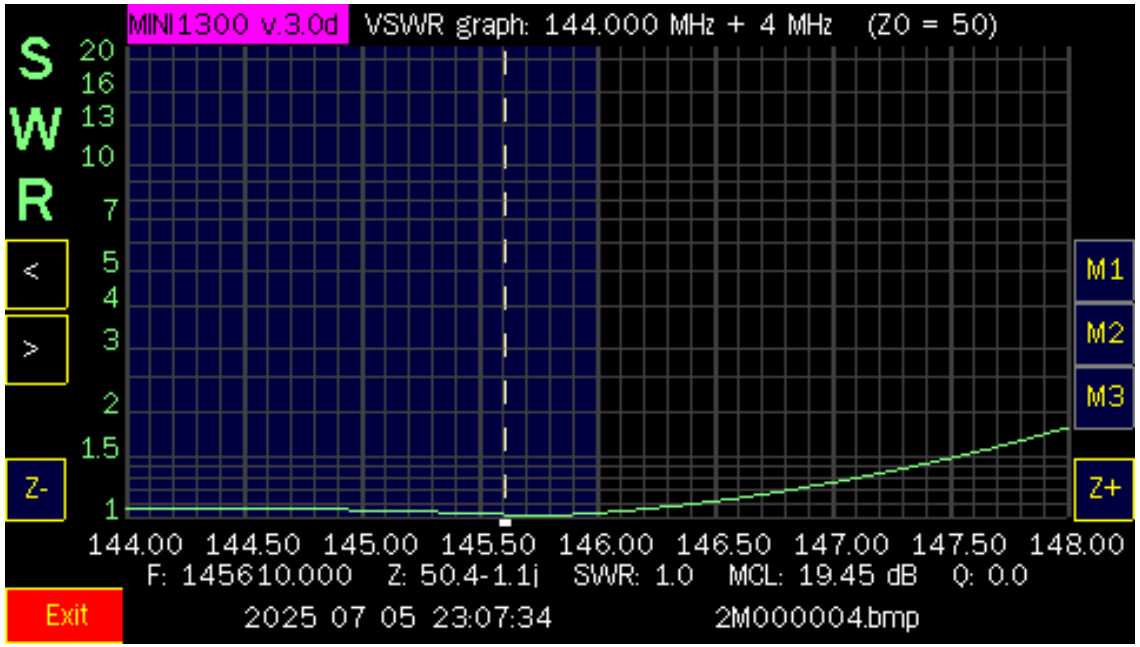
Split boom and linear loading for 6m

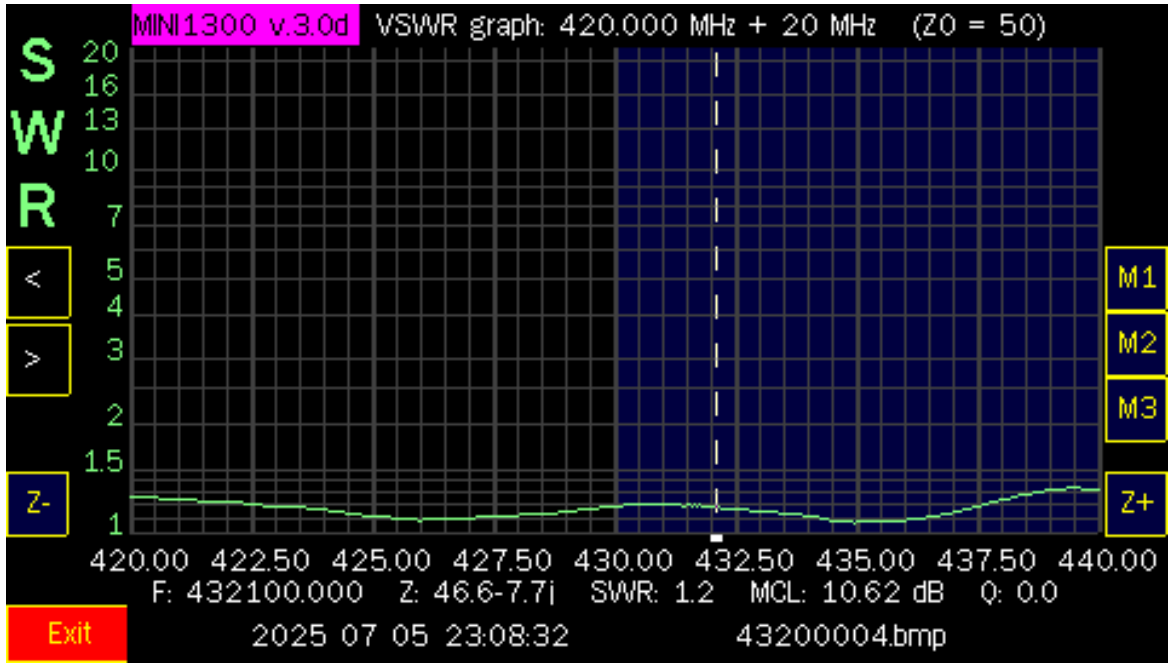


5/8 inch wood square dowl and direct 6m feed

U-shaped 7 inch inear loading for 6m


MINI1300 v.3.0d
VSWVR graph: 50.000 MHz + 4 MHz (Z0 = 50)
SWR
20 16 13 10 7 5 4 3 2 1.5 1
M1
M2
M3
Z+
Z-
50.000 50.500 51.000 51.500 52.000 52.500 53.000 53.500 54.000
F: 51190.000 Z: 53.2-12.7j SWR: 1.3 MCL: 9.00 dB Q: 0.0
Exit
2025 07 05 23:03:47
6M000004.bmp


MINI1300 v.3.0d
VSWVR graph: 144.000 MHz + 4 MHz (Z0 = 50)
SWR
20 16 13 10 7 5 4 3 2 1.5 1
M1
M2
M3
Z+
Z-
144.00 144.50 145.00 145.50 146.00 146.50 147.00 147.50 148.00
F: 145610.000 Z: 50.4-1.1j SWR: 1.0 MCL: 19.45 dB Q: 0.0
Exit
2025 07 05 23:07:34
2M000004.bmp

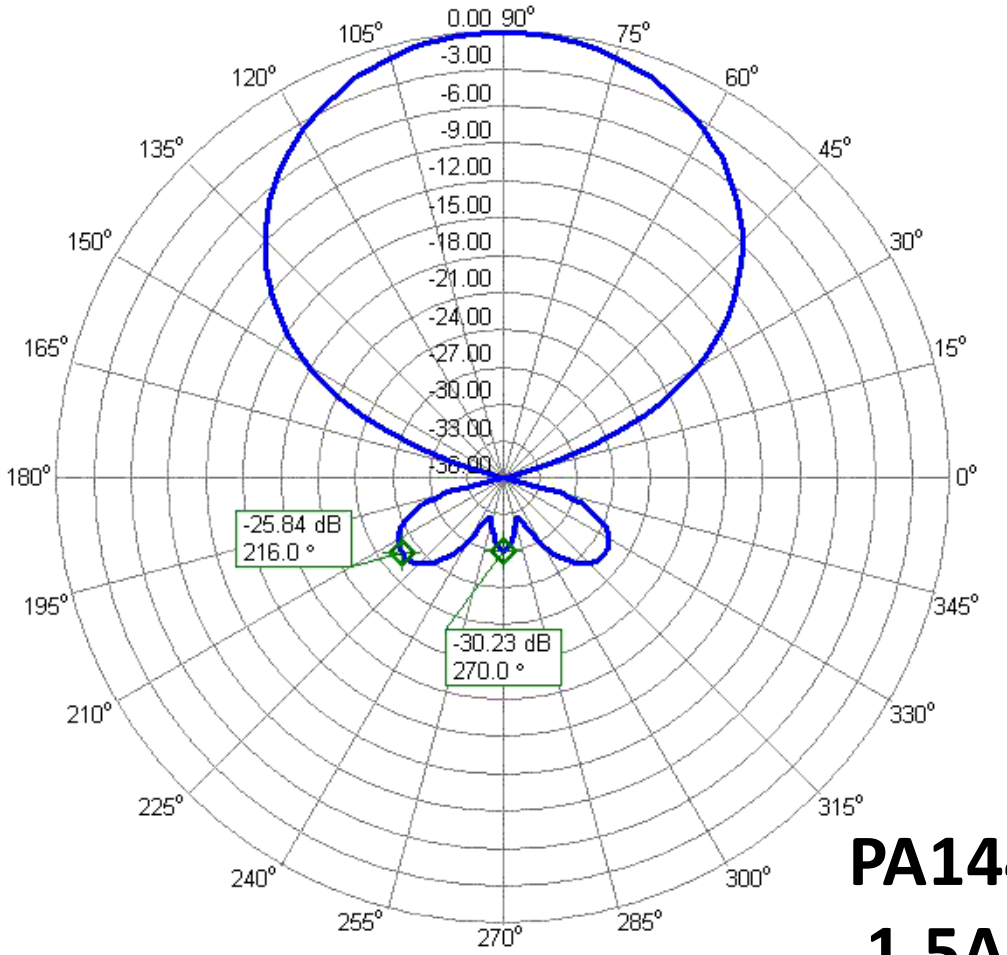

MINI1300 v.3.0d
VSWVR graph: 420.000 MHz + 20 MHz (Z0 = 50)
SWR
20 16 13 10 7 5 4 3 2 1.5 1
M1
M2
M3
Z+
Z-
420.00 422.50 425.00 427.50 430.00 432.50 435.00 437.50 440.00
F: 432100.000 Z: 46.6-7.7j SWR: 1.2 MCL: 10.62 dB Q: 0.0
Exit
2025 07 05 23:08:32
43200004.bmp

And it fits inside a Subaru Imprezza without any disassembly !

Note: When using this antenna on 6m the boom is “hot” so it must be mounted to an insulated mast or insulated from a metal mast in some way.

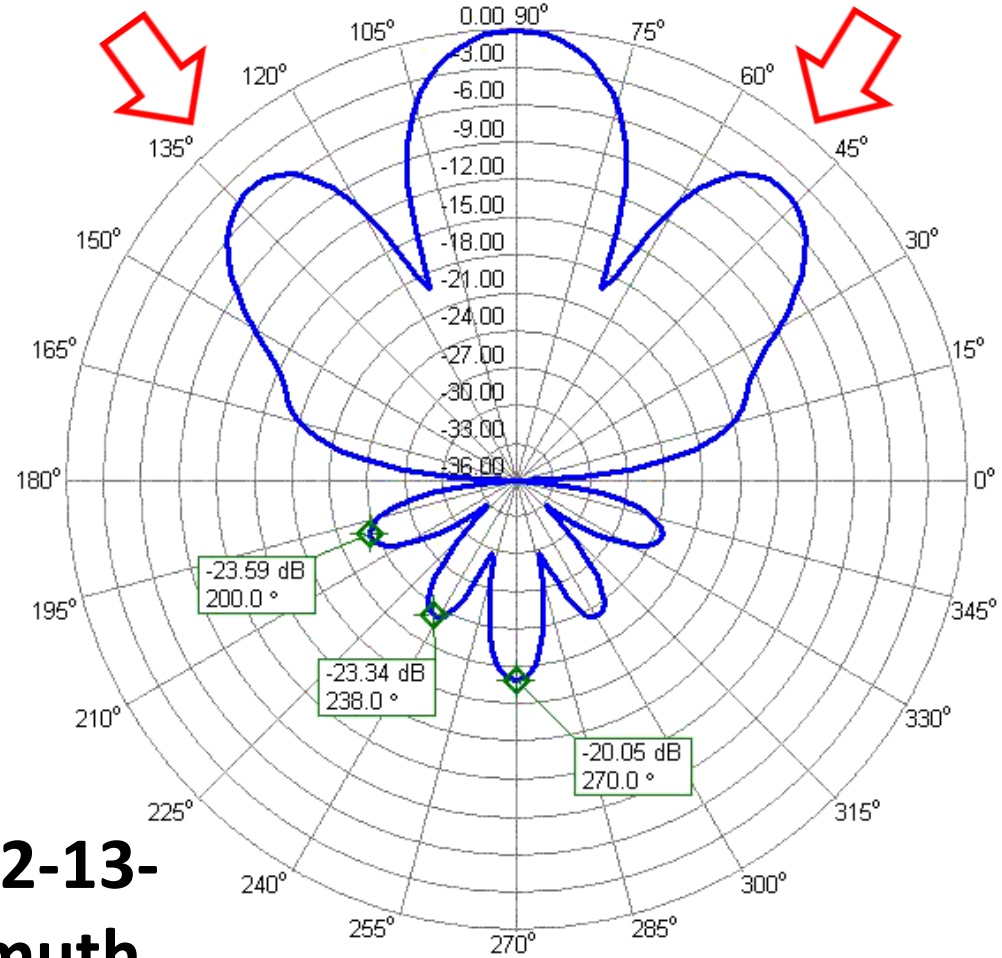
Note: As a dipole the null is on the same azimuth heading as the 2 & 432 beam heading. You may want to rotate the antenna 90 degrees for best 6m signals.

Possible Future Project – 432 improvements while maintaining all other features ?



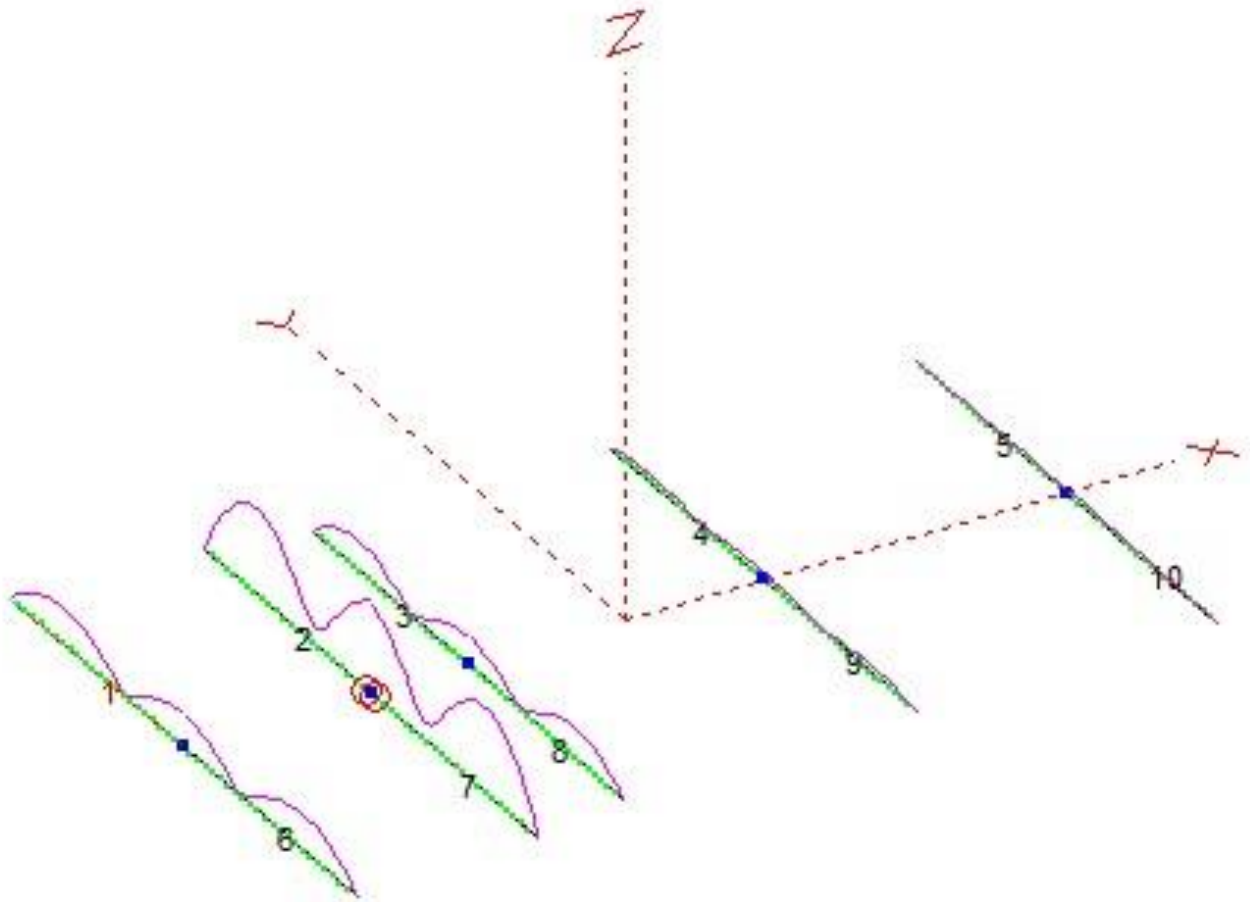
144 MHz

PA144-432-13-1.5A Azimuth Patterns



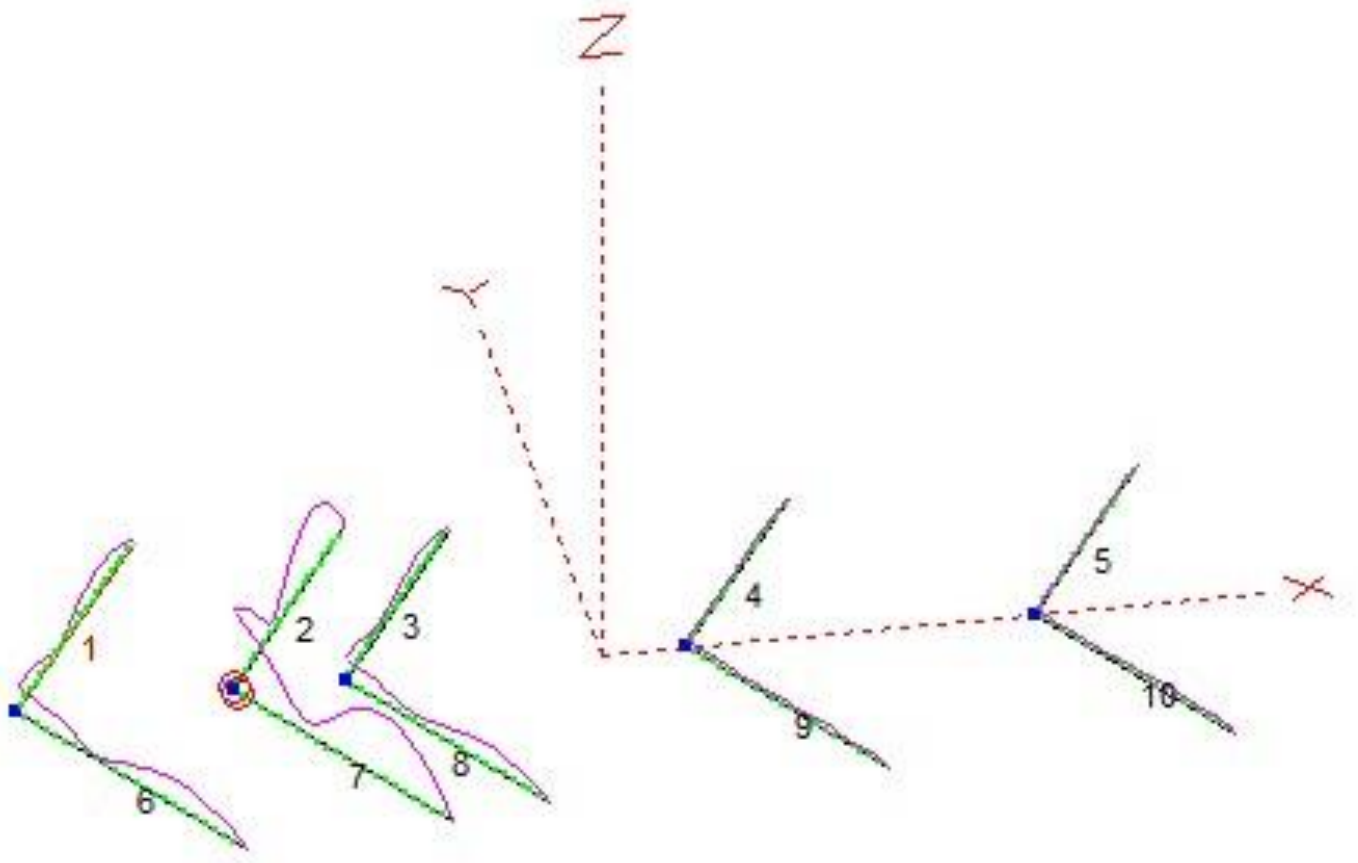
432 MHz

EZNEC

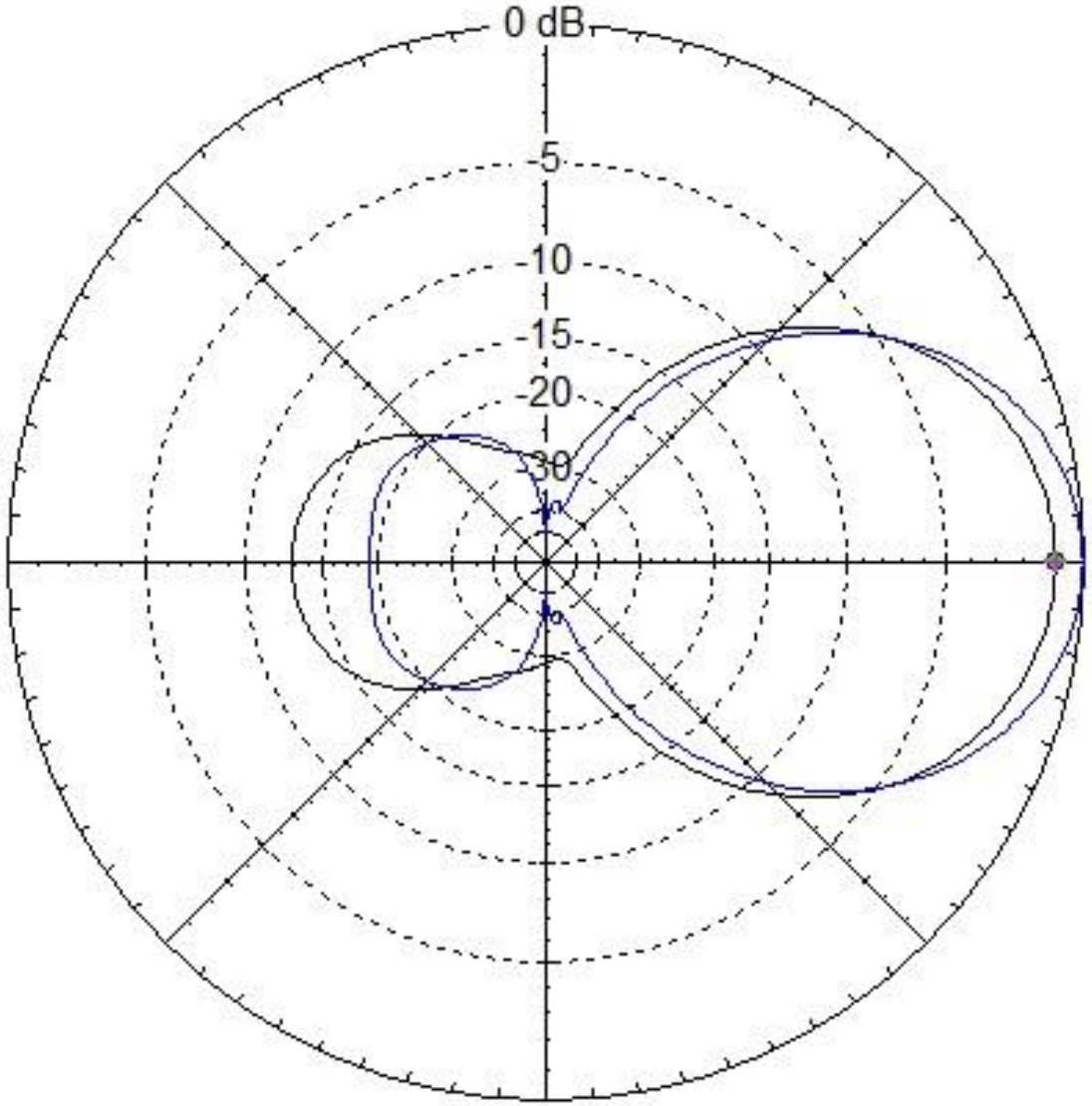


PA144-432-13-1.5A modeling of just the 2m elements on 432 MHz

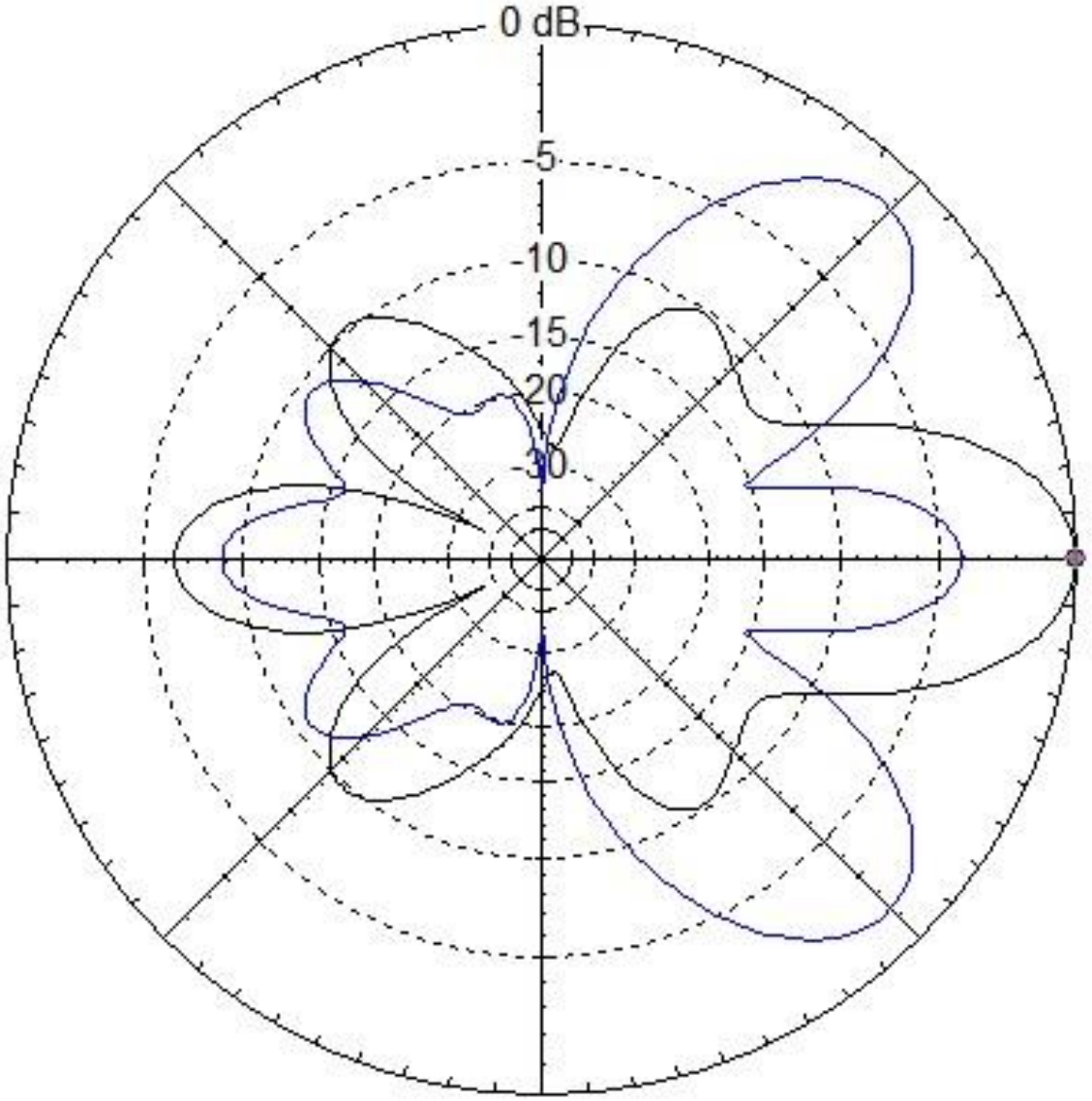
EZNEC



Same model but with 2m elements swept forward 30 degrees

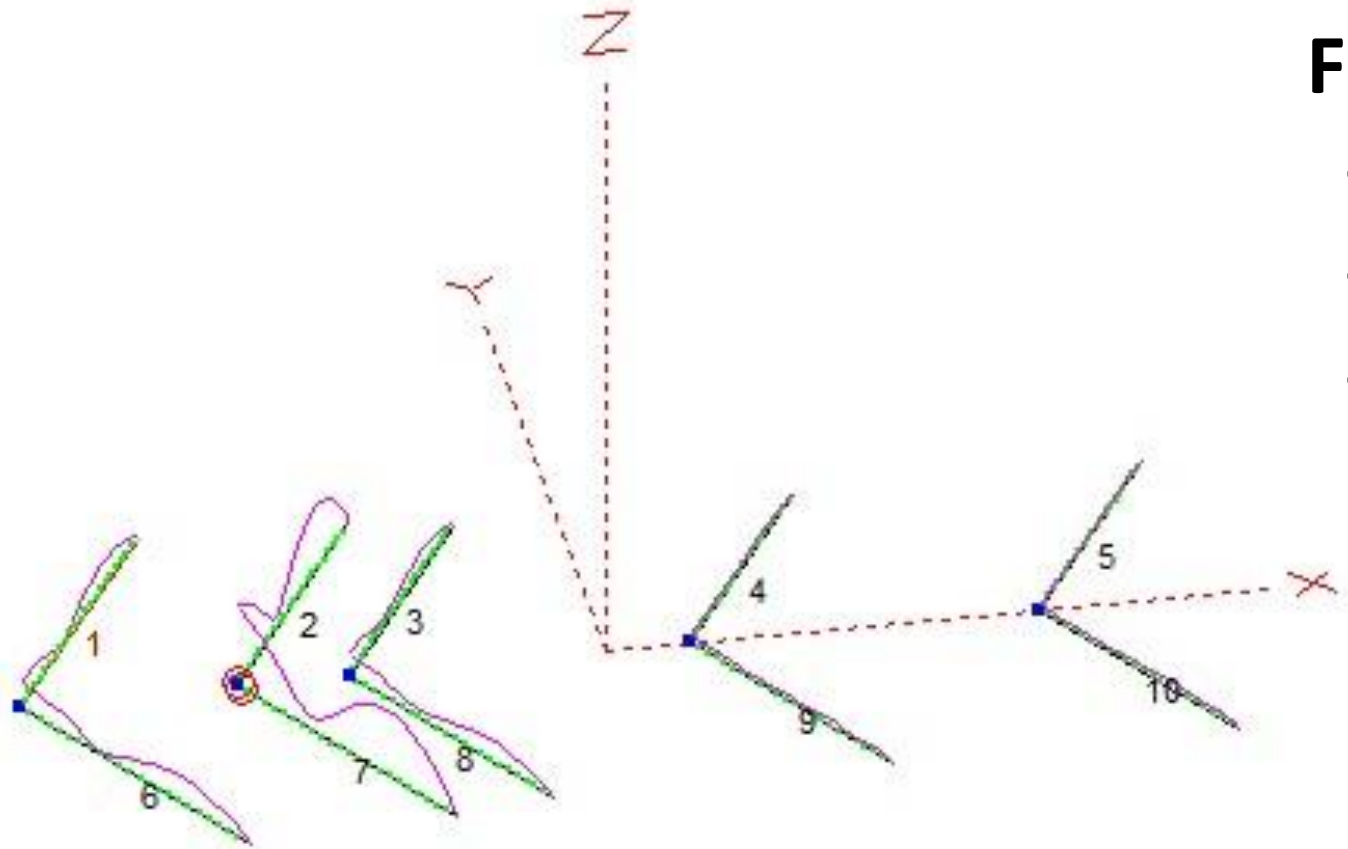


144 MHz: *Maybe* 1 dB reduction in gain



432 MHz: *Maybe* 4 dB improvement in gain

EZNEC



Future Design:

- **Maintain 6m capability**
- **Add 432 directors?**
- **144 & 432 matching?**


73
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VHF SOCIETY
NORTHERN LIGHTS
RADIO SOCIETY