40 Meter Wire Antennas

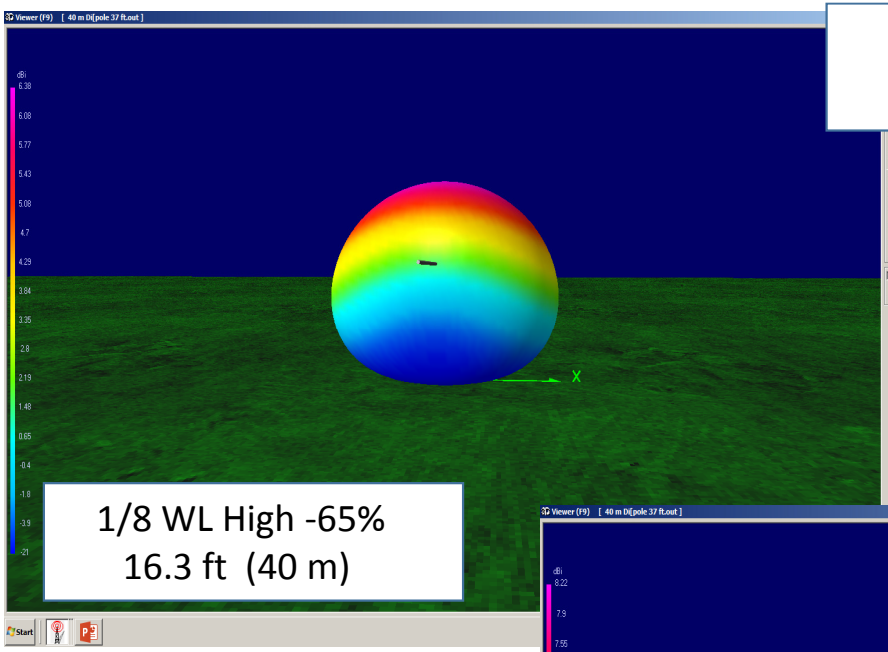
Review of Antenna Patterns and Efficiency also Radiation Angle and Skip Distance

An Analysis and Comparison of 19 Wire Horizontal Antennas and 6 Vertical Antennas and a Mobile Vertical

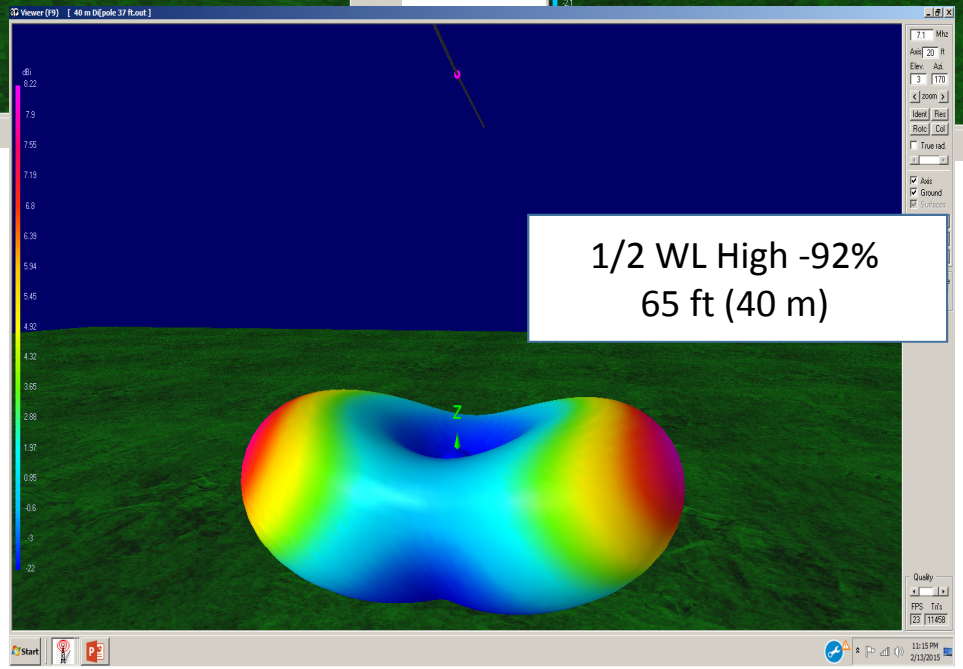
ERP Calculations are made using 100 W Power and 37 ft Antenna Height

K5QY

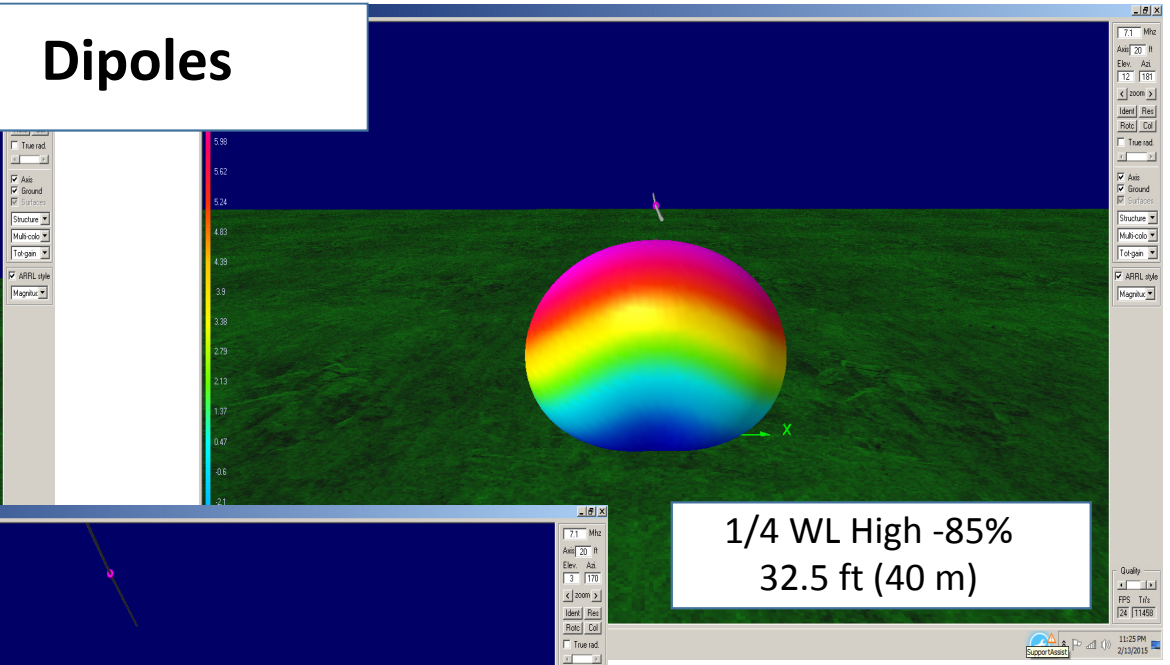
Dipoles



1/8 WL High -65%
16.3 ft (40 m)



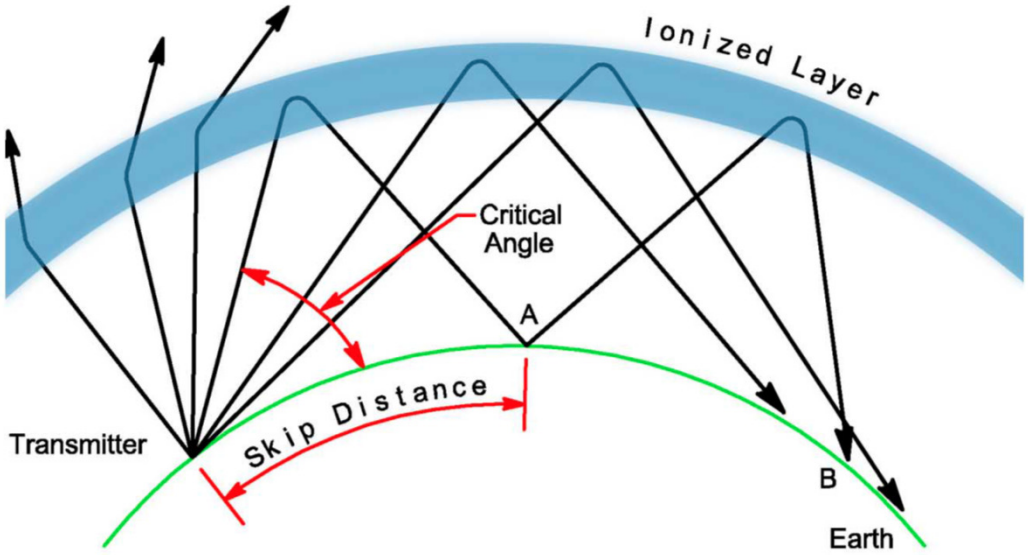
1/2 WL High -92%
65 ft (40 m)



1/4 WL High -85%
32.5 ft (40 m)

Dipole Pattern Vs Height and Efficiency Vs Height

An Inverted Vee Efficiency is Less



40 Meters

Take-Off Angle (deg)	Typical Skip Distance (miles)
45	400-800
30	650-1,300
20	950-1700
15	1,200-2,000
12	1,300-2,300
10	1,400-2,400

Transmit System Gain (dBW)

TSG = 10 X (log (Pt)/ log(10) Ant Gain – Coax Loss)

Example:

100W, (4 dBi-2.14 dipole), 1 dB coax loss = 20.9 dBW TSG

100W, (7 dBi-2.14 dipole), 1 dB coax loss = 23.9 dBW TSG

+3 dB increase +3 dB increase

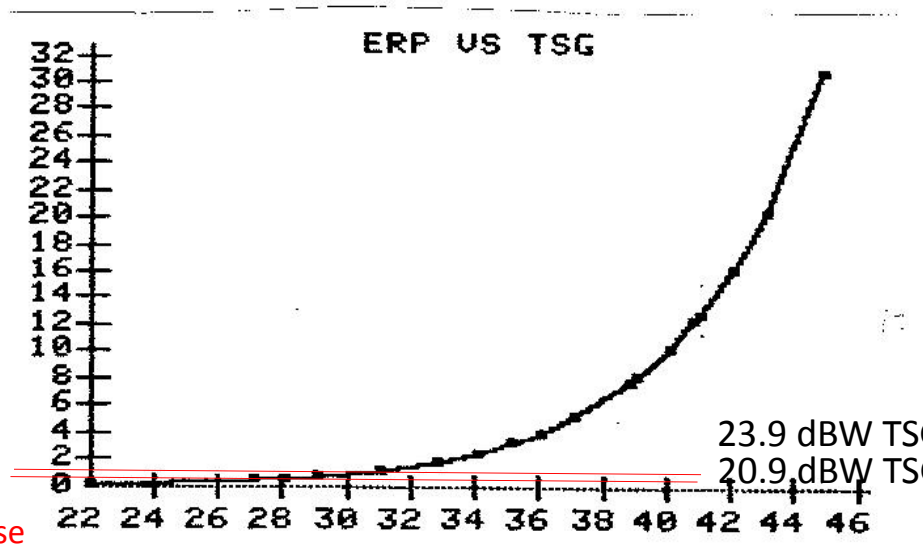
EFFECTIVE RADIATED POWER (ERP)

$$ERP = \log_{-1}(TSG / 10)$$

OR

Effective Isotropic Radiated Power (EIRP)

(Uses only dBi antenna gain)



242 W ERP
121 W ERP
+3 dB increase

23.9 dBW TSG
20.9 dBW TSG

As transmit system gain increases, ERP improves exponentially; and big gun HAM stations can easily reach above 12 kW ERP

ERP Is Calculated to Show the Equivalent Power in the Best Antenna Direction

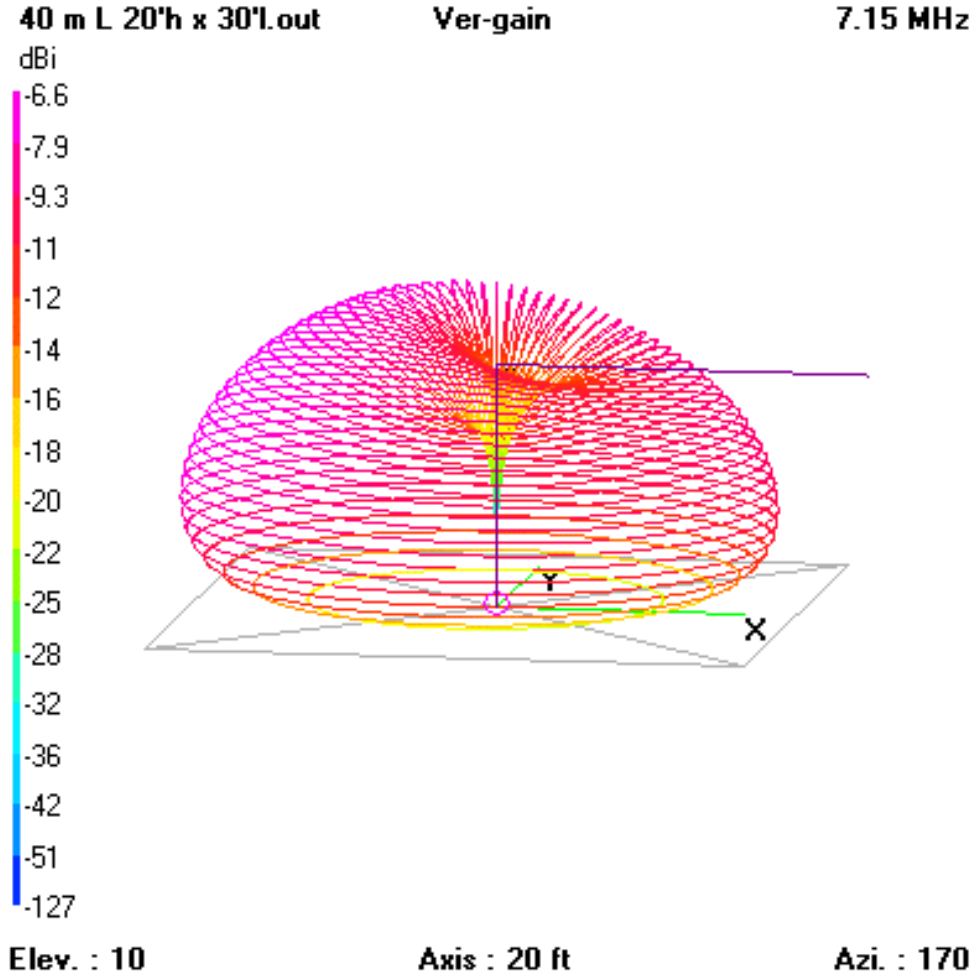
40 Meter Antennas

40 meter “L” Wire

20 ft High X 30 ft Long
50 ft 14 AWG Wire
Ground Rod Only
7.44 uH Series – 124 pF
Shunt L-Matching

SWR <2:1 Across the Band

ERP = 13 W at 45 degrees

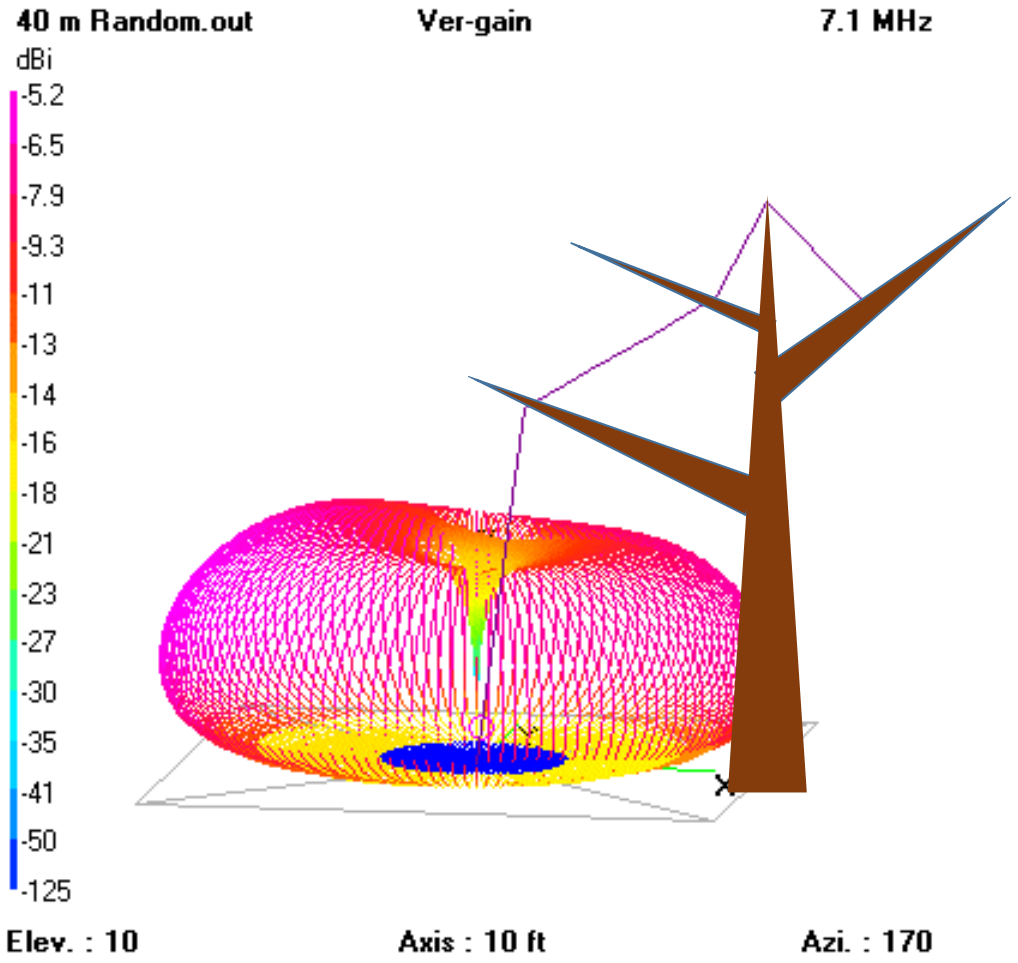


40 Meter Antennas

40 meter Random Wire

24 ft Apex
34 ft 14 AWG Wire
Ground Rod Only
SWR <3:1 Across the Band

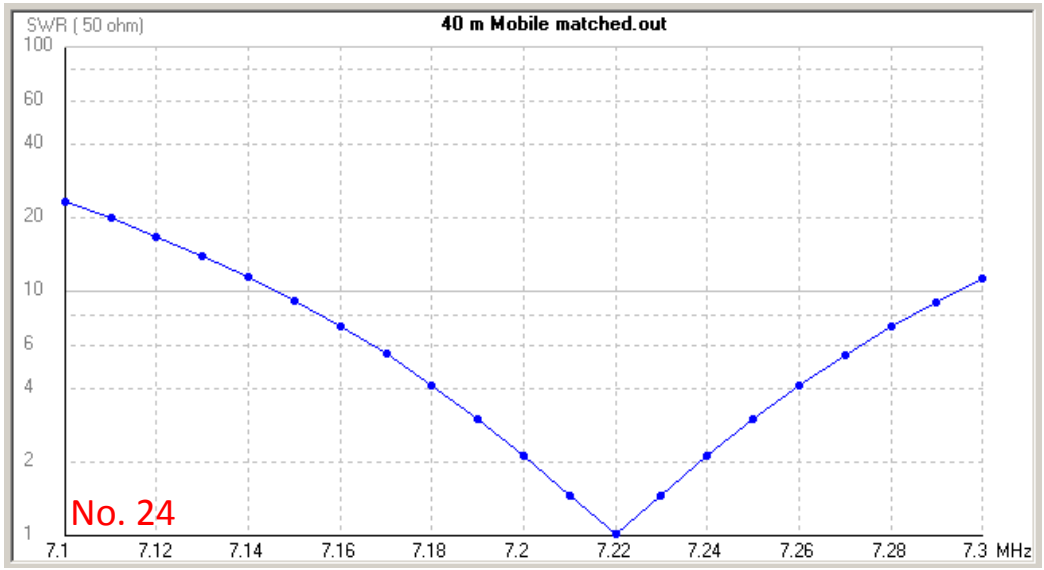
ERP = 18 W at 27.5 degrees

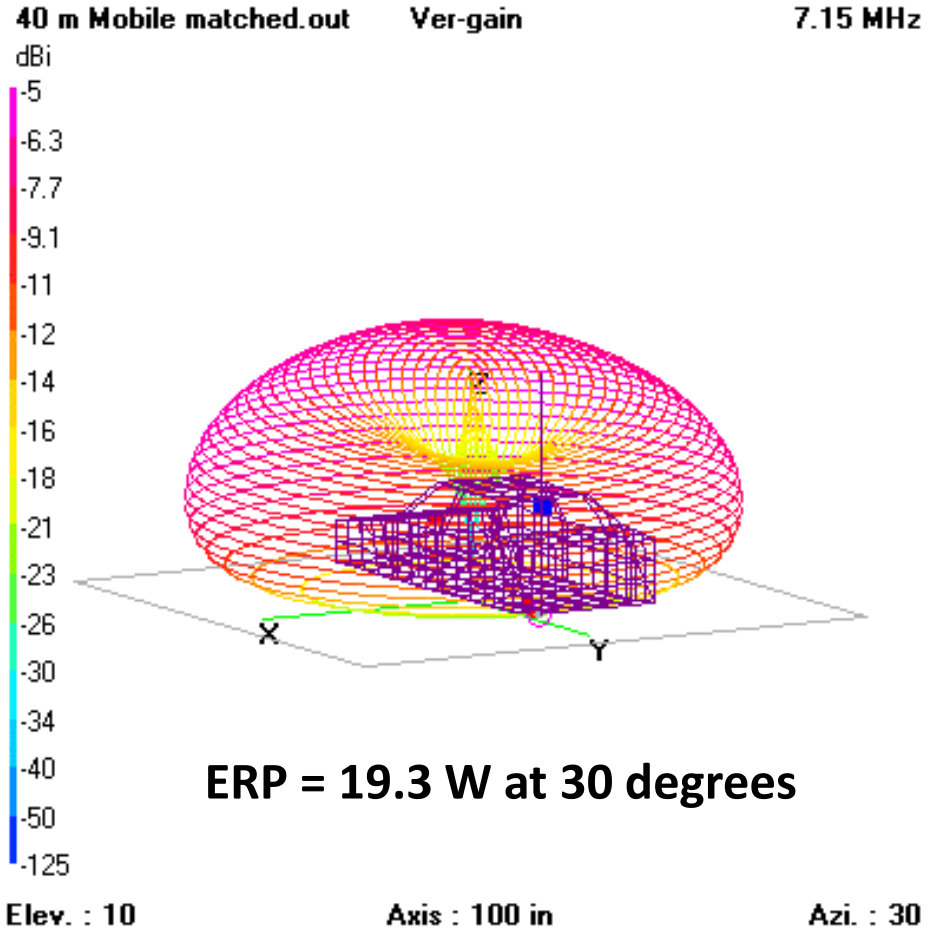


40 Meter Antennas

40 meter Center-Loaded Mobile Antenna

96 in. Whip
Tip is 10 ft Above Ground
Matching 3 W loss





ERP = 19.3 W at 30 degrees

40 Meter Antennas

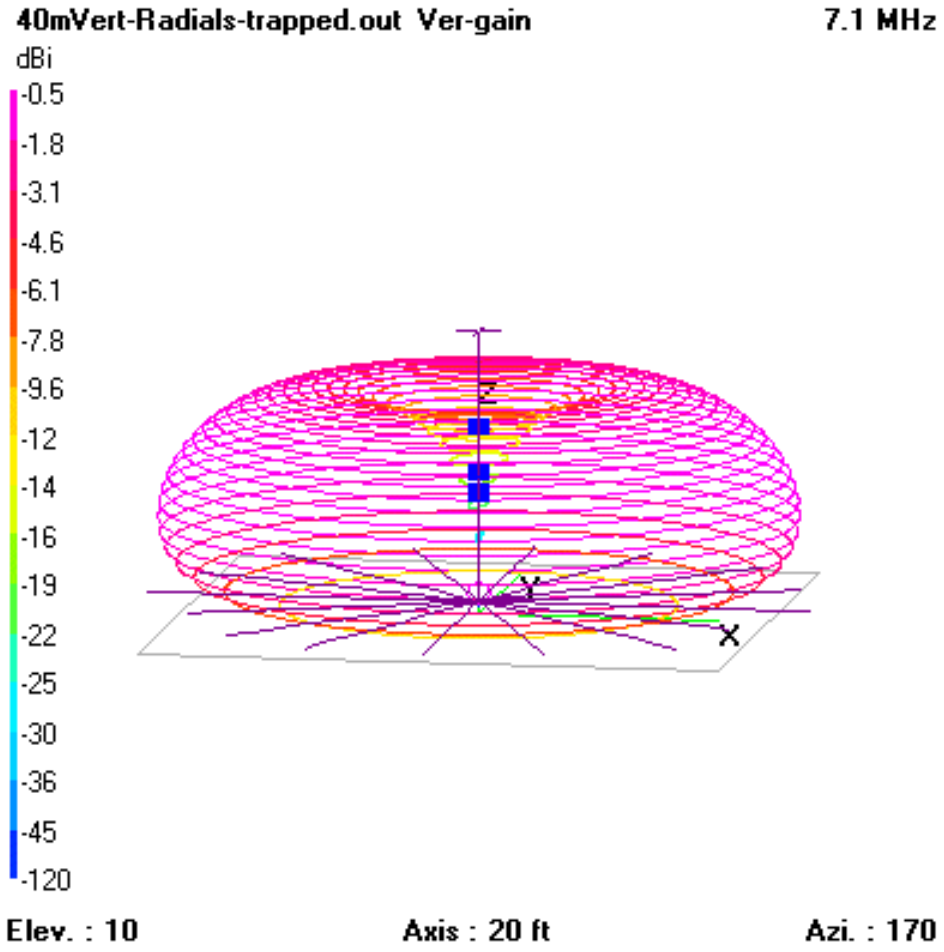
40 meter Trapped Vertical

K5QY Design
22 ft Tall
16 Radials
Ground Rod

SWR <2.3:1 Across the Band
Inductance Reduces SWR BW

ERP = 54.3 W at 25 degrees

Band	L	C
10	1.1	28.2
15	1.5	37.5
20	2.2	56.0
	4.8 uH	



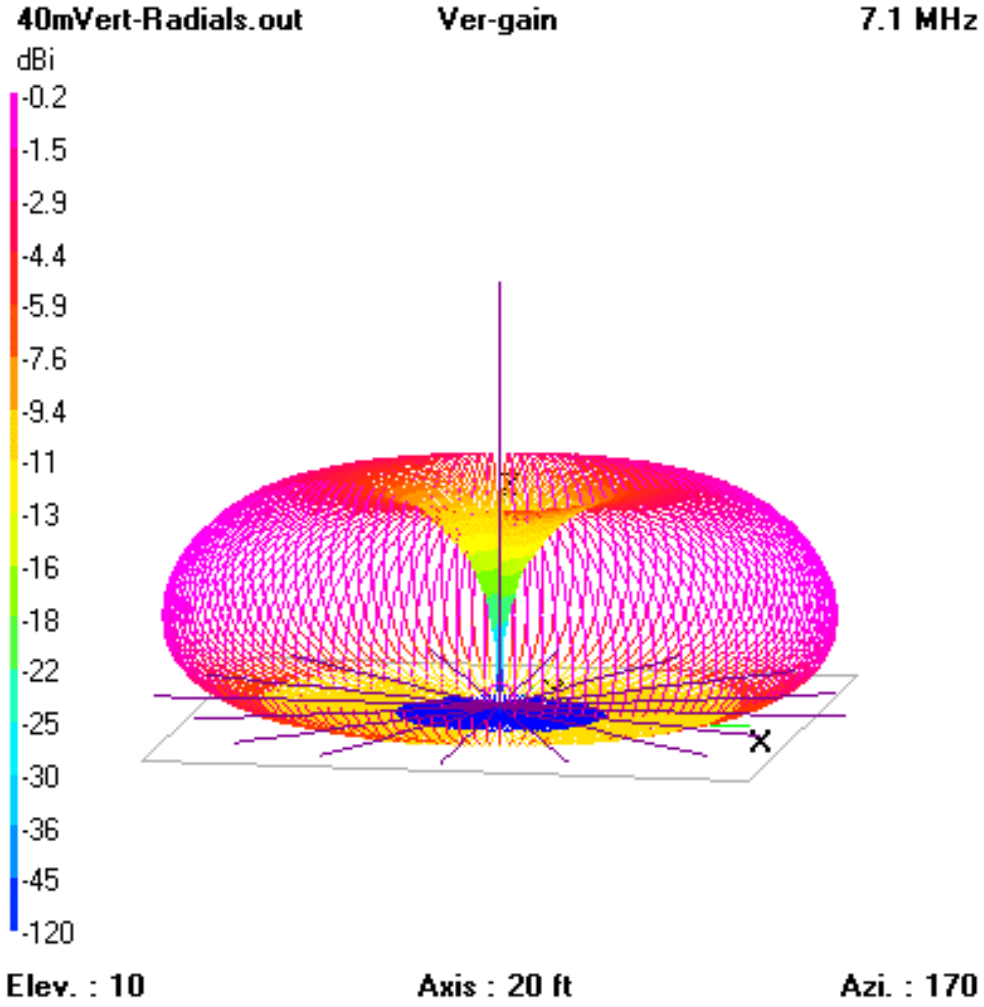
40 Meter Antennas

40 meter Vertical

Full Size 33.5 ft
16 Radials

SWR <1.6:1 Across the Band
(No Inductive Loading)

ERP = 58 W at 25 degrees



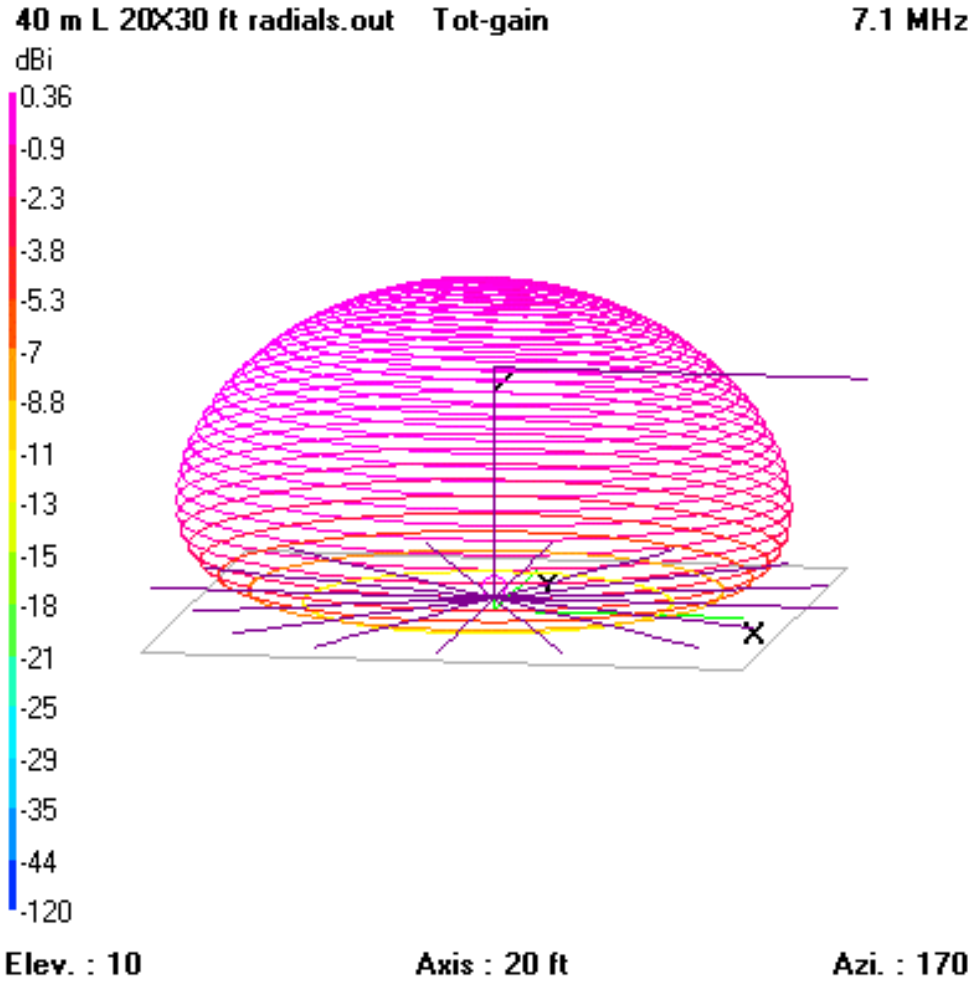
40 Meter Antennas

40 meter “L” Wire

20 ft High X 30 ft Long
16 Radials

L-Matched (4 W loss)
SWR <2:1 Across the Band

ERP = 66 W at 45 degrees



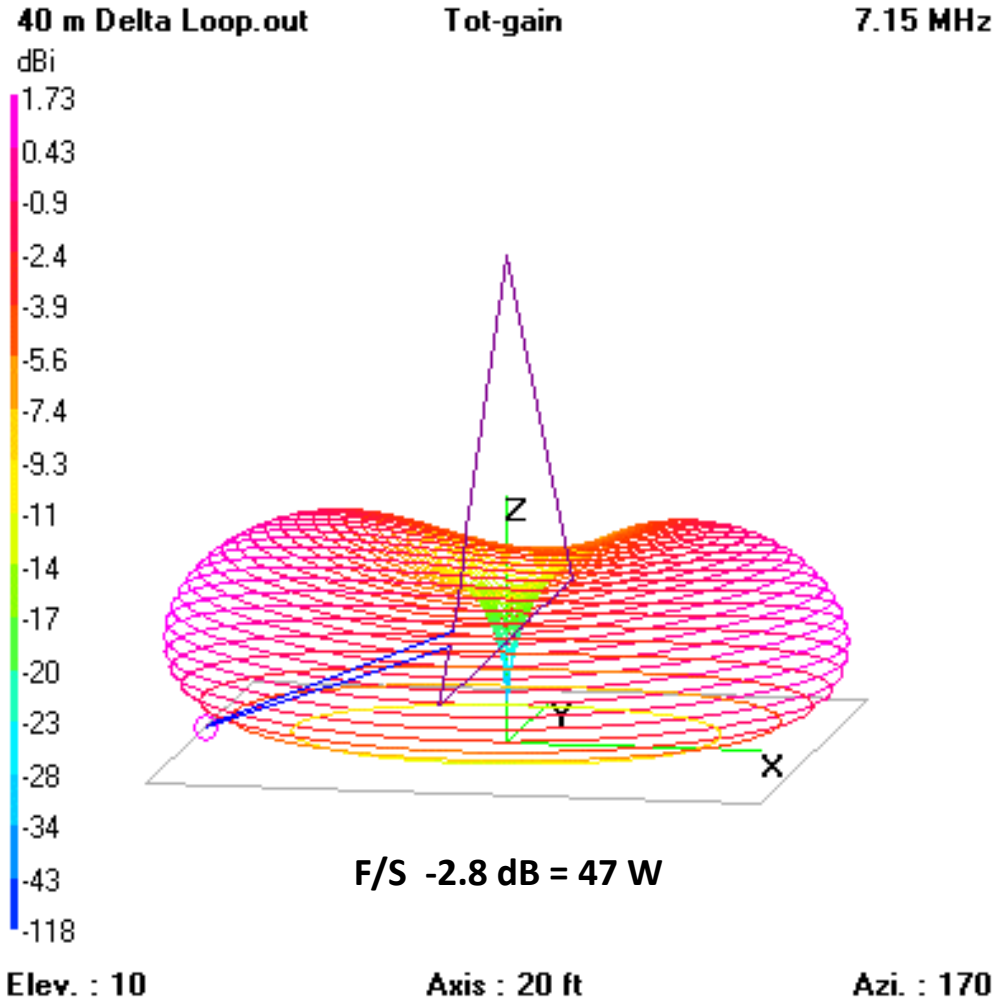
40 Meter Antennas

40 meter Delta Loop

37 ft High
7 ft off ground
140 ft loop
¼ WL 75-Ohm coax matching

SWR <2:1 Across the Band

ERP = 91 W at 22.5 degrees



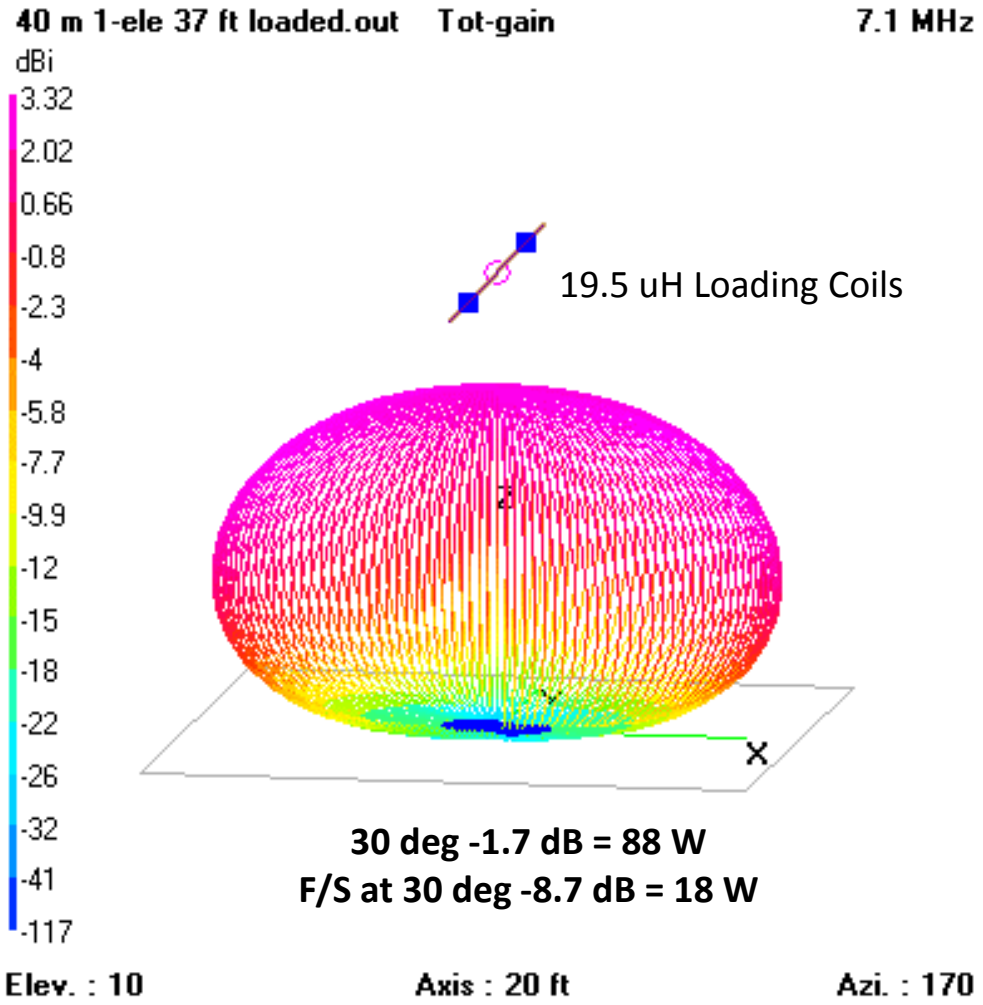
40 Meter Antennas

40 meter Short Loaded Dipole

37 ft High
41 ft length

SWR <3.3:1 Across the Band
Inductance Reduces SWR BW

ERP = 131 W at 57.5 degrees

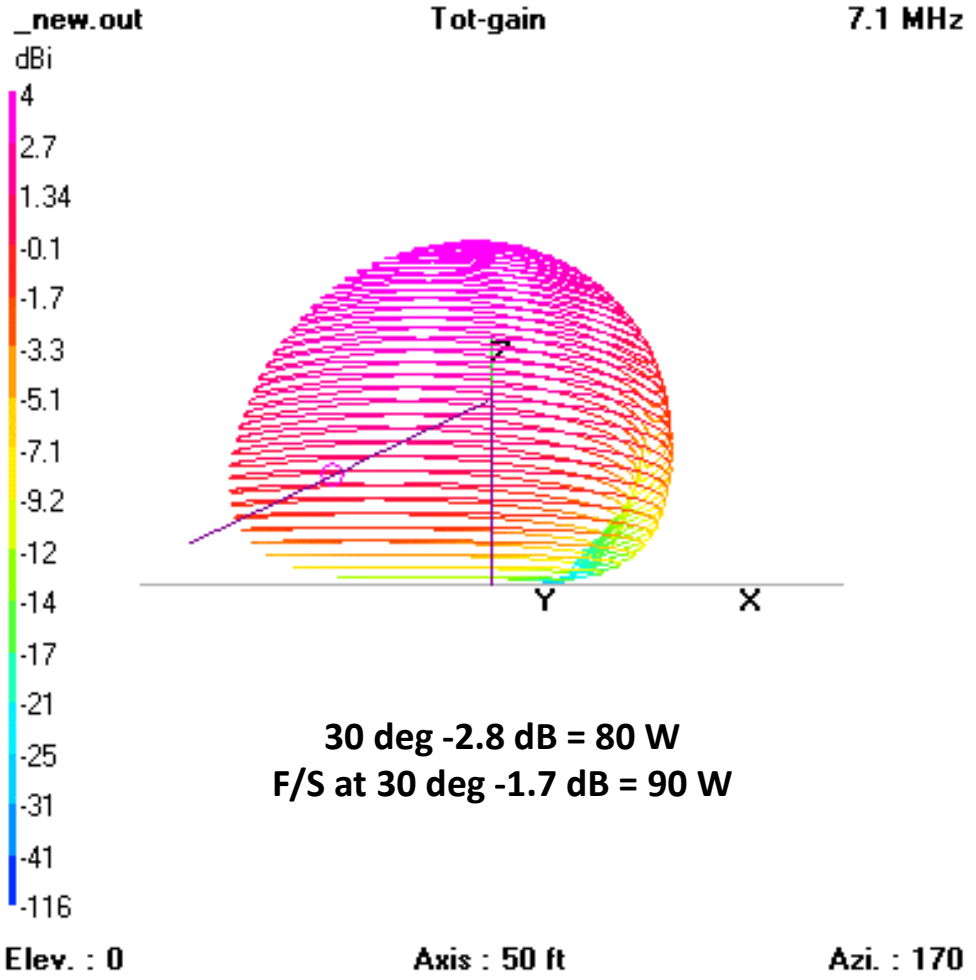


40 Meter Antennas

40 meter Sloping Dipole

8 ft to 37 ft High
SWR <2.4:1 Across the Band

ERP = 153.2 W at 80 degrees



30 deg -2.8 dB = 80 W
F/S at 30 deg -1.7 dB = 90 W

40 Meter Antennas

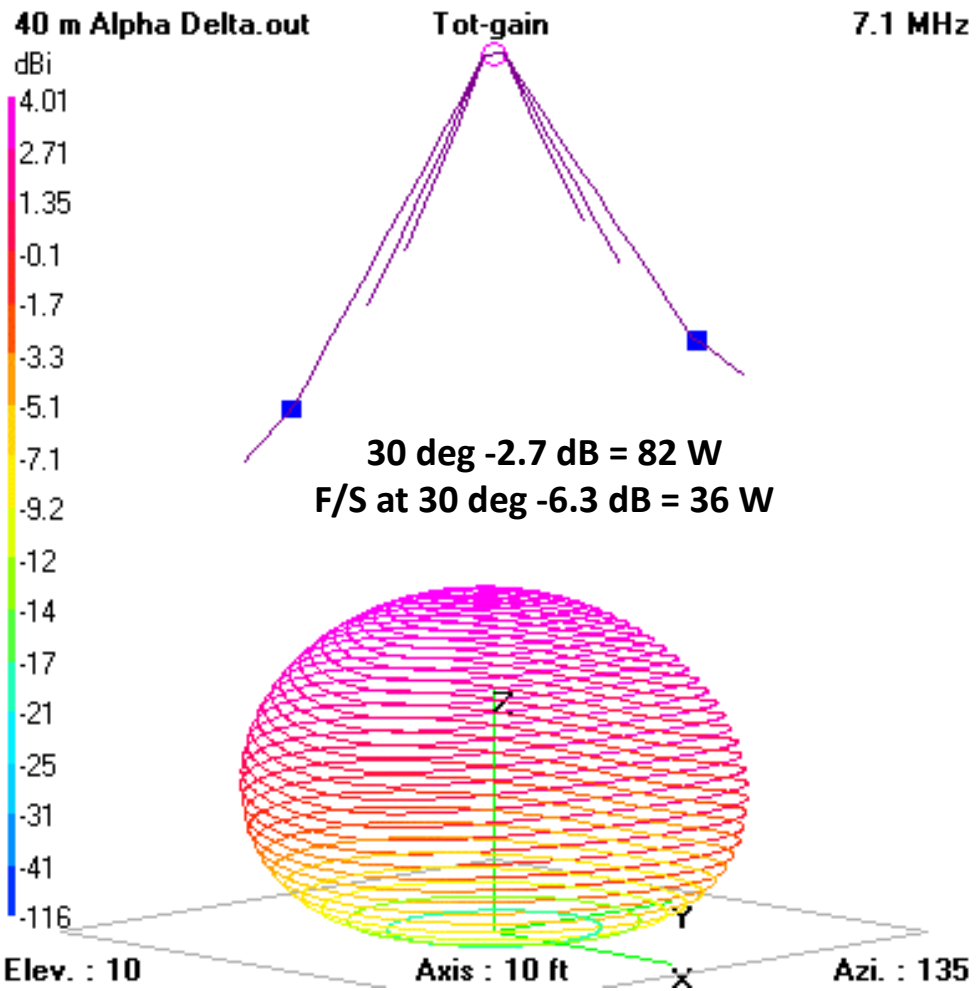
Alpha-Delta DX-EE
40 m Inverted-Vee
37 ft –Apex 90 degrees
40 ft Length

***The coils use distributed Capacitance for 20 m trap resonance**

ERP = 153.5 W at 87.5 degrees

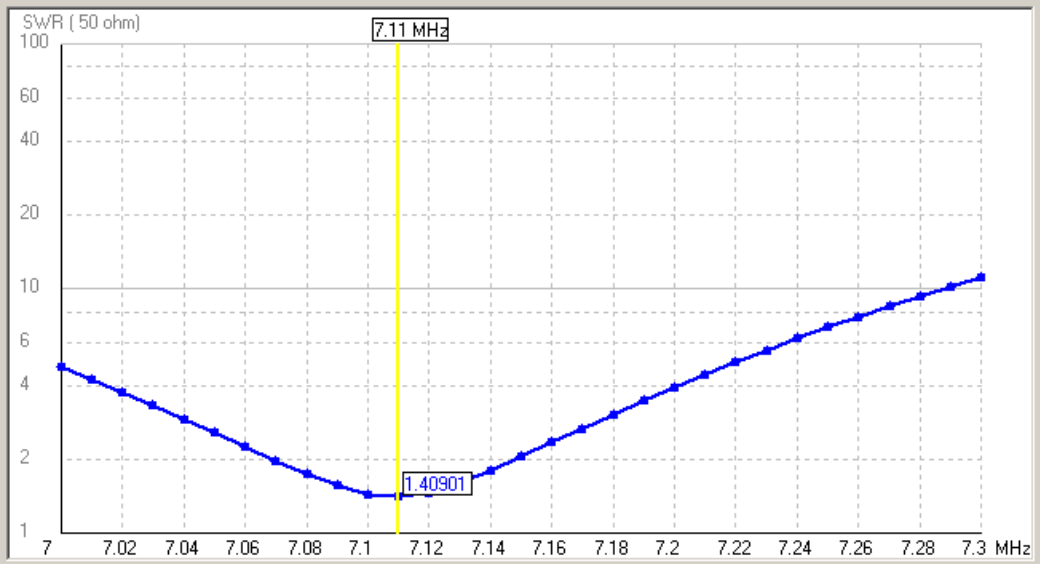
*Assumes 20 m trap uses a large L-to-C ratio (38 uH/2.8 pF) to obtain the shortened 40 ft length. Refer to Nov 2014 QST, pg 68, “Inductors at RF”

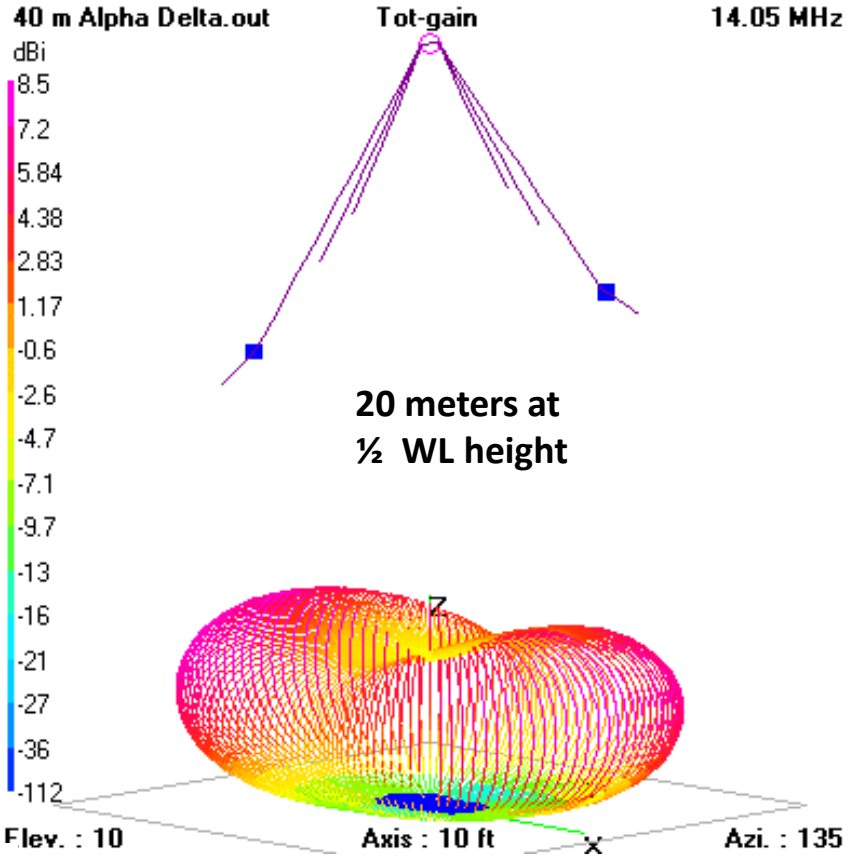
No. 17



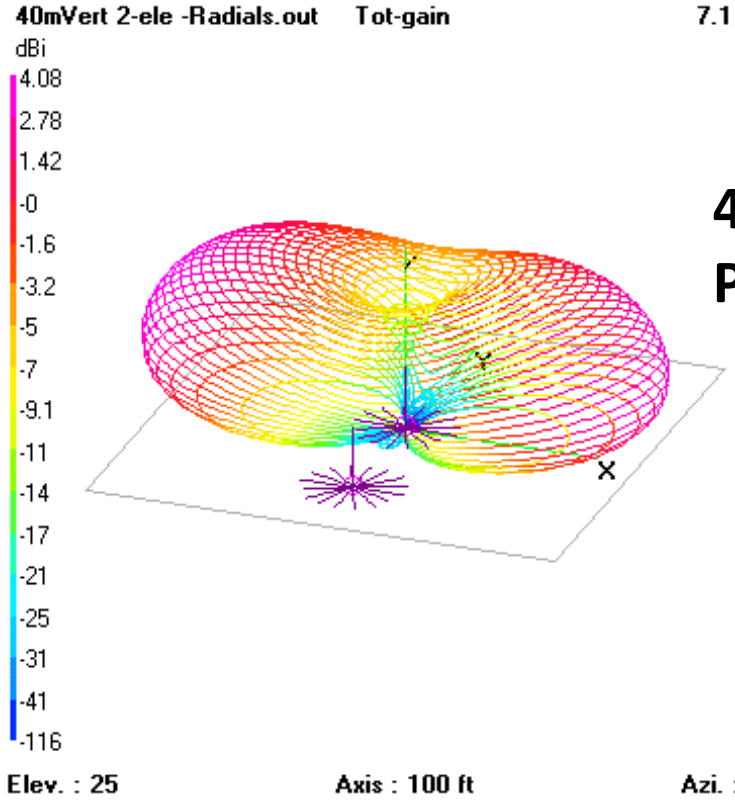
40 Meter Antennas

Alpha-Delta DX-EE Inverted-Vee
Large Coil results in higher losses and narrower SWR bandwidth
SWR between 7.0 and 7.3 MHz



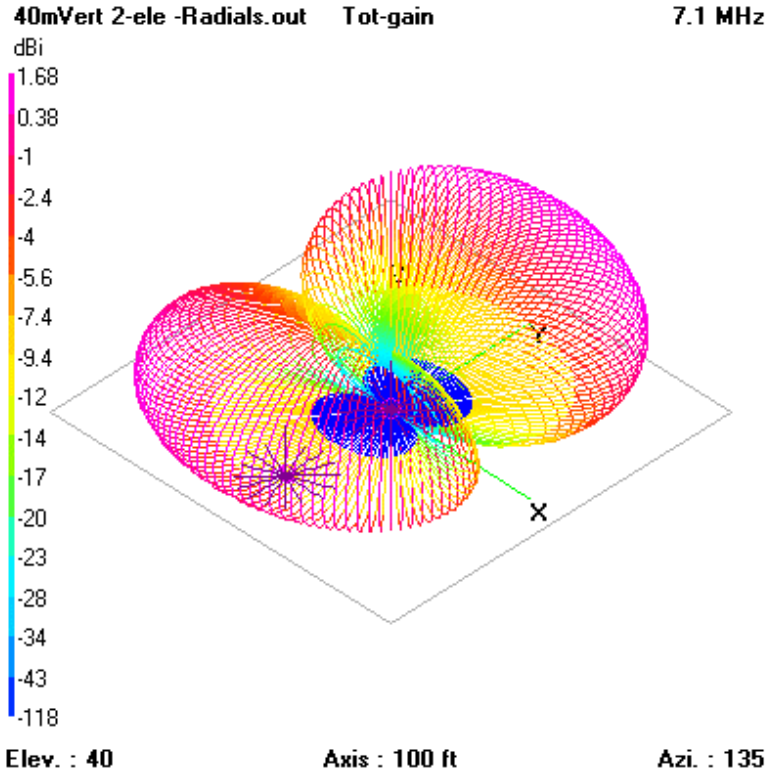


40 Meter Antennas



40 m 2-element Phased Verticals

75 ft Spacing



Broadside Pattern (E/W)
SWR <2.1:1 Across the Entire Band
ERP = 157 W at 25 degrees

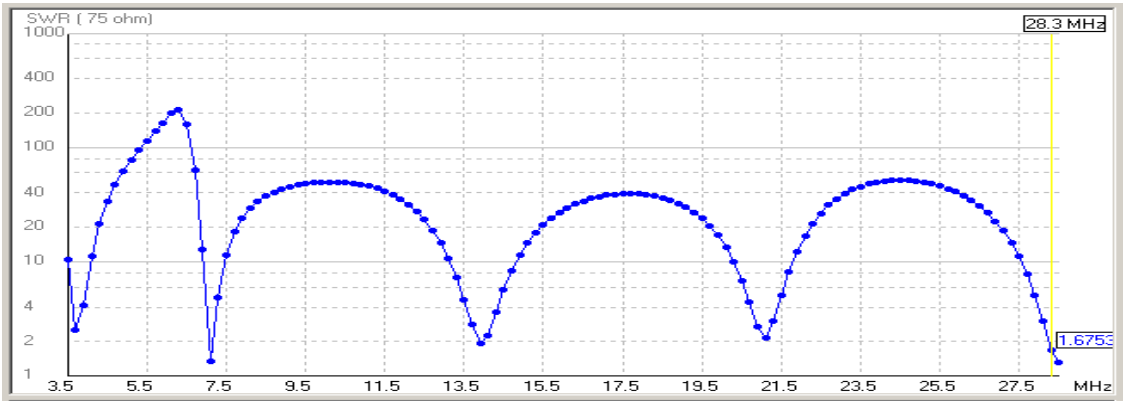
End Fire Pattern (N/S)
SWR <1.5:1 Across the Entire Band
ERP = 90 W at 25 degrees

40 Meter Antennas

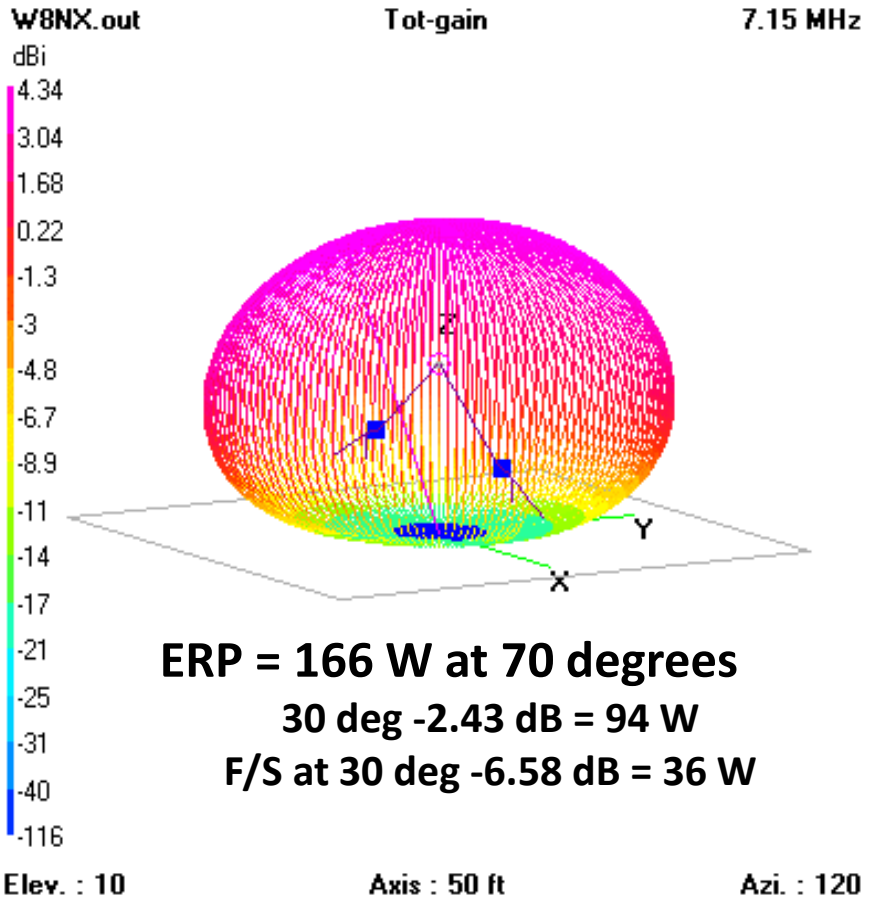
40 meter W8NX Vee

37 ft High -110 deg Apex
107 ft total length
75/40/20/15/10 meter Bands
75-Ohm Feedline
40 m Trap/20-10 m Stub tuned

SWR Covers the bands less than 3:1



No. 15



ERP = 166 W at 70 degrees
30 deg -2.43 dB = 94 W
F/S at 30 deg -6.58 dB = 36 W

40 Meter Antennas

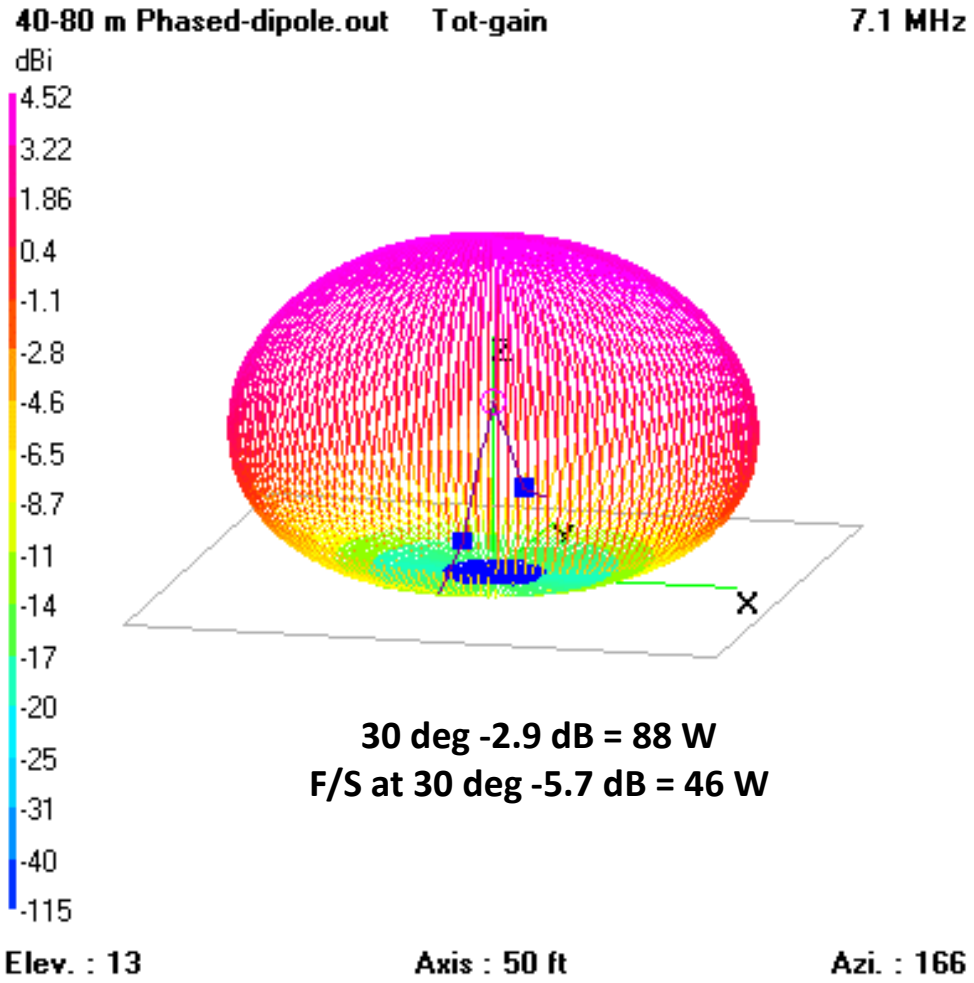
40/80 meter Trapped Dipole

37 ft High -110 deg Apex

Narrow SWR Bandwidth

SWR <3:1 between 7.02 to 7.23 MHz
(Due to Inductance of Traps)

ERP = 172 W at 87.5 degrees



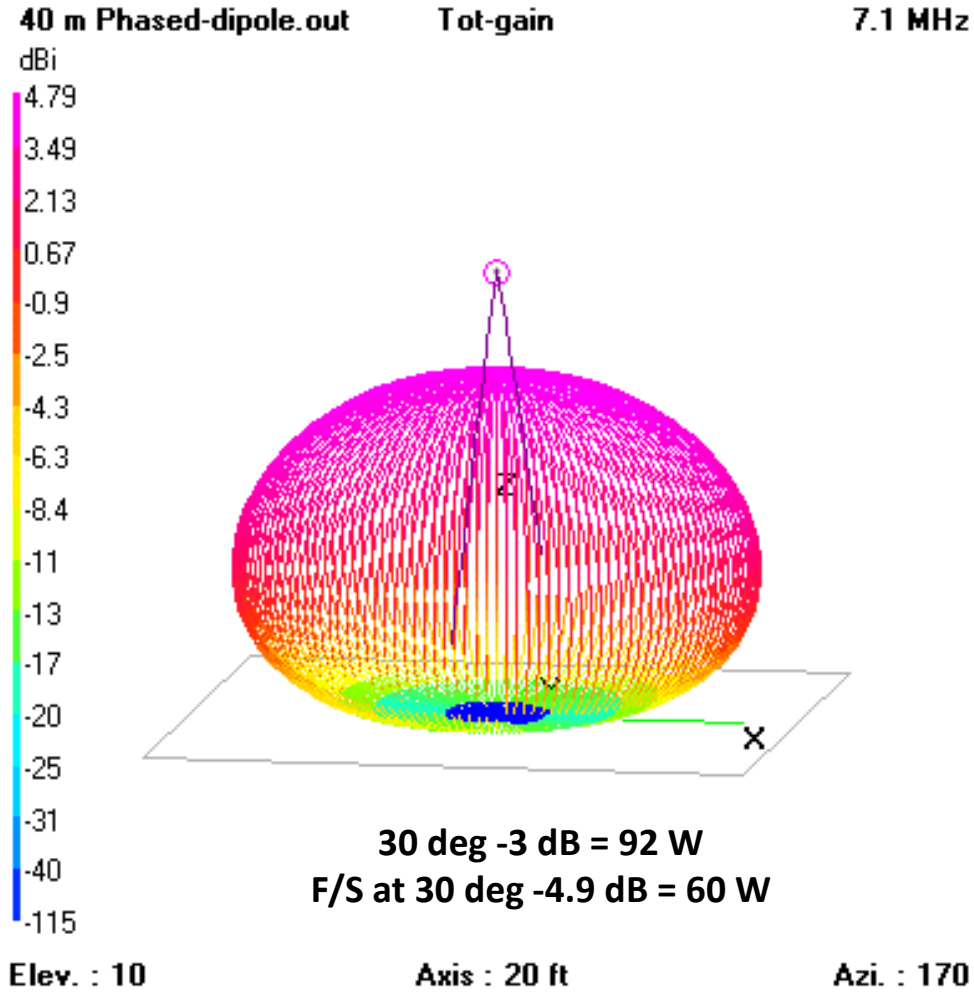
30 deg -2.9 dB = 88 W
F/S at 30 deg -5.7 dB = 46 W

40 Meter Antennas

40 meter ½ WL
Inverted-Vee

65 ft length
37 ft High -90 deg Apex
SWR <2:1 Across the Band

ERP = 184 W at 87.5 degrees



30 deg -3 dB = 92 W
F/S at 30 deg -4.9 dB = 60 W

40 Meter Antennas

40 meter OCF Dipole Vee

K5QY Design

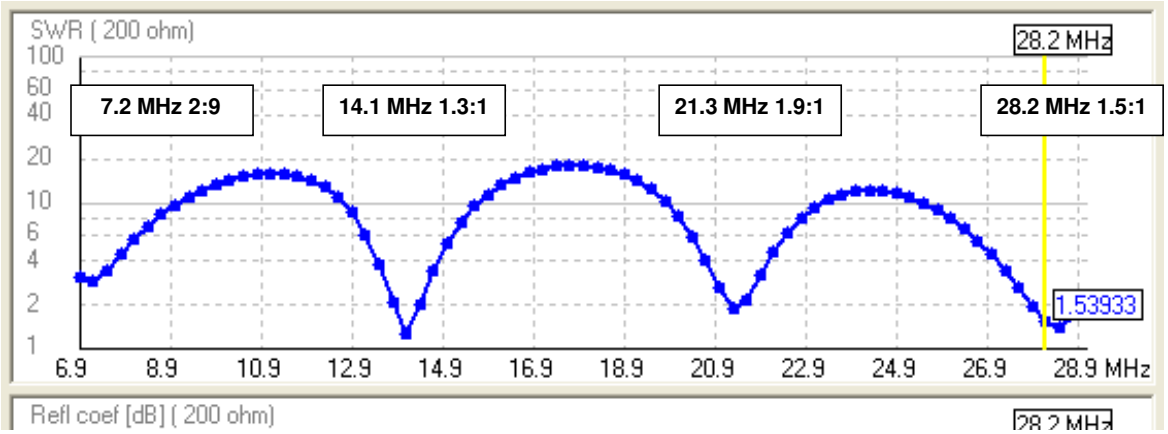
68 Ft 14 AWG Wire

Fed through a 4:1 Current Balun

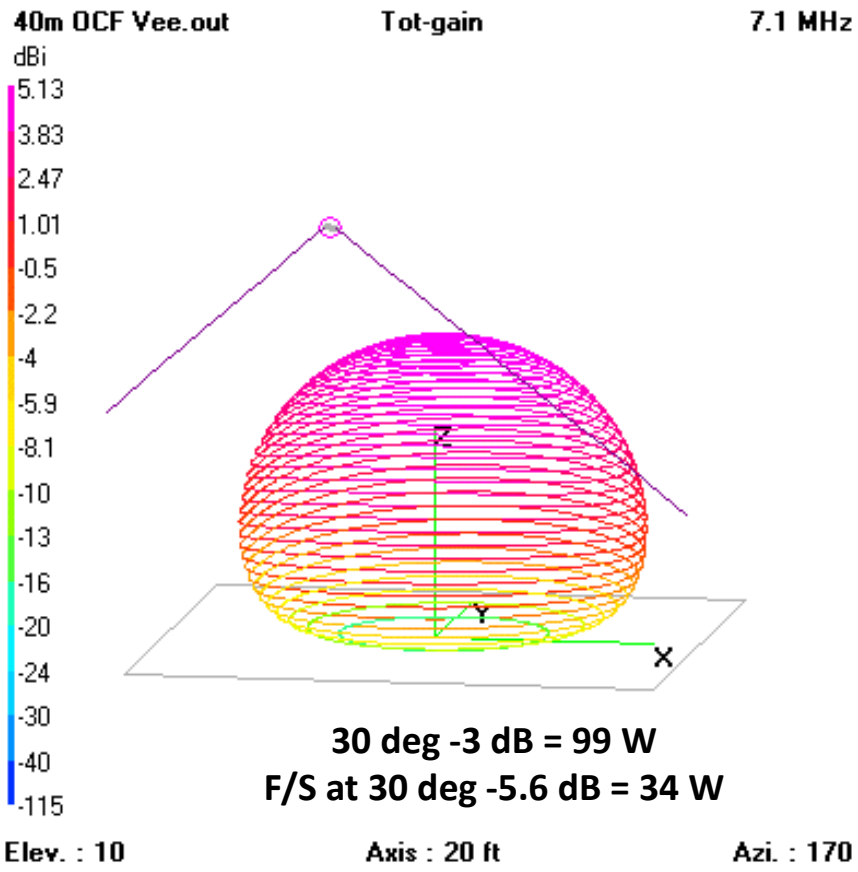
Transceiver SWR 3:1 autotuner

will match 40/20/15/10 meters

ERP = 199 W at 85 degrees



No. 12



30 deg -3 dB = 99 W

F/S at 30 deg -5.6 dB = 34 W

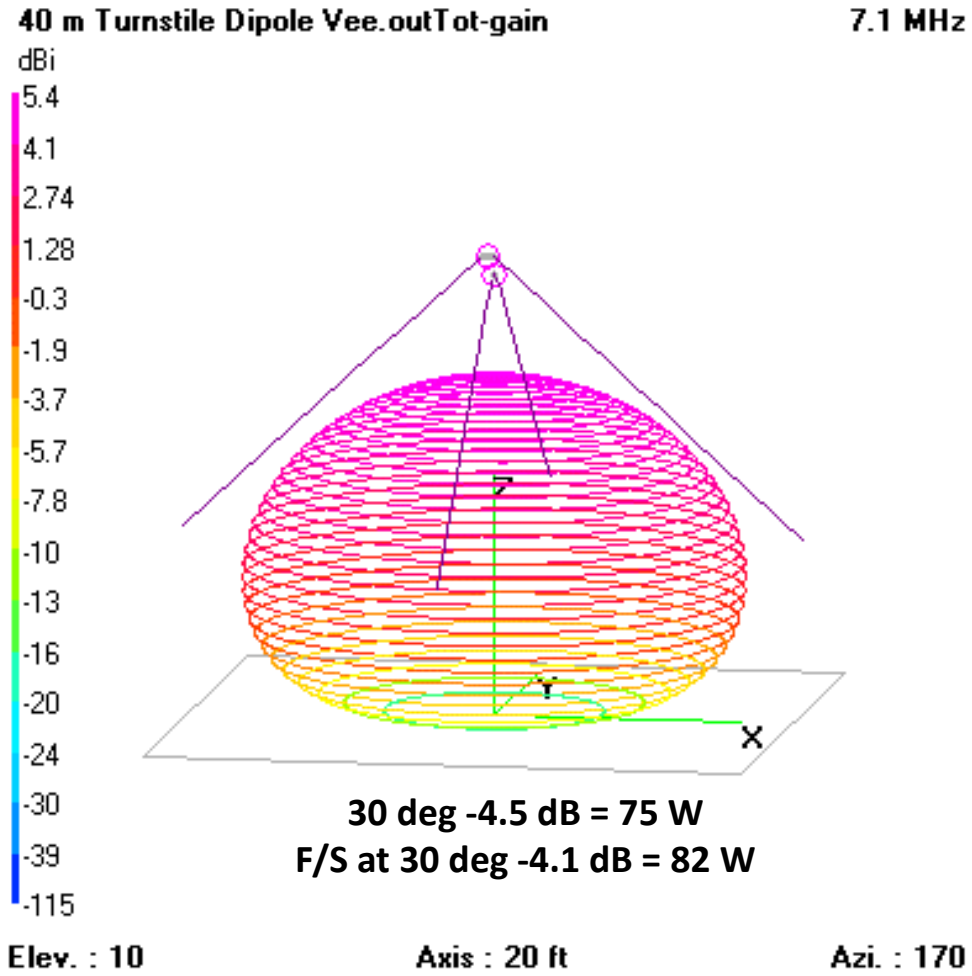
40 Meter Antennas

40 meter Turnstile Inverted-Vee

37 ft High -90 deg Apex
Second Vee Fed with 22 ft RG-58
for 90 degree Phase Delay

SWR <1.8:1 Across the Band

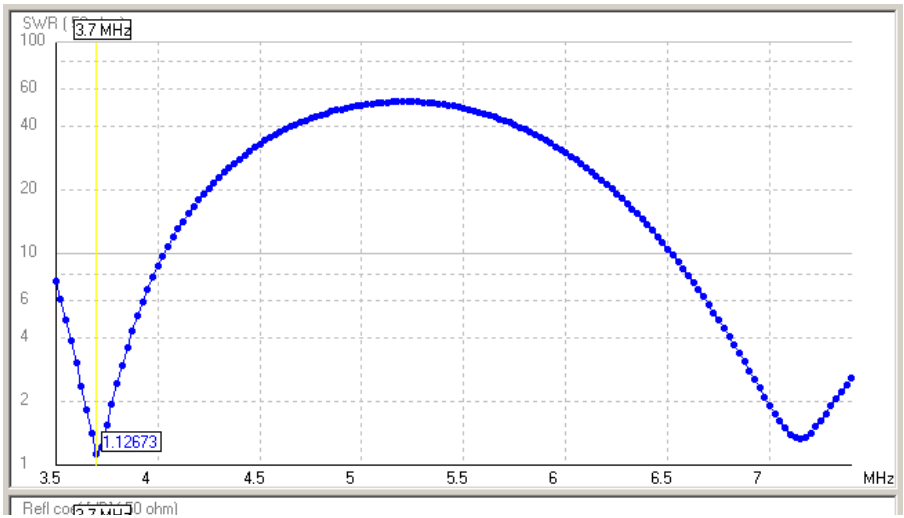
ERP = 211 W at 87.5 degrees

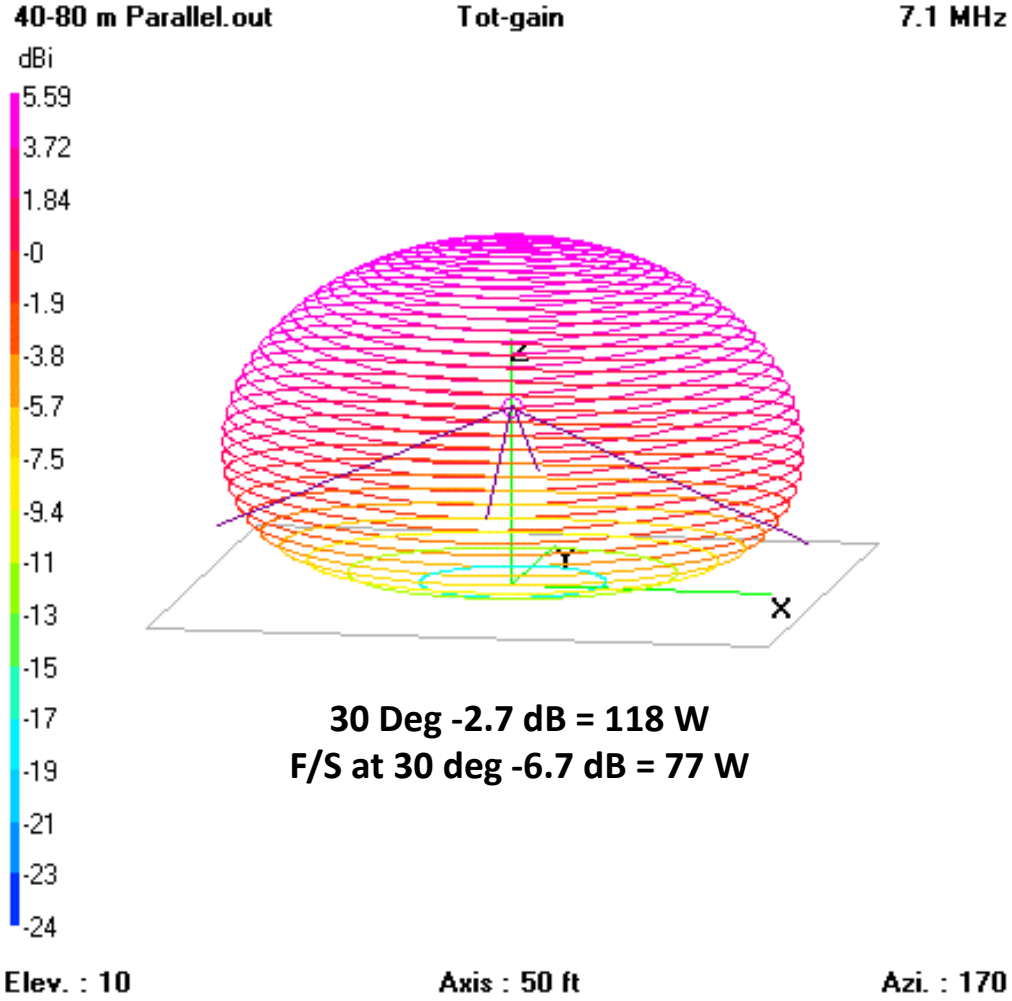


40/80 meter Crossed Vee

37 ft –Apex 125 degrees

ERP = 221 W at 87.5 degrees





30 Deg -2.7 dB = 118 W
F/S at 30 deg -6.7 dB = 77 W

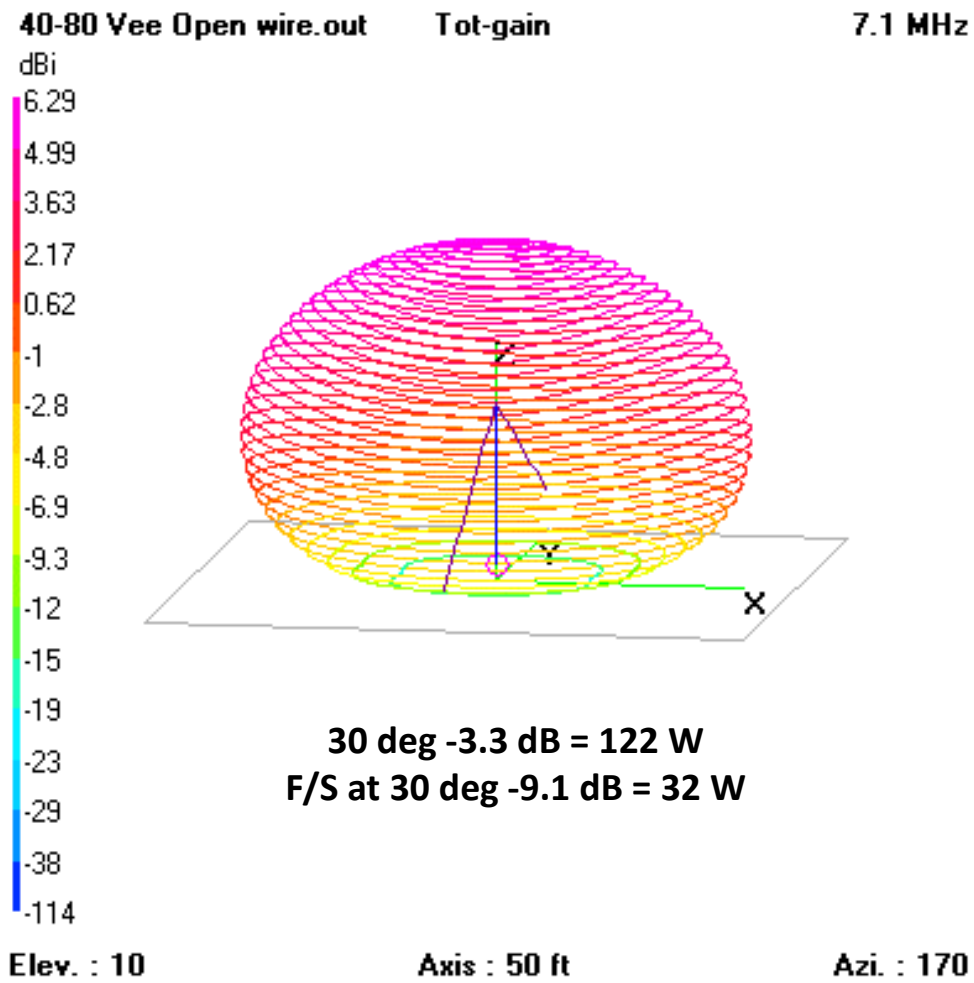
No. 10

40 Meter Antennas

40 meter Full-Wave Vee

131 ft length
37 ft -100 deg apex
¼ W 450-Ohm Matching
SWR <2:1 Across the Band

ERP = 260 W at 87.5 degrees



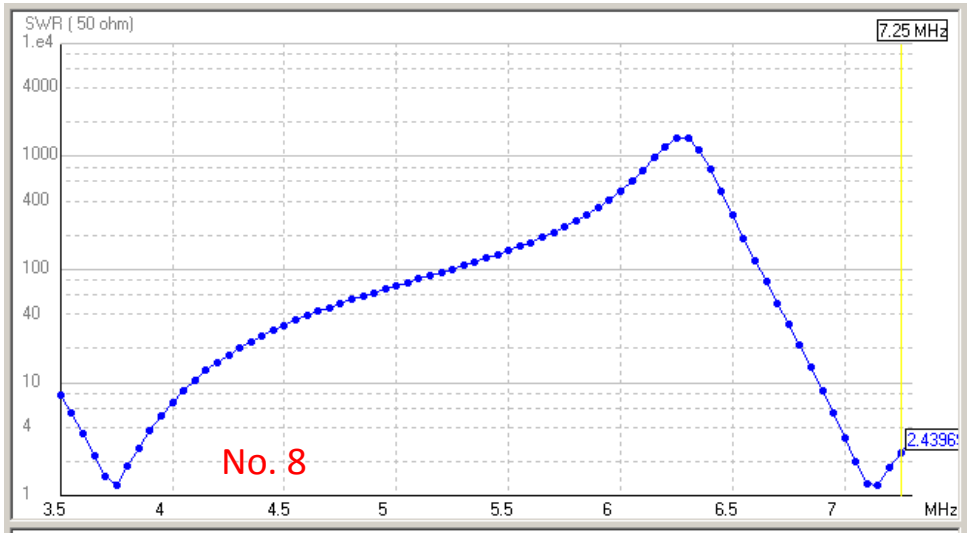
30 deg -3.3 dB = 122 W
F/S at 30 deg -9.1 dB = 32 W

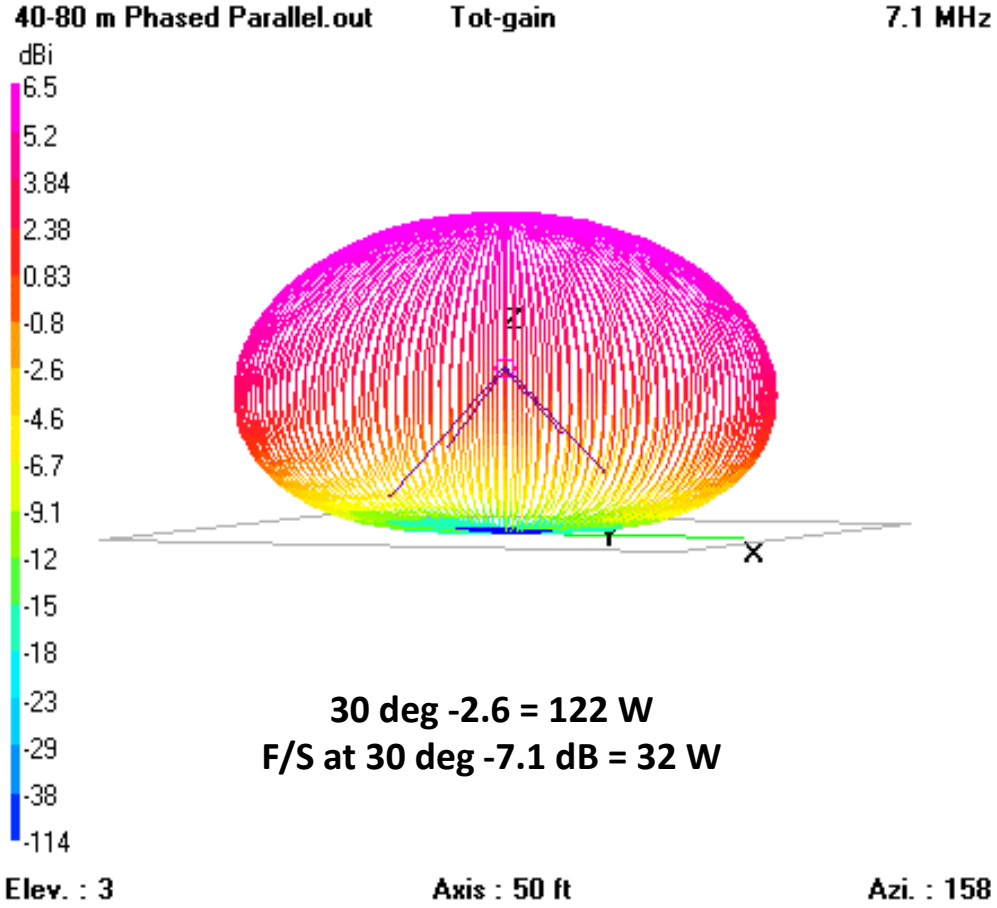
40 Meter Antennas

40/80 meter Parallel Vee

37 ft –Apex 125 degrees

ERP = 272 W at 55 degrees
Requires a 3:1 or better Autotuner
(K3 or TenTec 10:1 Autotuners)





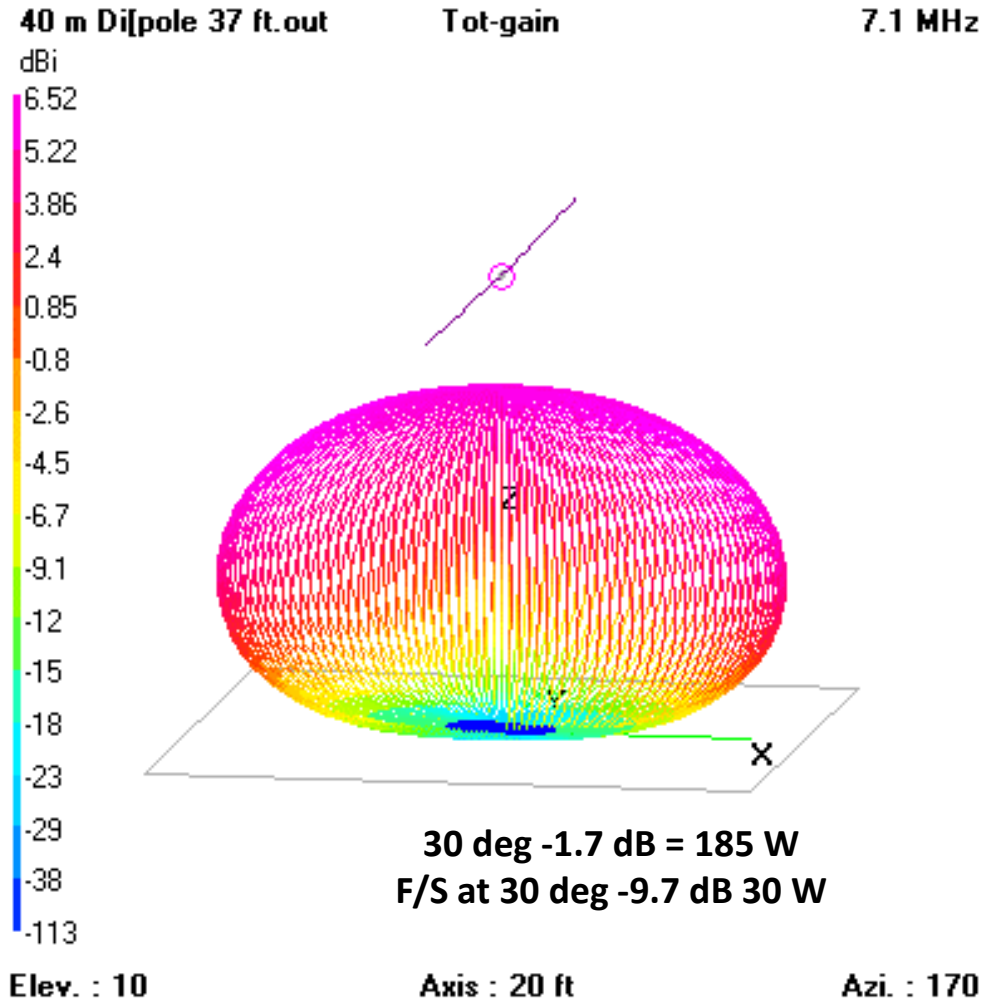
30 deg -2.6 = 122 W
F/S at 30 deg -7.1 dB = 32 W

40 Meter Antennas

40 meter ½ WL Dipole

65 ft Length
37 ft High
SWR <2:1 Across the Band

ERP = 273 W at 57.5 degrees



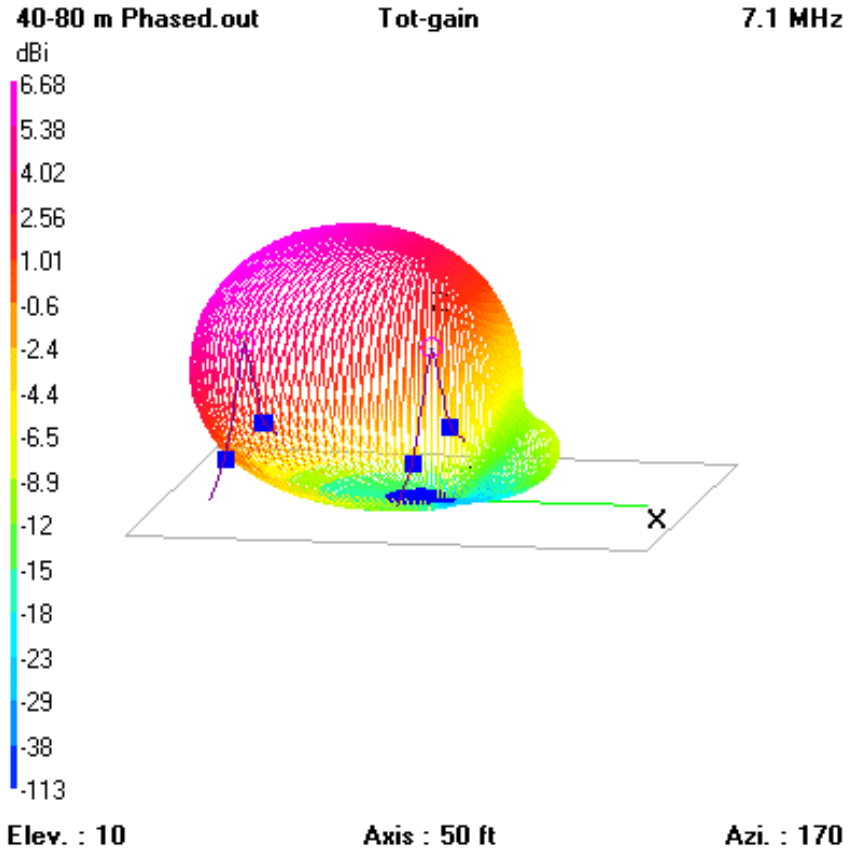
40 Meter Antennas

40/80 meter Trapped Phased Inverted-Vees

37 ft High -110 deg Apex
33 ft Spacing
14 AWG Wire
Unadilla KW-40 Traps
ERP = 276 W at 55 degrees

Narrow SWR Bandwidth
(Due Inductance of Traps)

3.0:1	1.5:1	3.0:1
7.05 MHz	7.12 MHz	7.24 MHz

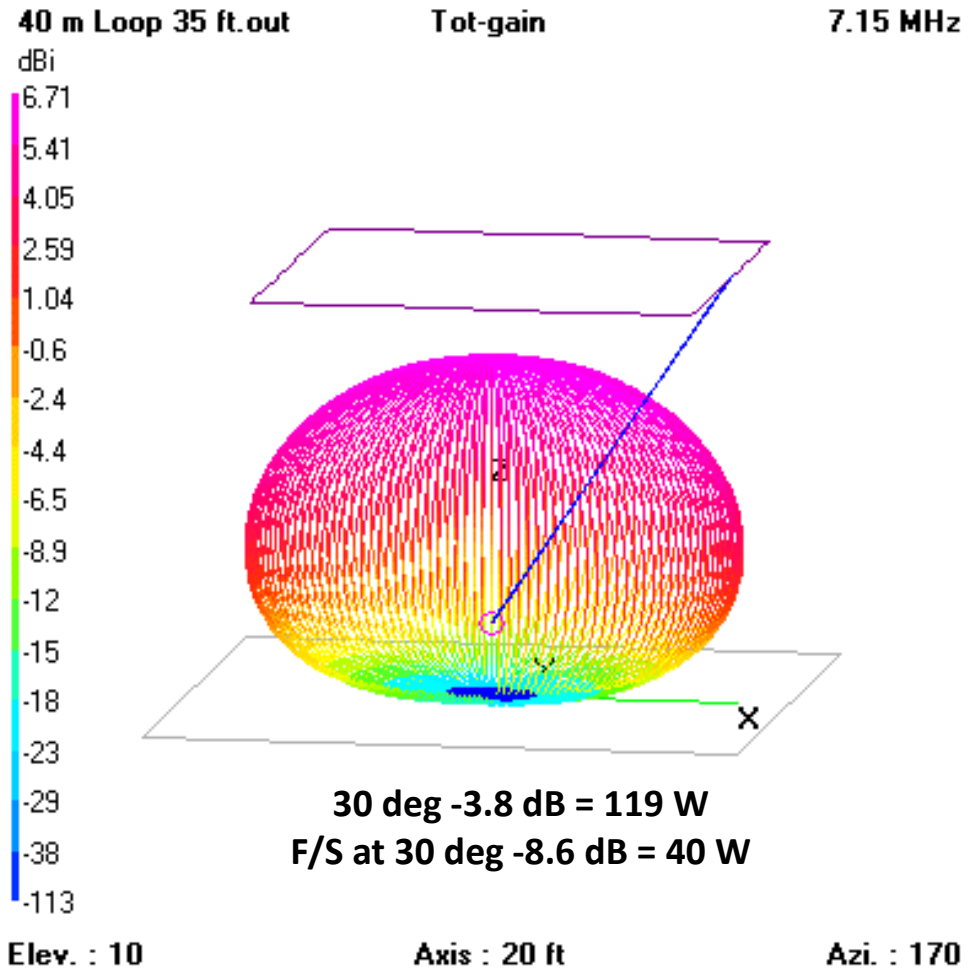


40 Meter Antennas

40 meter Loop

35.5 ft x 35.5 ft
¼ WL 75-Ohm coax matching
SWR <2:1 Across the Band

ERP = 286 W at 87.5 degrees

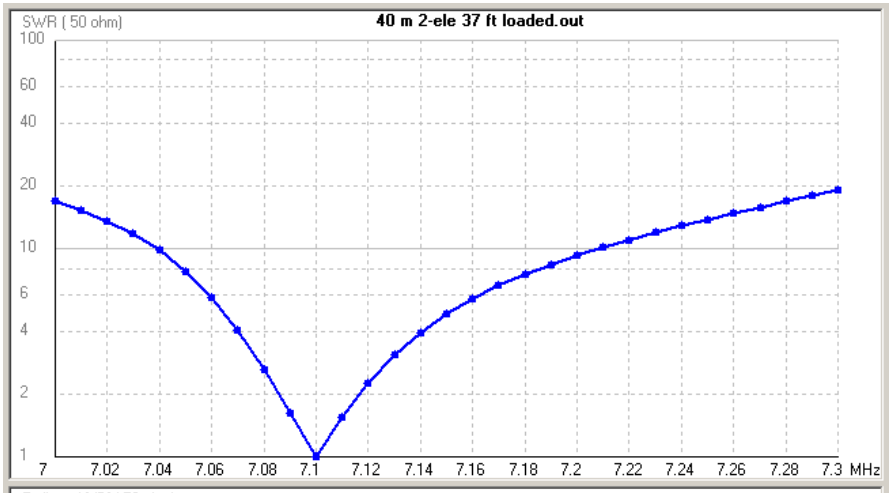


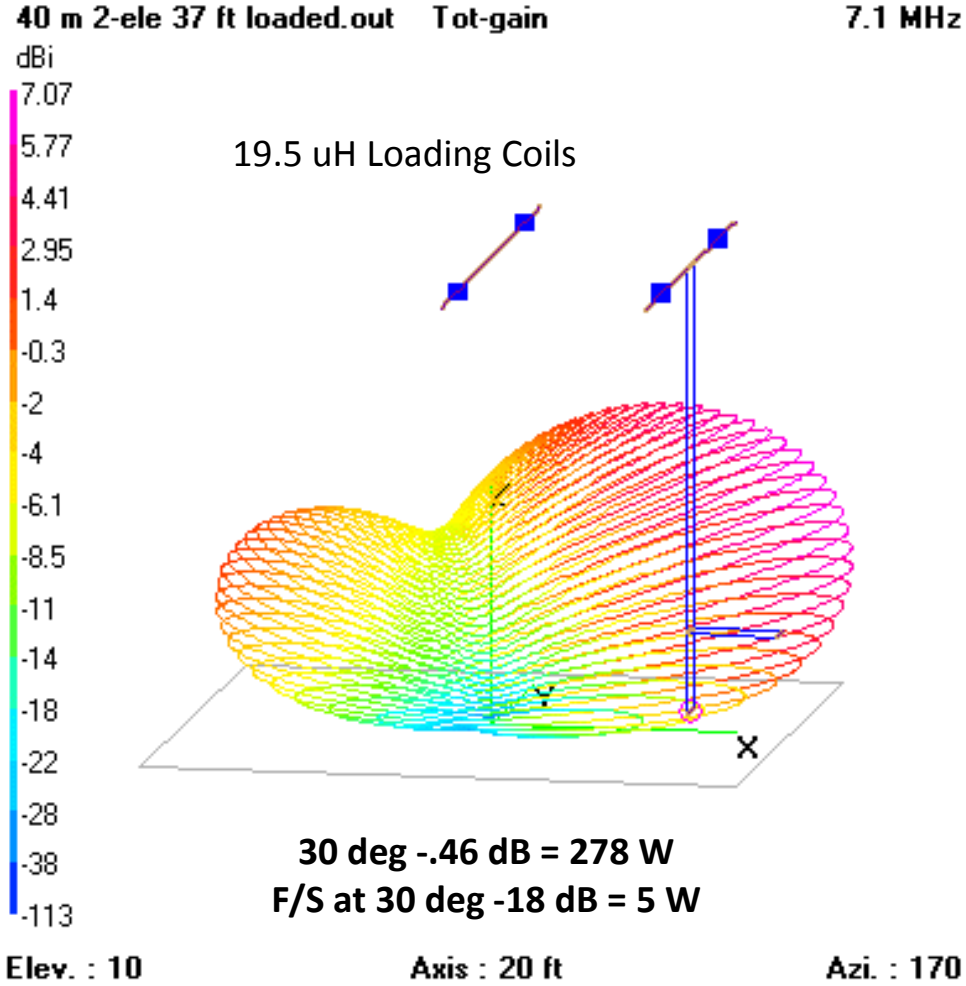
40 Meter Antennas

40 meter 2-ele Loaded Yagi

K5QY designed "Shorty Forty"
Very Narrow SWR Bandwidth
Coaxial Stub Matching

ERP = 314 W at 40 degrees



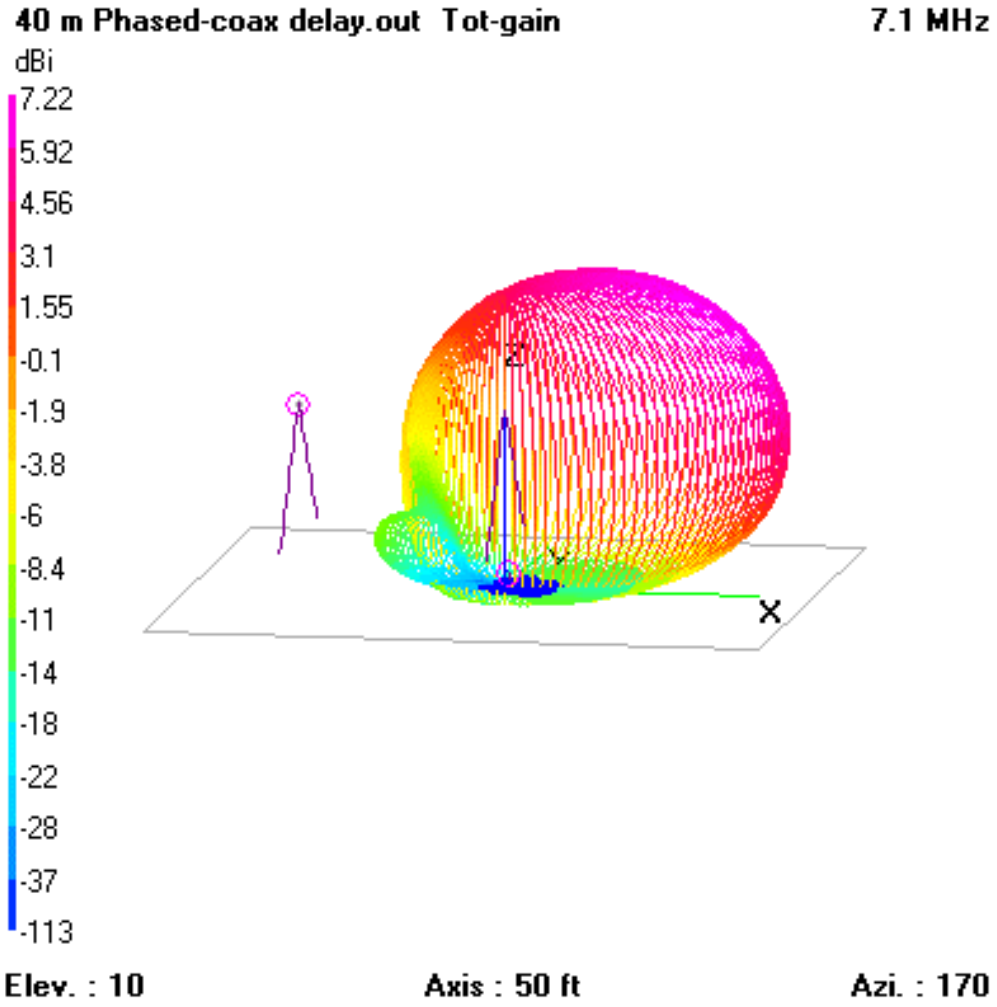


40 Meter Antennas

40 meter Phased Inverted-Vees

½ Wavelength -90 deg Apex
50–Ohm Coax for Phase Delay
Uses ESI Omega-T 2000C
Steering-Combiner
40 ft Spacing

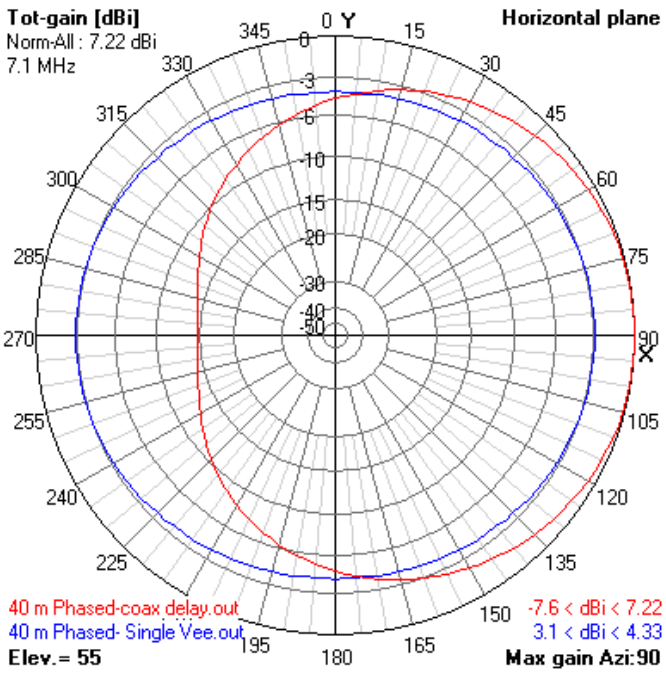
Endfire Pattern
ERP = 322 W at 55 deg Endfire (E or W)
138 W at 55 deg Broadside (N/S)



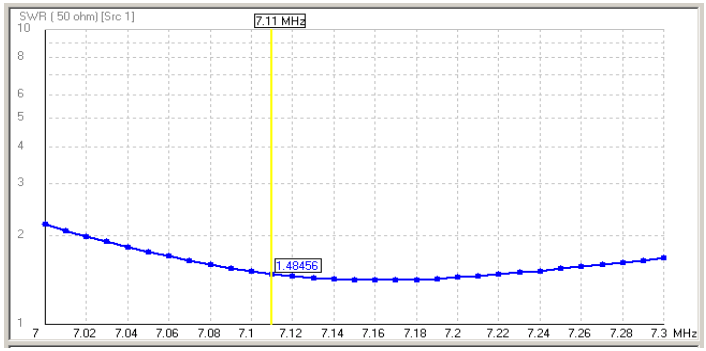
40 Meter Antennas

½ WL Phased Inv-Vees End-fire and Broadside Comparison Vs Single Vee

55 deg Take-Off Angle



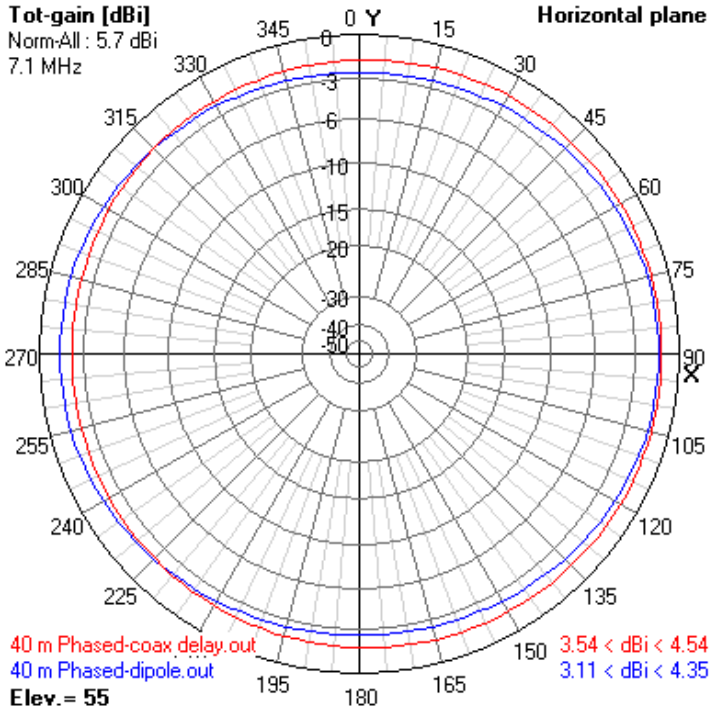
Horizontal End-Fire View



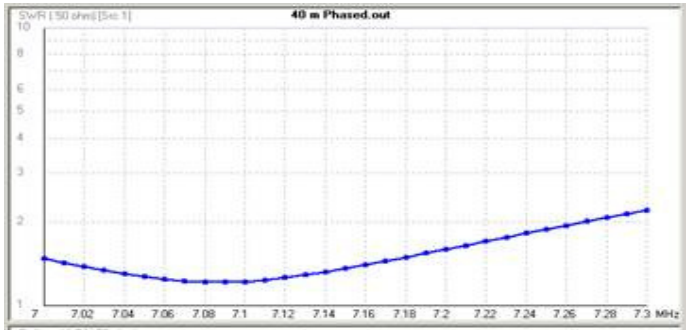
SWR from 7.0 to 7.3 MHz

< End Fire (E/W)

Broadside (N/S) >



Horizontal Broadside View

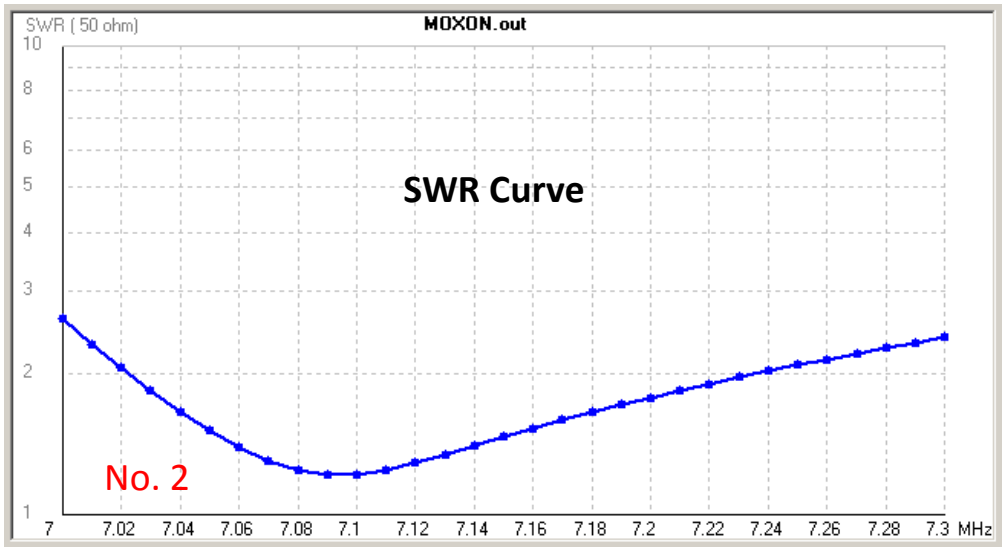


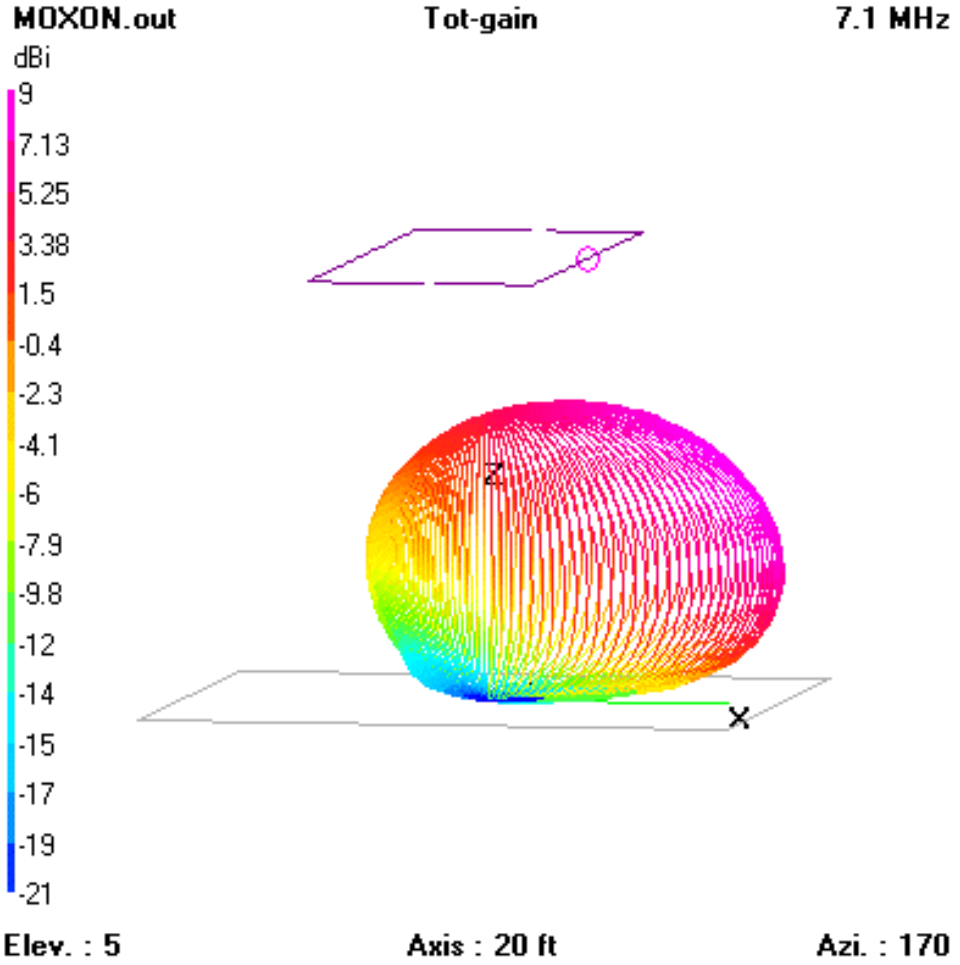
40 Meter Antennas

40 meter Moxon
2-ele Beam

50 ft X 18 ft

ERP = 484.3 W at 40 degrees



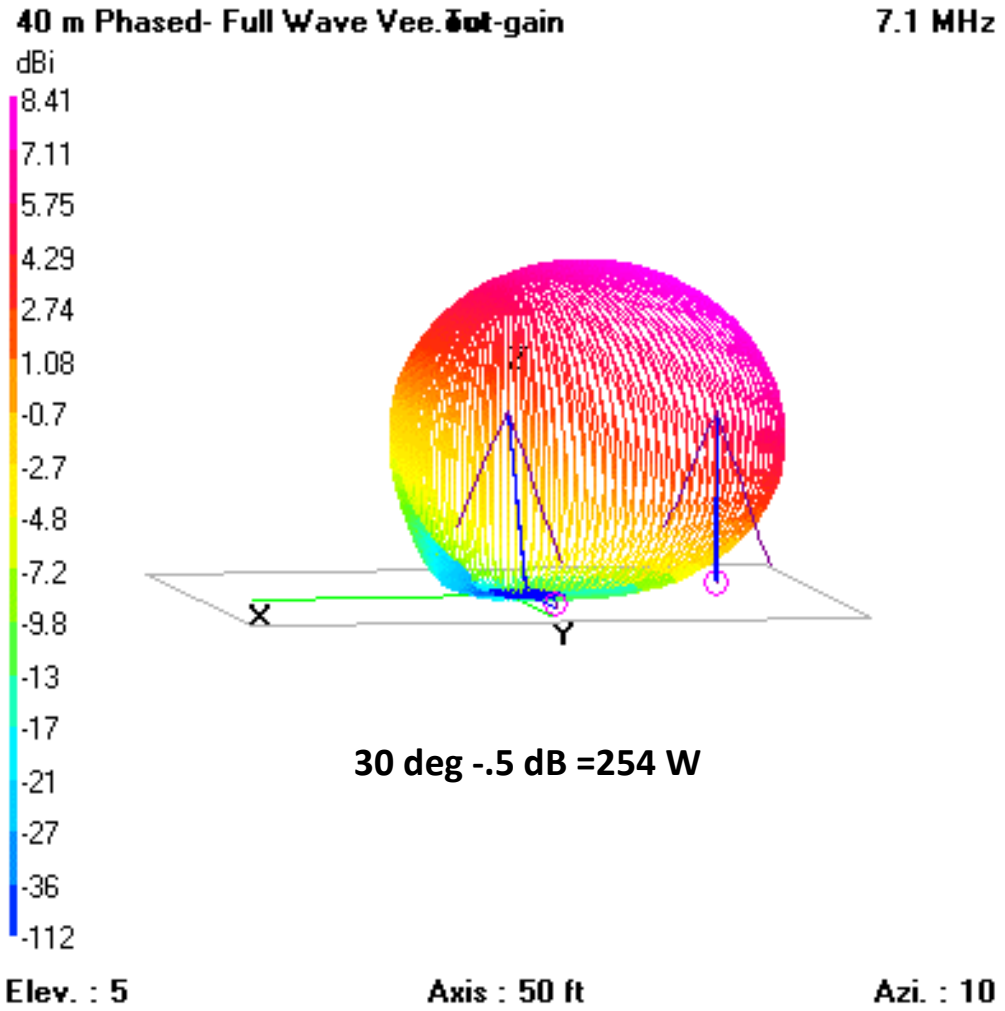


40 Meter Antennas

40 meter Phased Full-Wave Inverted-Vees

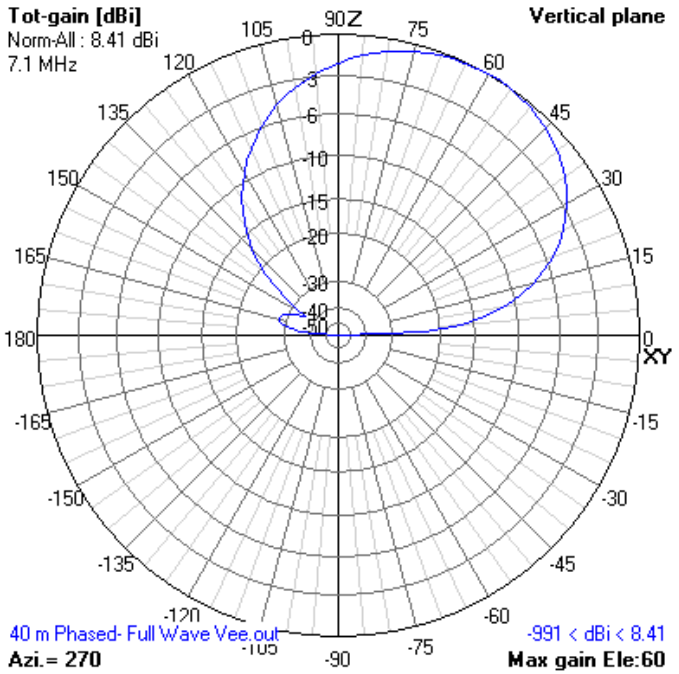
Each leg 63.8 ft –Ends at 10 ft
¼ WL 450-Ohm Matching
50-Ohm Coax for Phase Delay
Uses ESI Omega-T 2000C
Steering-Combiner
40 ft Spacing

ERP = 423 W at 55 deg Endfire (E or W)
173 W at 55 deg Broadside (N/S)



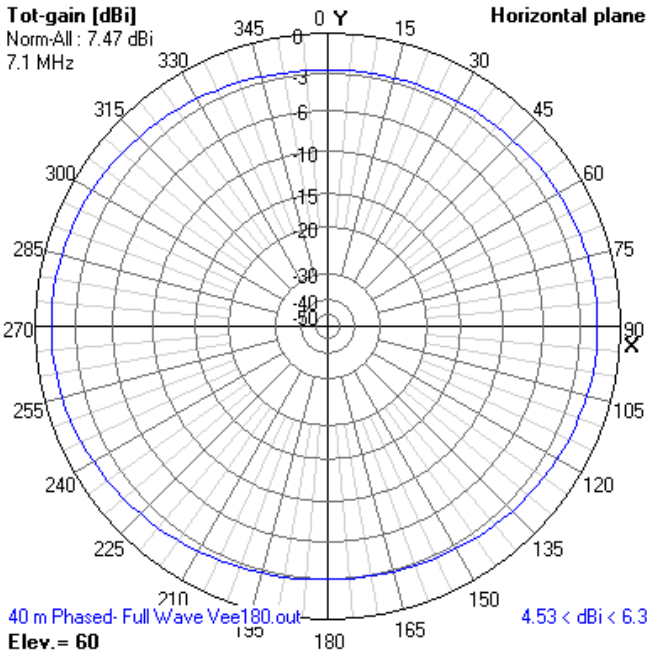
30 deg -.5 dB =254 W

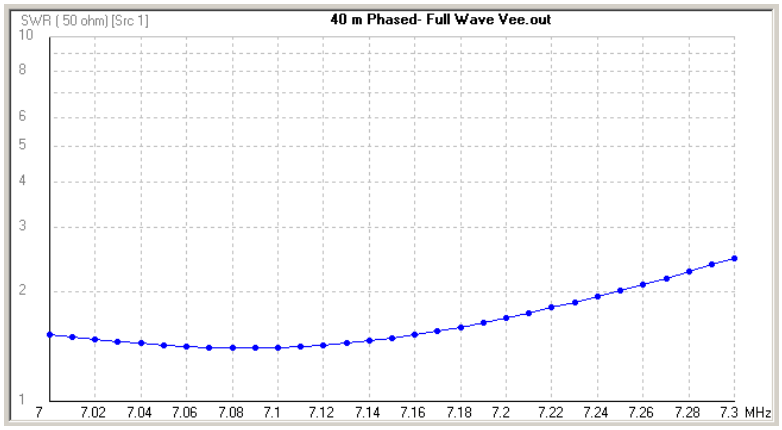
40 Meter Antennas



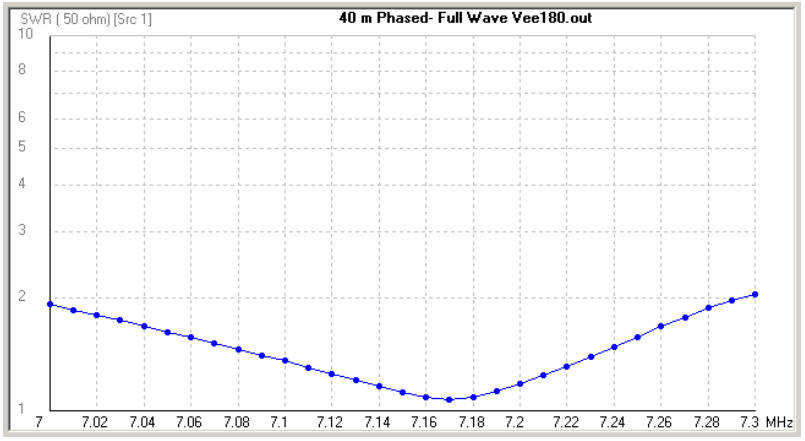
< Gain Pattern Endfire
(E or W) 8.41 dBi at 55 deg

Gain Pattern Broadside
(N/S) 4.53 dBi at 55 deg >





SWR 7 to 7.3 MHz
< E or W N/S >



40 meter Phased Full-Wave Inverted-Vees

Gain and F/B Curve at 55 degrees

(Tuned for best SSB)

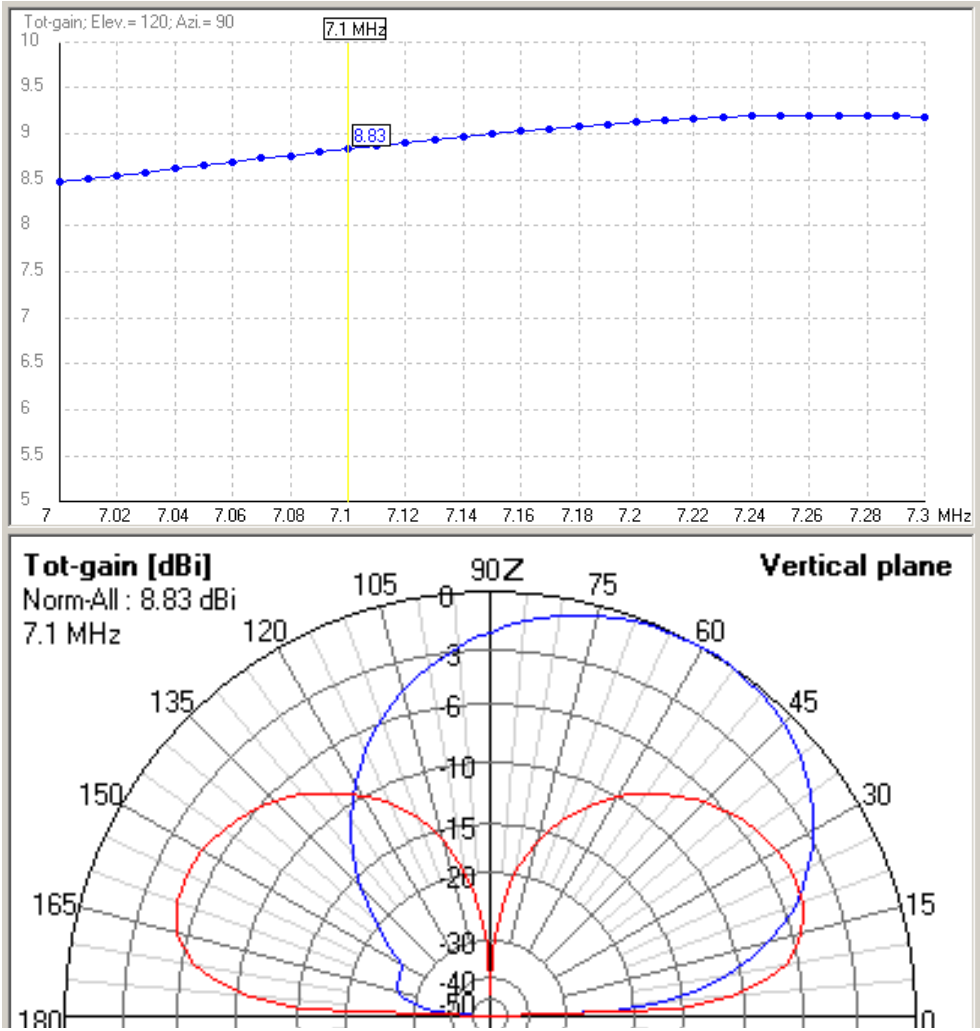
62.38 ft Each leg

Ends raised from 10 ft to 12 ½ ft

and a slight decrease of wire lengths

Increases Antenna Impedance and improves the 450-Ohm transformation to 50 Ohms

Slight improvement of SWR BW and Gain



Phased Verticals Vs Phased Full-Size Vees

2015 40 Meter Field Day Antennas

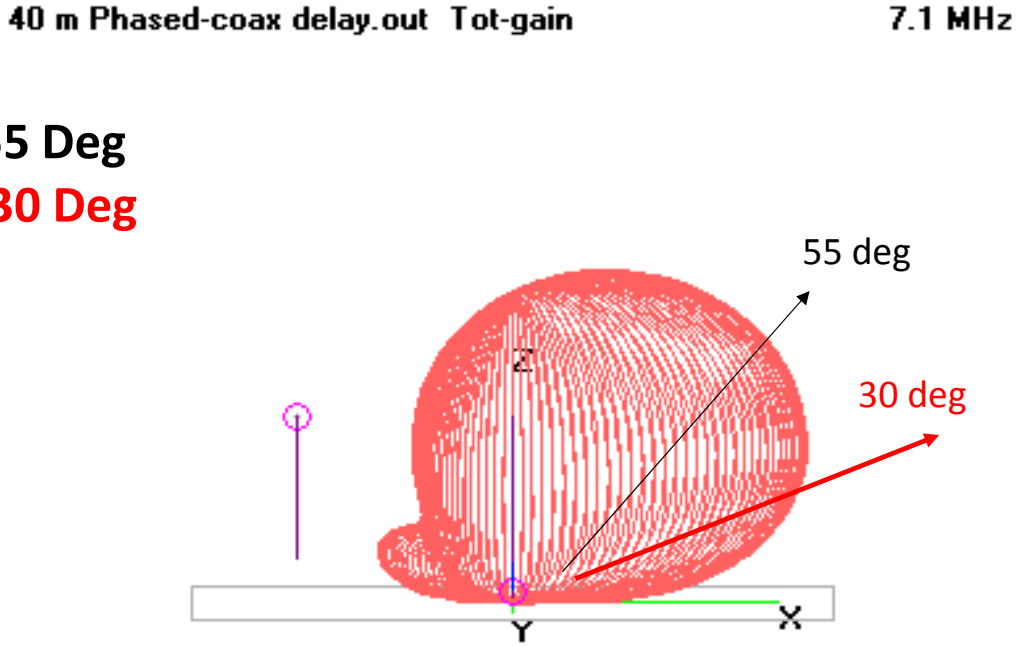
2014 Field Day Antenna

Single 40/80 m Inv-Vee 37 ft
apex approximately 120 degrees

ERP = 158 W at 55 Deg
= 133 W at 30 Deg

2015 Field Day Antenna

Two full-size phased Inverted-Vees
for 40 m (no 80 m operation planned)



ERP = 634 W at 55 Degrees (150 W)
= 380 W at 30 Degrees

THE END

K5QY

http://www.k5qy.net/