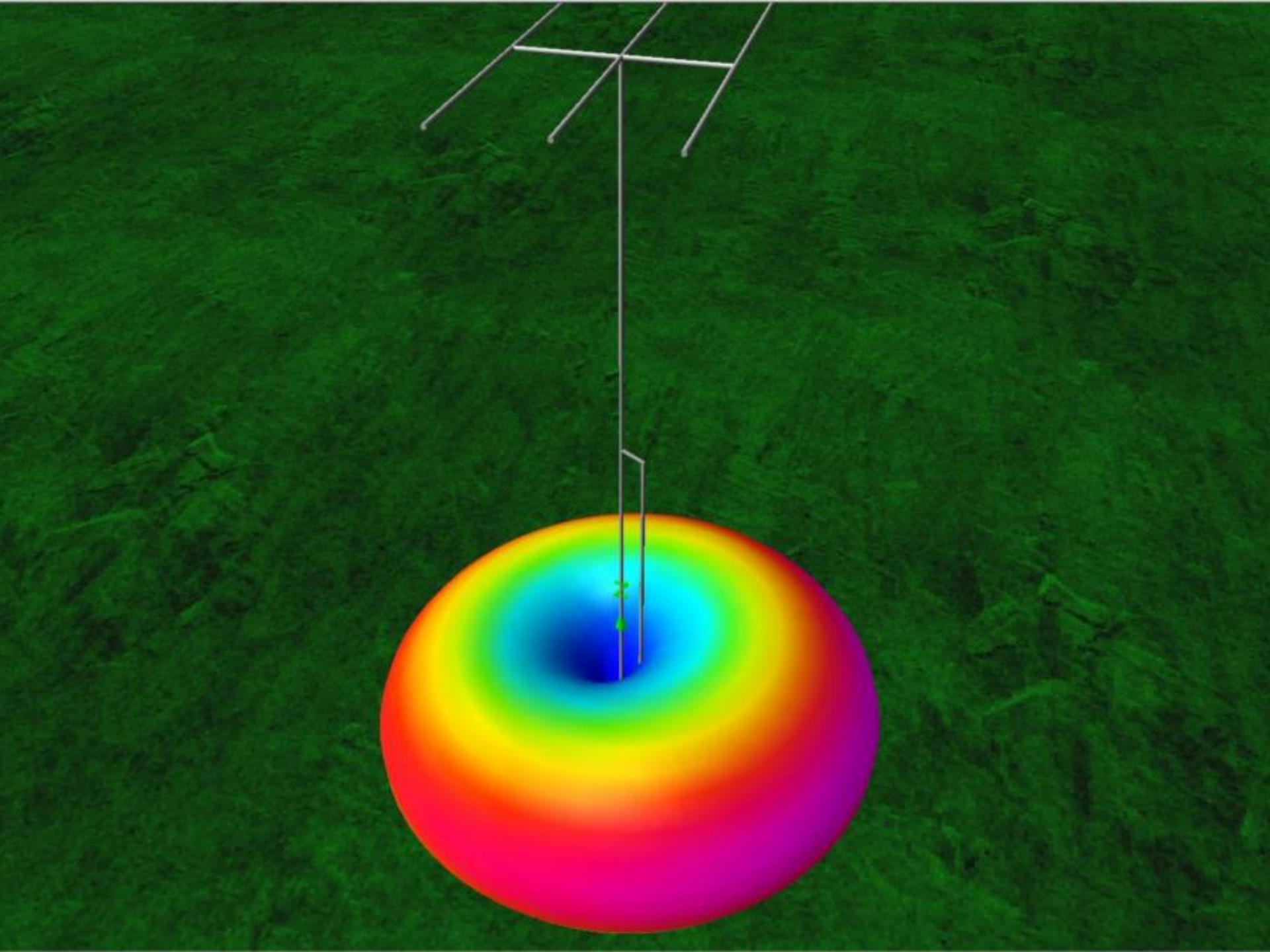
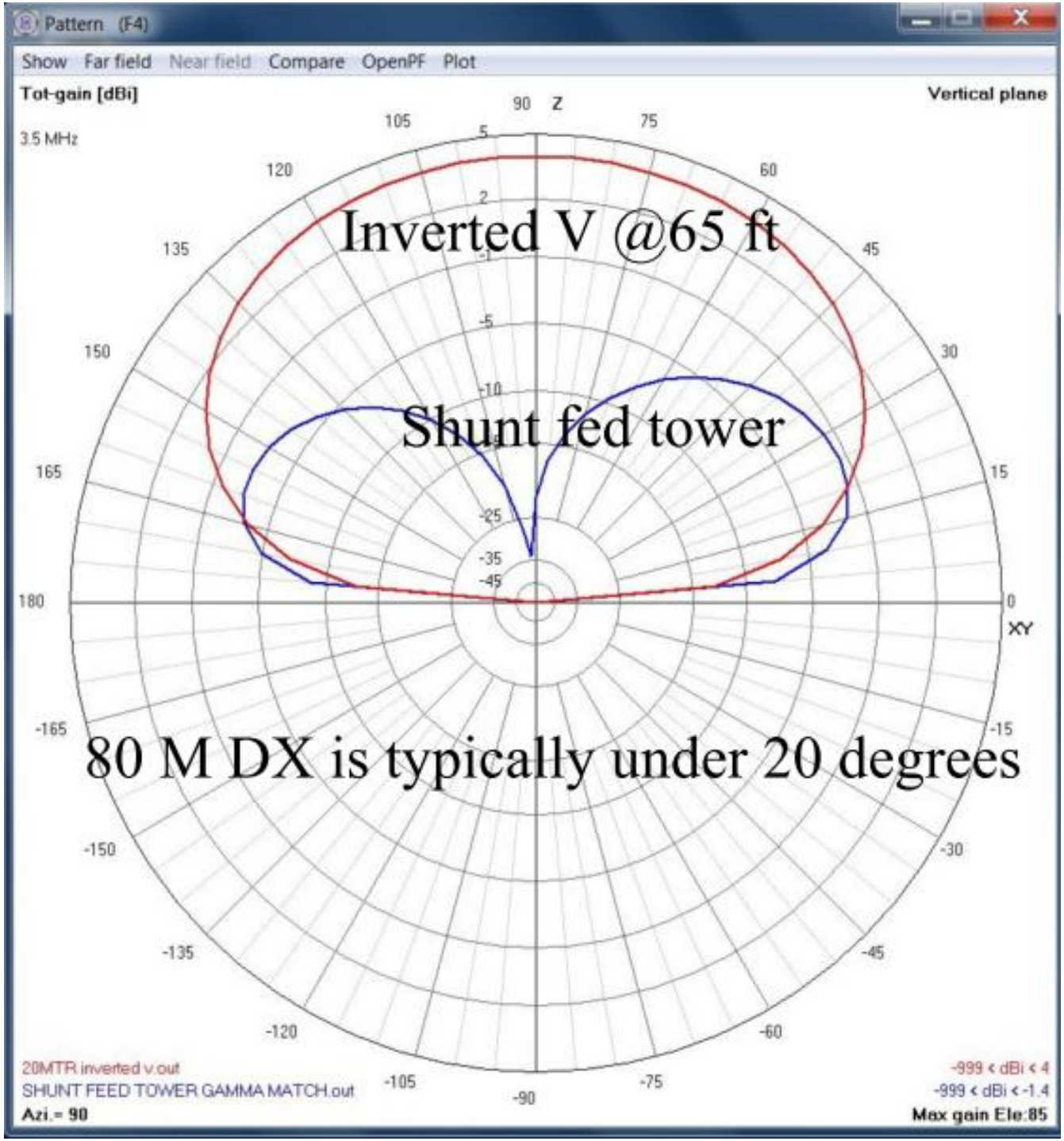
Mast som antenne på 160-80-40

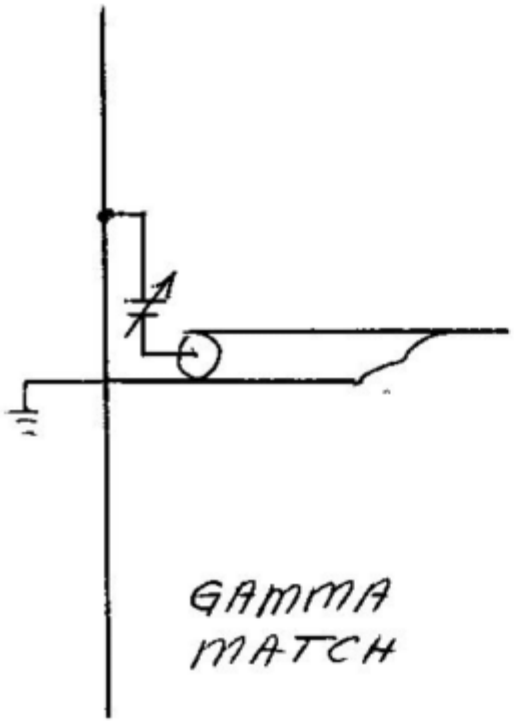
Håvard Nasvik

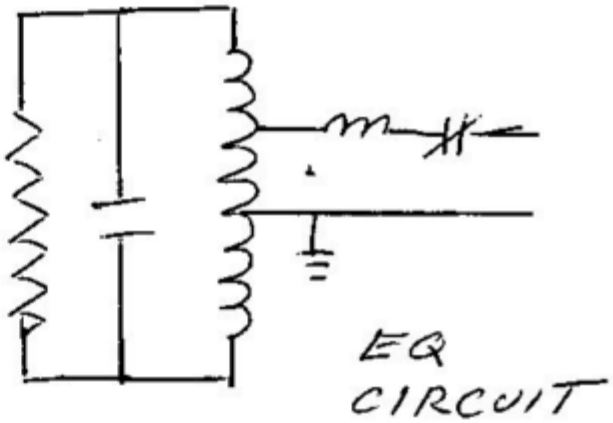
LB9RE

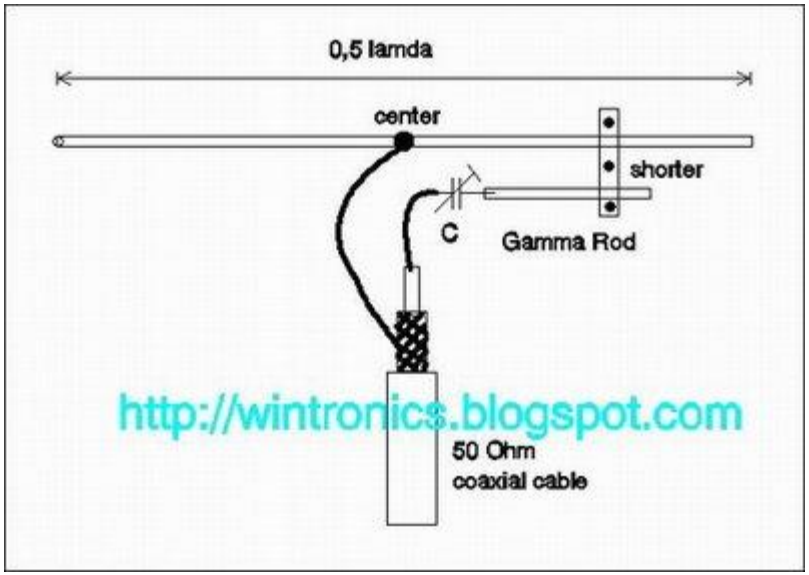


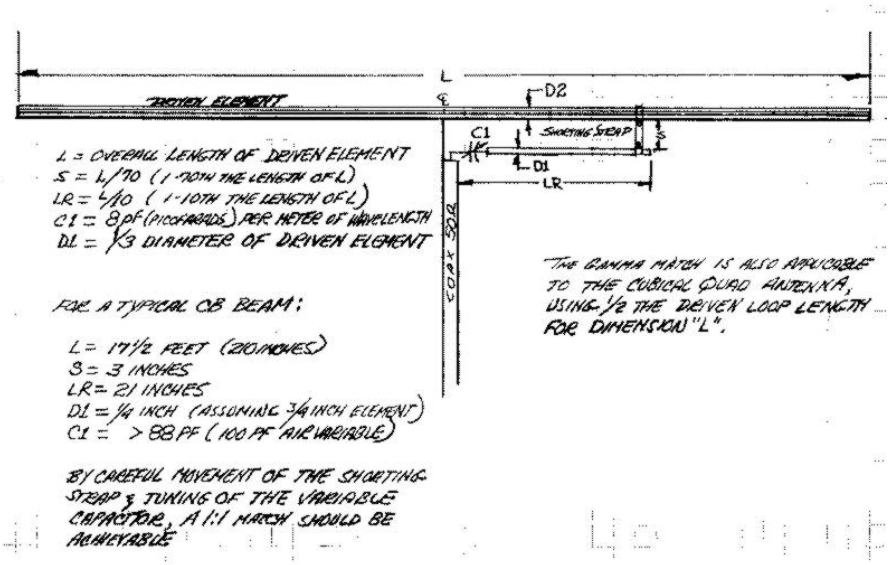

Pattern (F4)
Show Far field Near field Compare OpenPF Plot
Tot-gain [dBi]
Vertical plane
3.5 MHz
Inverted V @65 ft
Shunt fed tower
80 M DX is typically under 20 degrees
20MTR inverted v.out
SHUNT FEED TOWER GAMMA MATCH.out
Azi.= 90
-999 < dBi < 4
-999 < dBi < -1.4
Max gain Ele:85

The Gamma Match









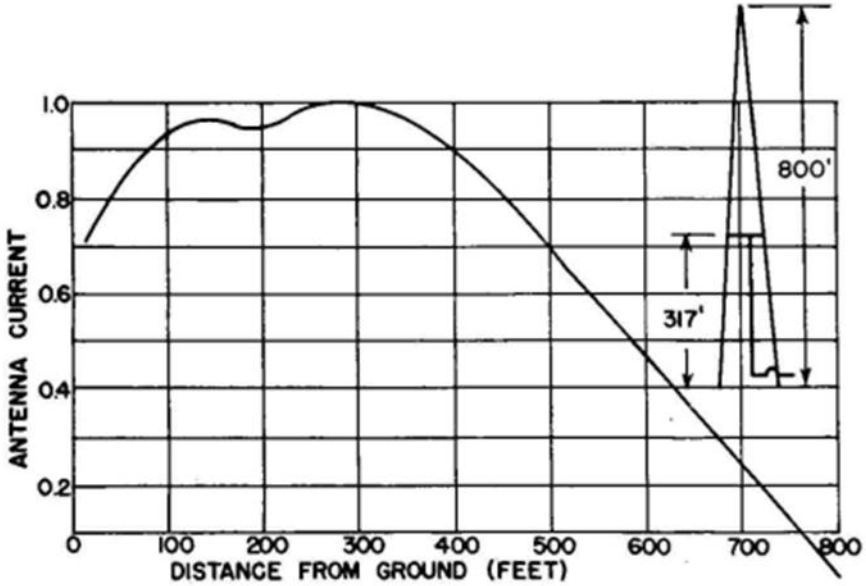
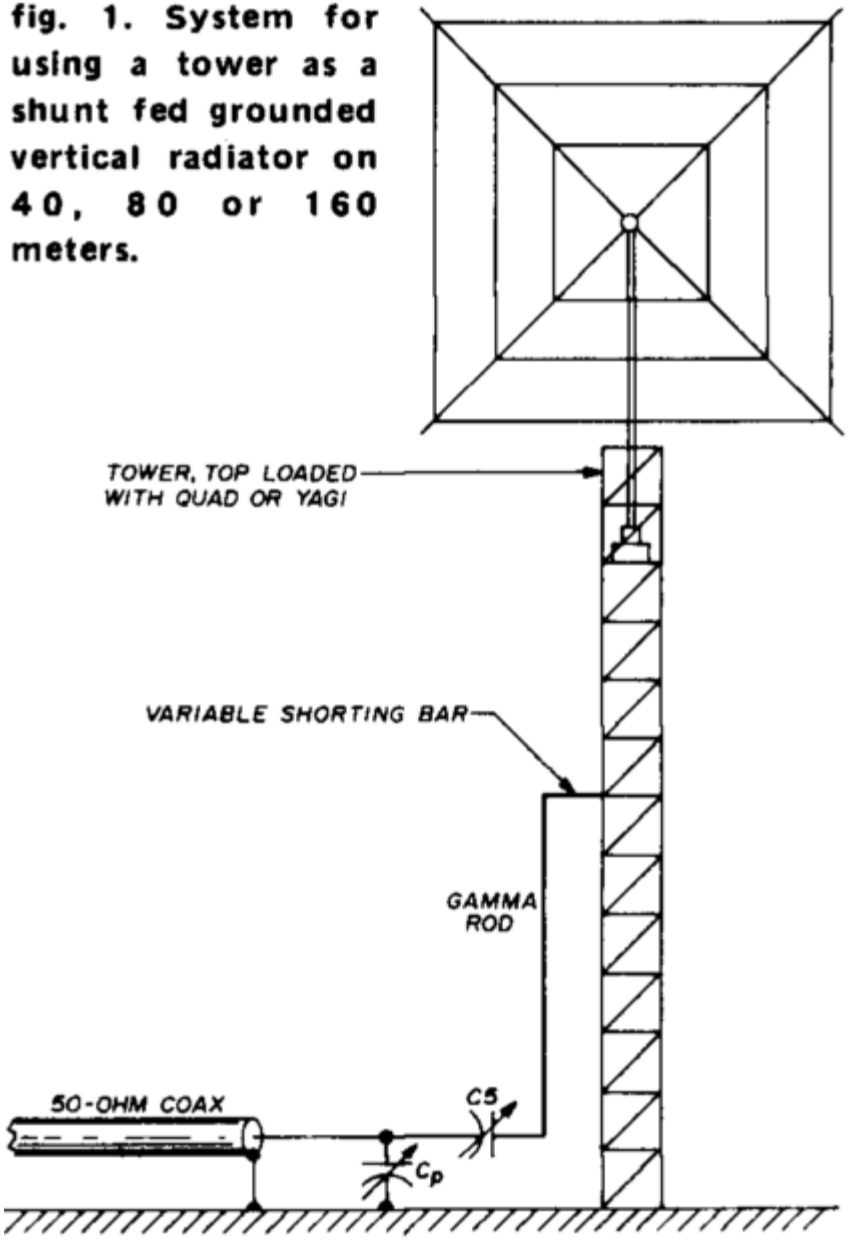


fig. 1. System for using a tower as a shunt fed grounded vertical radiator on 40, 80 or 160 meters.



W4OQ, John R. True,
Ham Radio,
May 1975, s 34-39

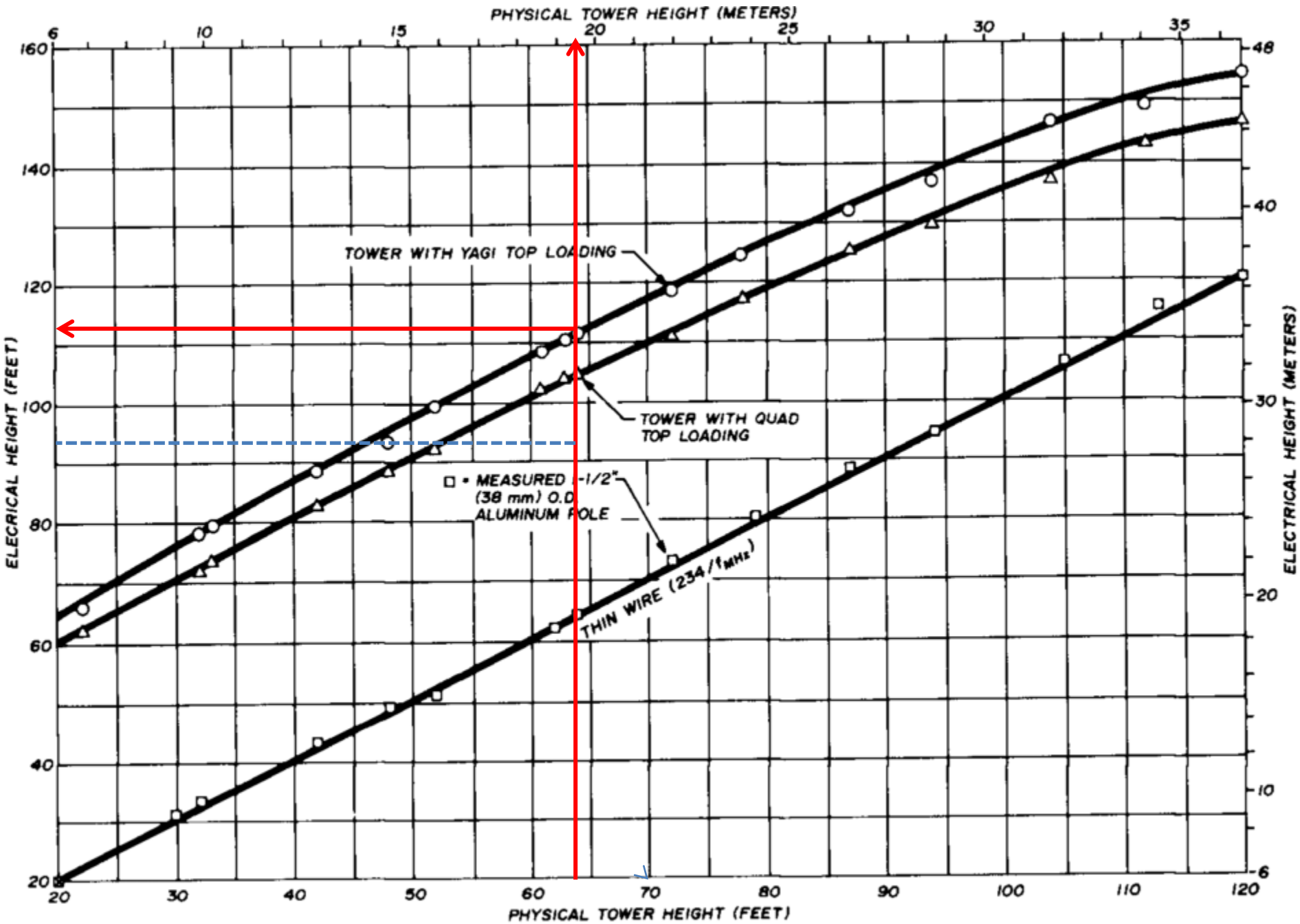


fig. 2. Physical vs electrical height of towers top loaded with Yagi beams or cubical quads.

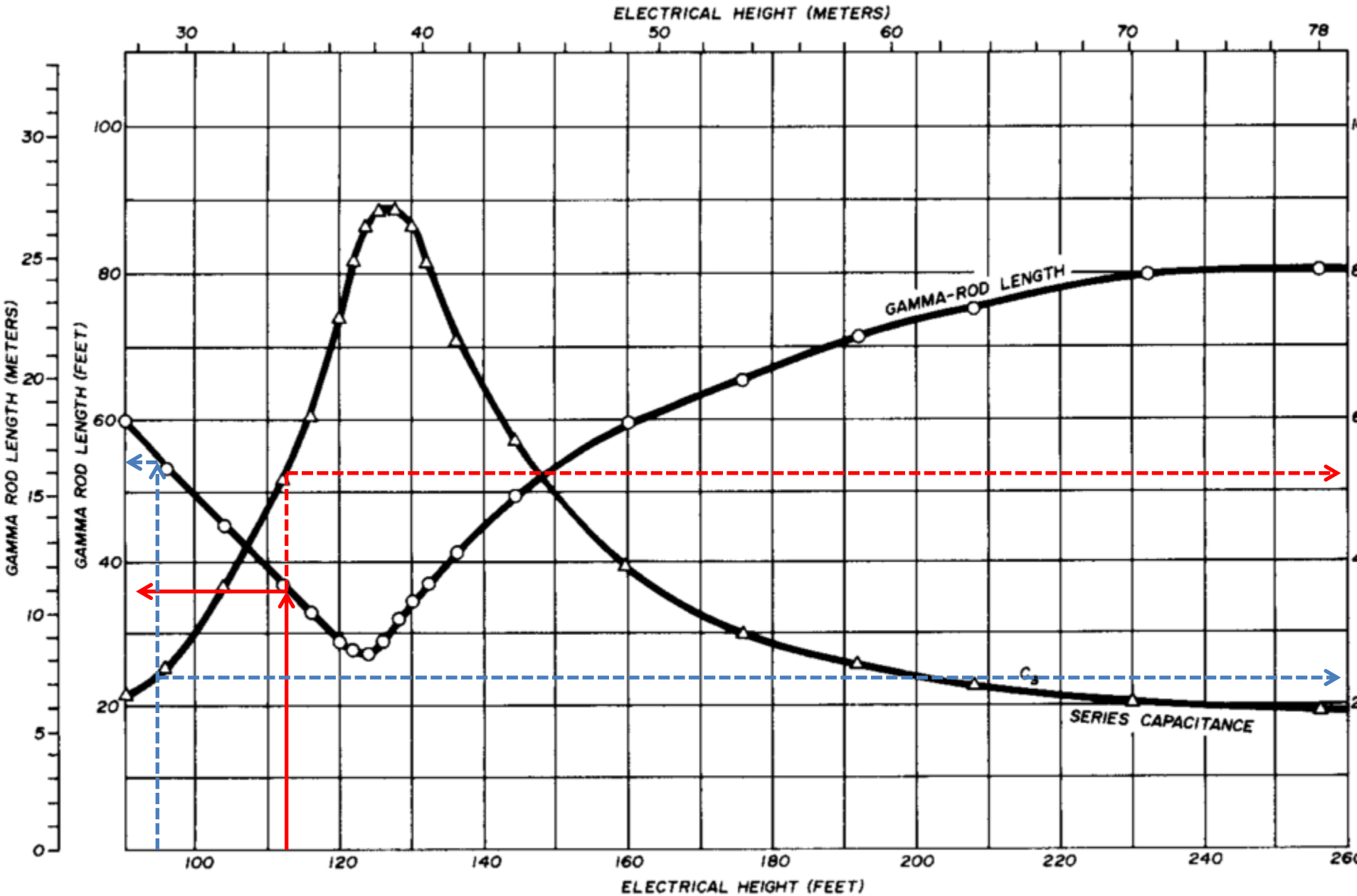


fig. 5. 160-meter vertical. Gamma rod length and series capacitance vs electrical height of tower Parallel capacitance required to match 50-ohm transmission lines is approximately 1300 pF.

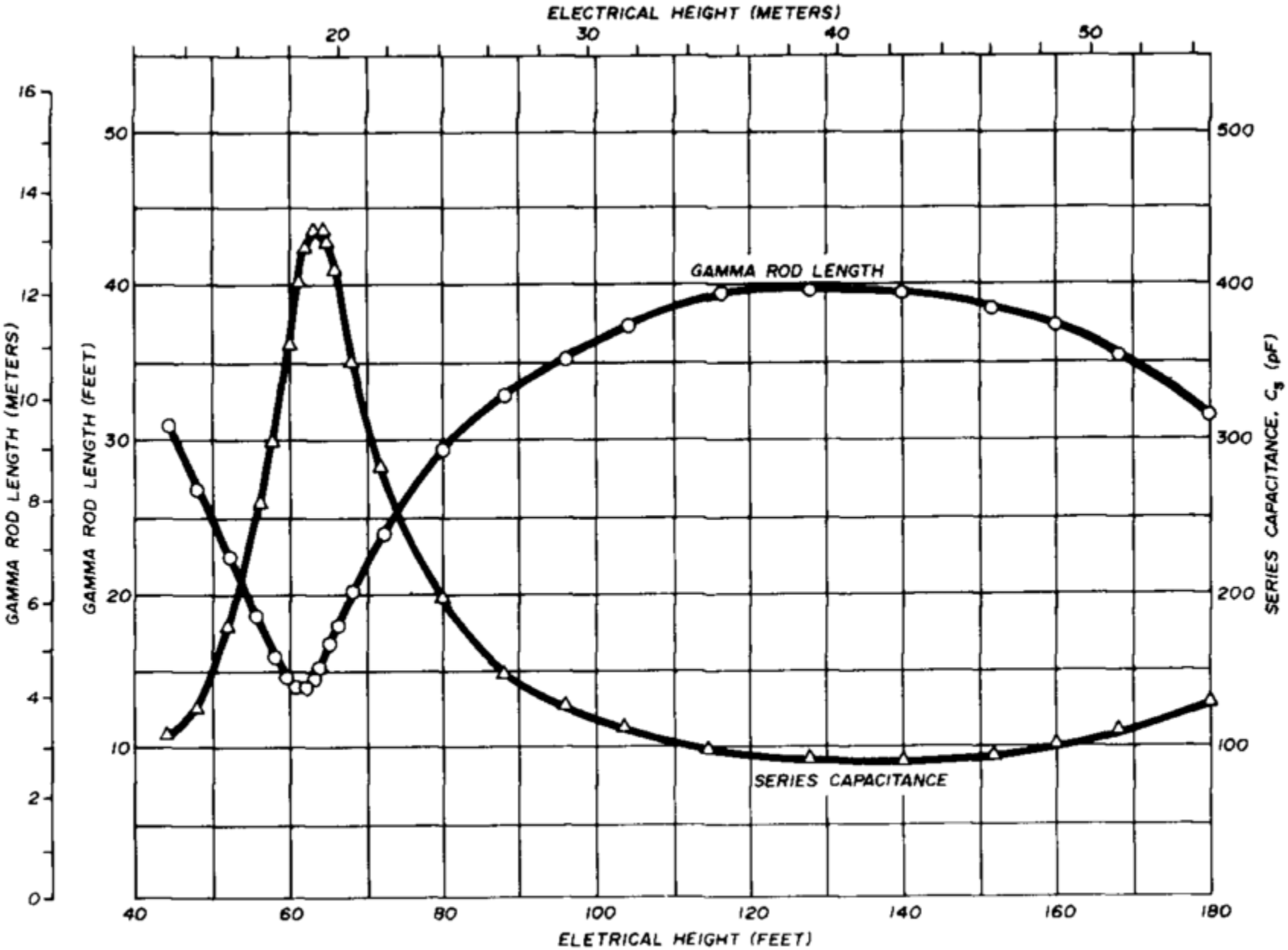


fig. 4. 80-meter vertical. Gamma rod length and series capacitance vs electrical height of tower. Recommended parallel capacitance to match 50-ohm transmission lines is 650 pF (at least half should be variable).

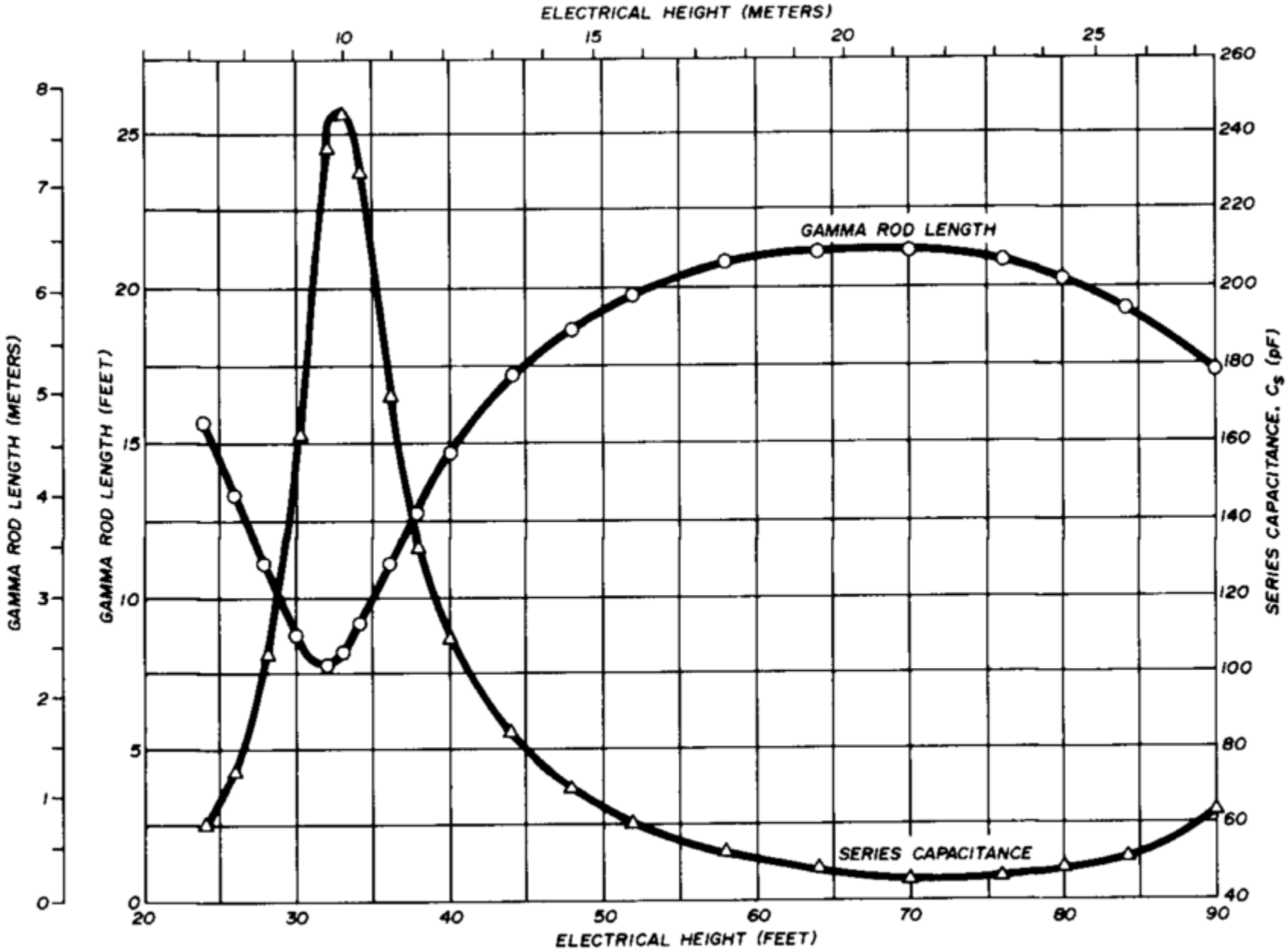


fig. 3. 40-meter vertical. Gamma rod length and series capacitance vs electrical height of tower. Recommended parallel capacitance to match 50-ohm transmission lines is 320 pF (at least 100 pF of which should be variable).

IV3PRK

Gamma Match Design

Using W7ITB, WB0IKN, W6NL Equations
Version 2.0, April 2000

Frequency, MHz: 1.83
Driven element diam: 27
Gamma rod diam: 1.1
Gamma rod spacing: 36
Feed point resistance: 28
Feed point reactance: 9
Feed line impedance: 50

Gamma length (degrees): 36.9384
Gamma length (feet): 55.17212
Gamma length (inches): 662.0654
Gamma capacitor (pF): 447.1565

I installed on the side of the tower an aluminium tube of 28 mm. diameter and 20 m. long, with mounting clamps adjustable for both distance and tapping positions.

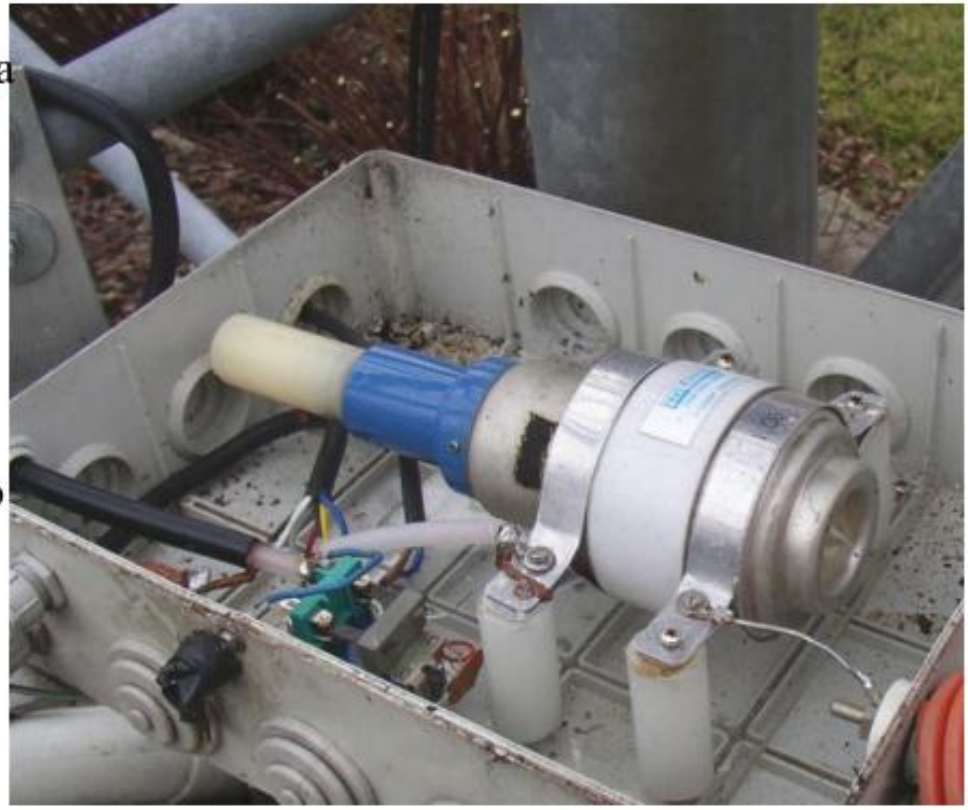
In fact the final length of the gamma rod resulted to be, for the best final match, 17.5 meters.

In the first years I was used to lay down about 60 quarter wave radials but, after a couple of seasons of rolling and unrolling them, I decided to change the ground system into a four elevated and tuned radials.

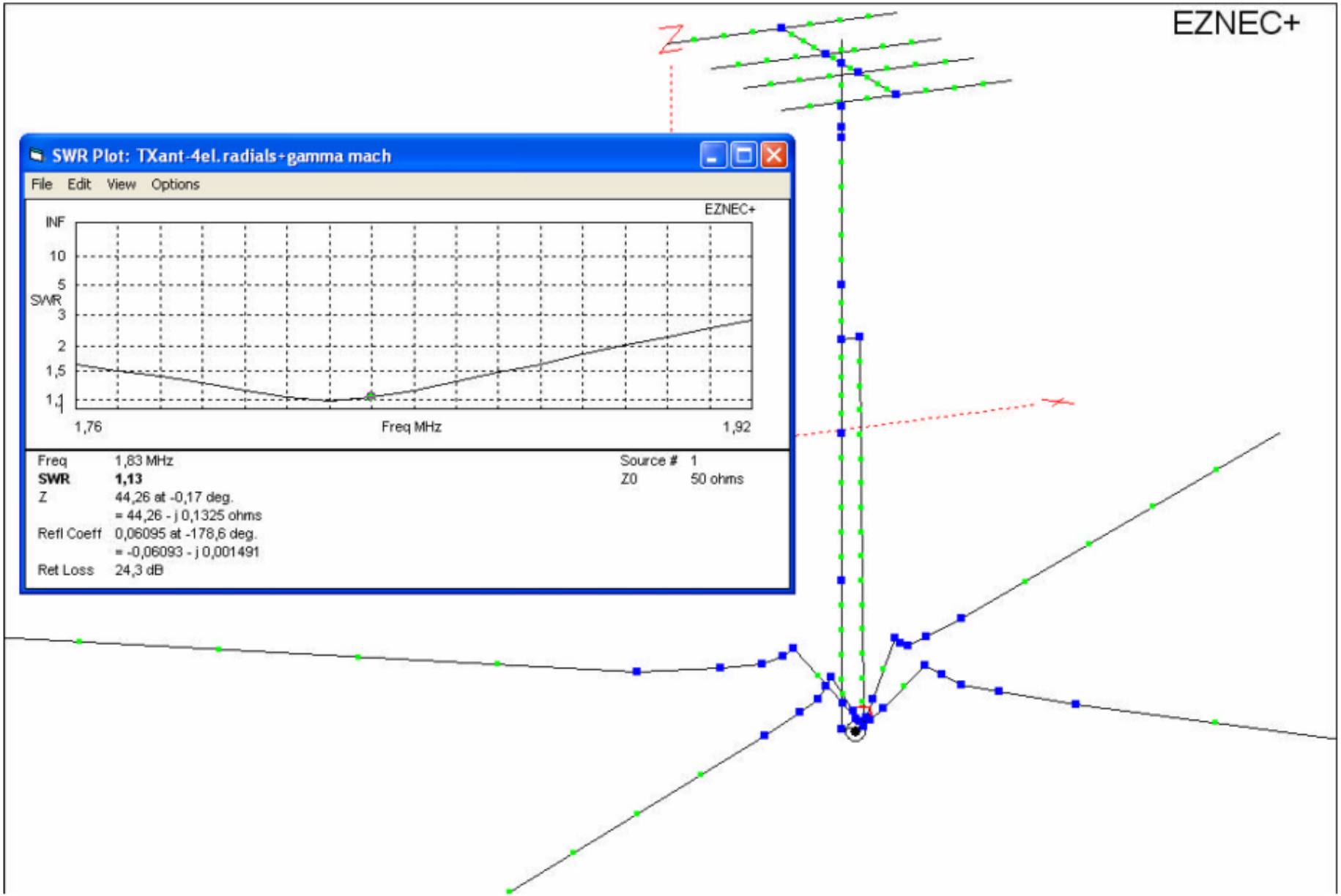
It appeared to be no decrease in the antenna efficiency and I never came back to the nuisance of the on ground radials!

There was no need to climb the tower to change the tapping position of the gamma rod, but just to find a new capacitance value for minimum SWR.

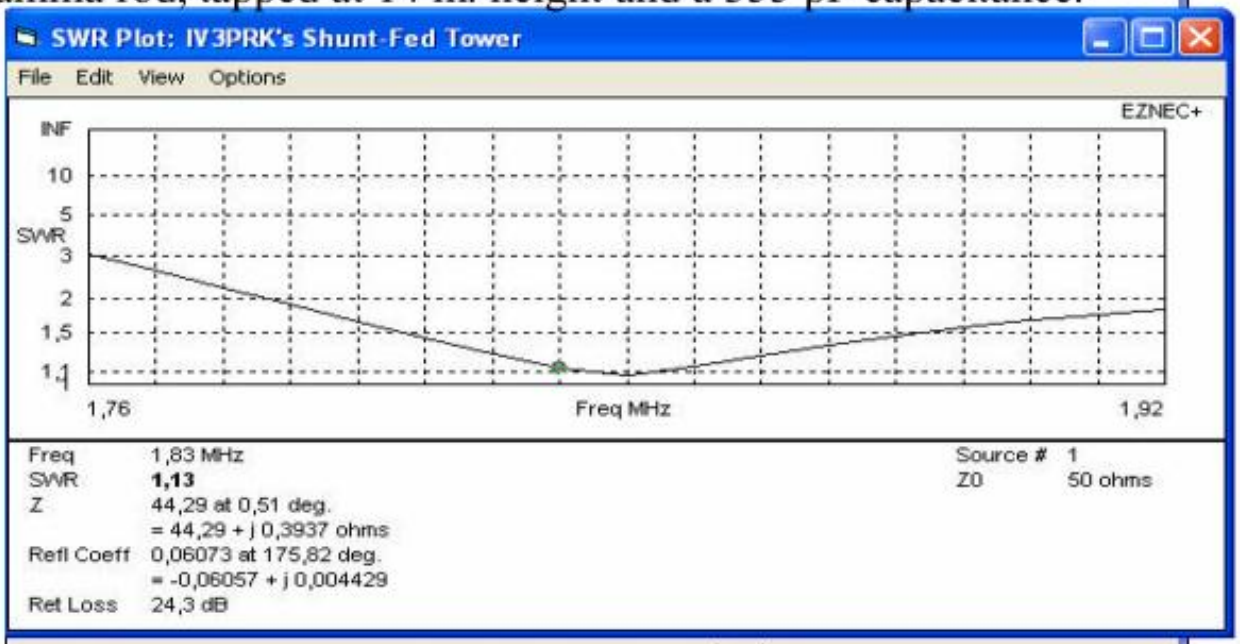
After fighting with combinations of mica and variable capacitors, I bought from "Fair Radio Sales " for 210 US$ a surplus Jennings ceramic vacuum capacitor, rated at 5KV, with a smooth regulation from 5 to 1.000 pF and never got a problem.



The following is the TX antenna model with the gamma match and the four elevated radials on real high accuracy ground. The gamma rod on this model is tapped here at 16 m. high and leads to a resistive part of the matched impedance of 44 ohms; a little bit higher should had led to 50 ohms, but it's already quite satisfying.



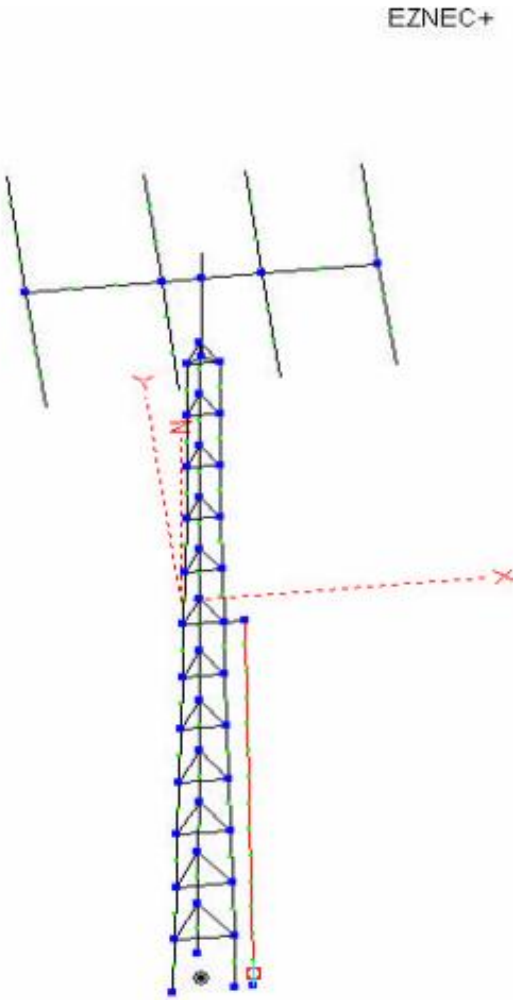
More recently our always remembered friend Earl, K6SE, the most authoritative person on shunt feeding towers, said that the equivalent cylindrical method was not working correctly for top loaded towers, and he found best accuracy by using the same diameter on all the wires. Earl offered to model accurately my own antenna and he came out with some different results: a shorter gamma rod, tapped at 14 m. height and a 355 pF capacitance.

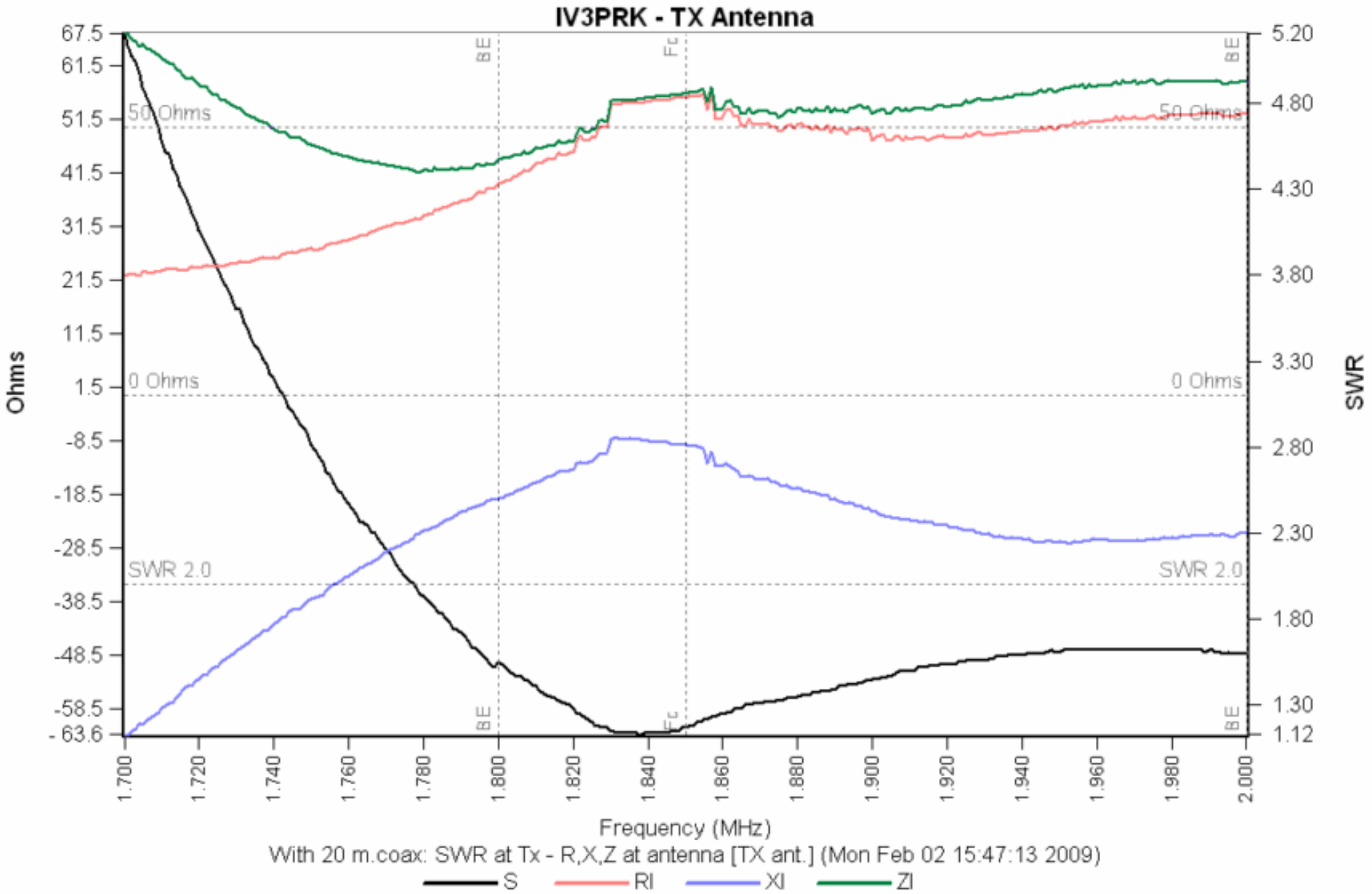


Freq	1,83 MHz
SWR	**1,13**
Z	44,29 at 0,51 deg.
	= 44,29 + j 0,3937 ohms
Refl Coeff	0,06073 at 175,82 deg.
	= -0,06057 + j 0,004429
Ret Loss	24,3 dB
Source #	1
Z0	50 ohms

Loads

No.	Specified Pos.		Actual Pos.		R	L	C	R Freq
	Wire #	% From E1	% From E1	Seg	(ohms)	(uH)	(pF)	(MHz)
1	1	0	3,57143	1	Short	Short	354,979	0




IV3PRK - TX Antenna
Ohms
SWR
67.5
61.5
51.5
41.5
31.5
21.5
11.5
1.5
-8.5
-18.5
-28.5
-38.5
-48.5
-58.5
- 63.6
5.20
4.80
4.30
3.80
3.30
2.80
2.30
1.80
1.30
1.12
50 Ohms
0 Ohms
SWR 2.0
BE
Fc
1.700
1.720
1.740
1.760
1.780
1.800
1.820
1.840
1.860
1.880
1.900
1.920
1.940
1.960
1.980
2.000
Frequency (MHz)
With 20 m.coax: SWR at Tx - R,X,Z at antenna [TX ant.] (Mon Feb 02 15:47:13 2009)
S
RI
XI
ZI

Det Ideelt utgangspunkt

- Mast på 24 m med yagi antenner gir…
  - Elektrisk lengde på 90 til 150 grader.
  - Godt utgangspunkt for en vertikal antenne med lav utstrålingsvinkel på lavbånd.
  - Yagi elementene bør være i elektrisk kontakt med bommen, nederste yagi teller mest.
  - Slopere/barduner øker mastens elektrisk lengde

Elektrisk lengde må måles,

kan ikke beregnes nøyaktig

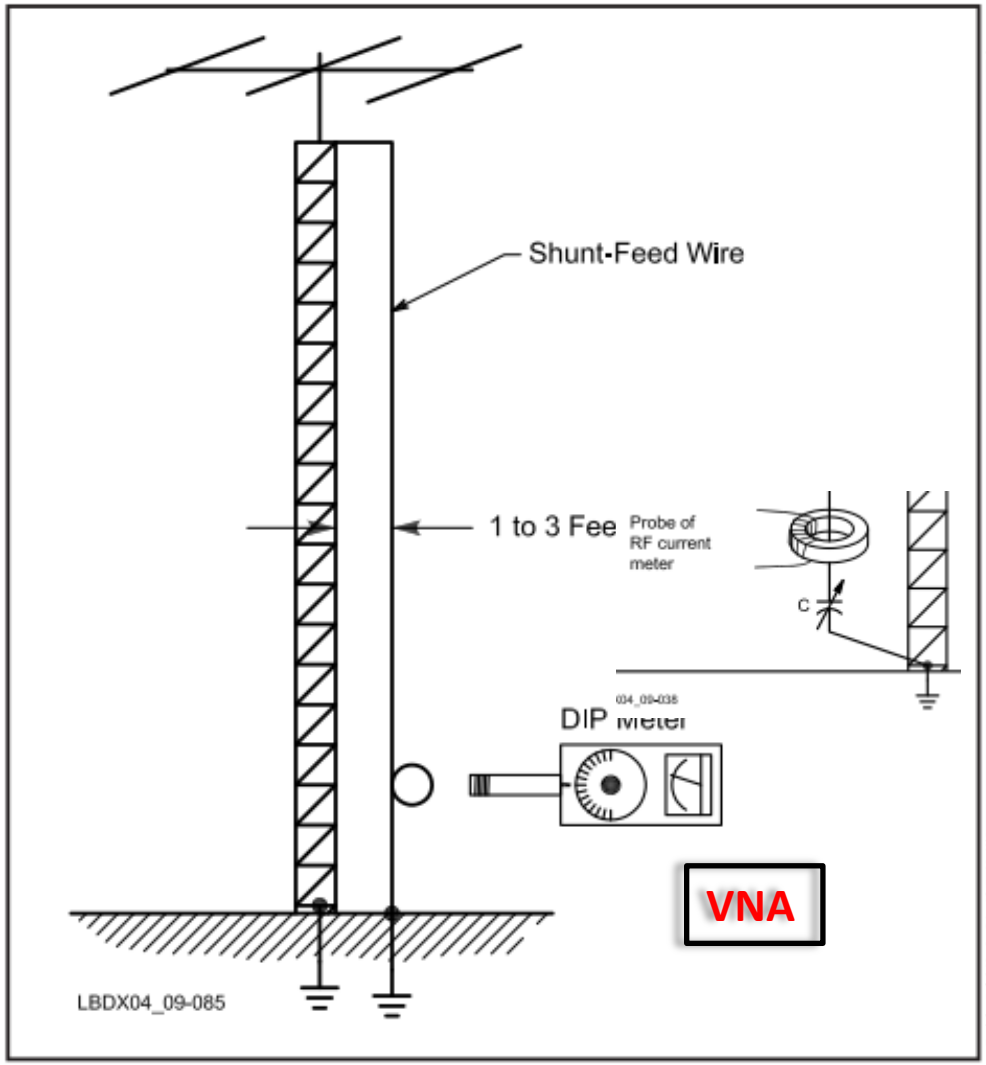


Fig 9-85—A method of "dipping" a tower with a shunt-feed wire connected to the top.

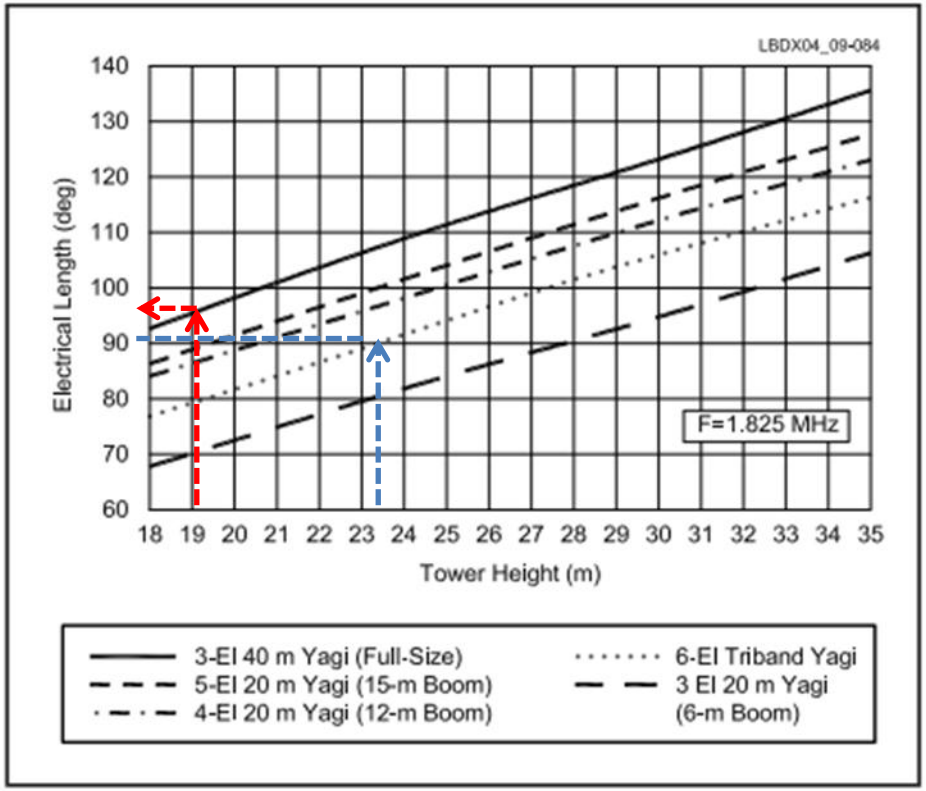


Fig 9-84—Electrical length of a tower loaded with a Yagi antenna. The chart is valid for 160 meters (1.825 MHz) and a tower equivalent diameter of 30 cm. For a larger tower diameter, the electrical length will be shorter (4° to 7° for a tower measuring 60 cm in diameter).

Måling

- Dipmeter;
  - Lengde (grader)= f(design)/f(målt)
- Eksempel:
  - f(målt)=1.6 MHz, f (design)=1.8, L=101 grader

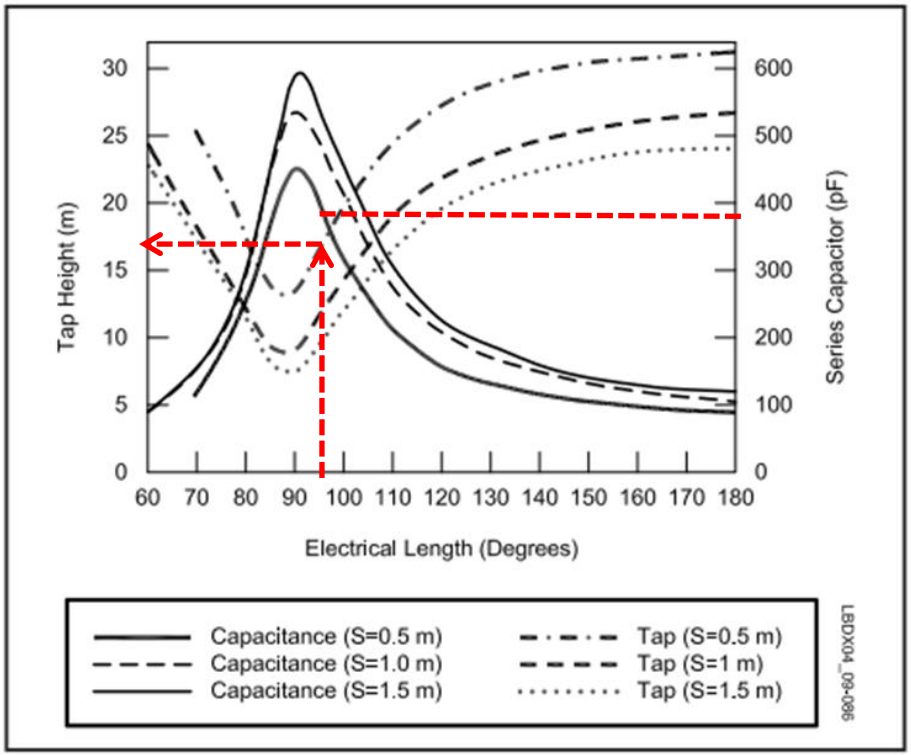


Fig 9-86—Tap height and values of the gamma series capacitor for a shunt-fed tower at 1.835 MHz. The tower diameter is 250 mm, and the gamma wire has a diameter of 10 mm. Three sets of curves are shown, for three spacings (S). The spacing is the distance from the wire to the tower center.

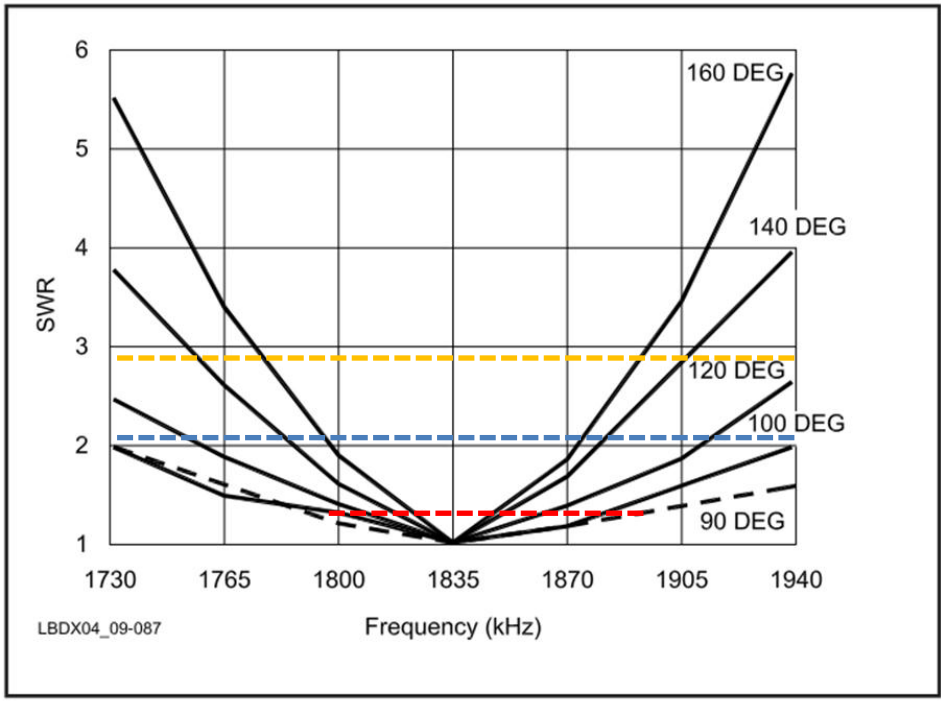


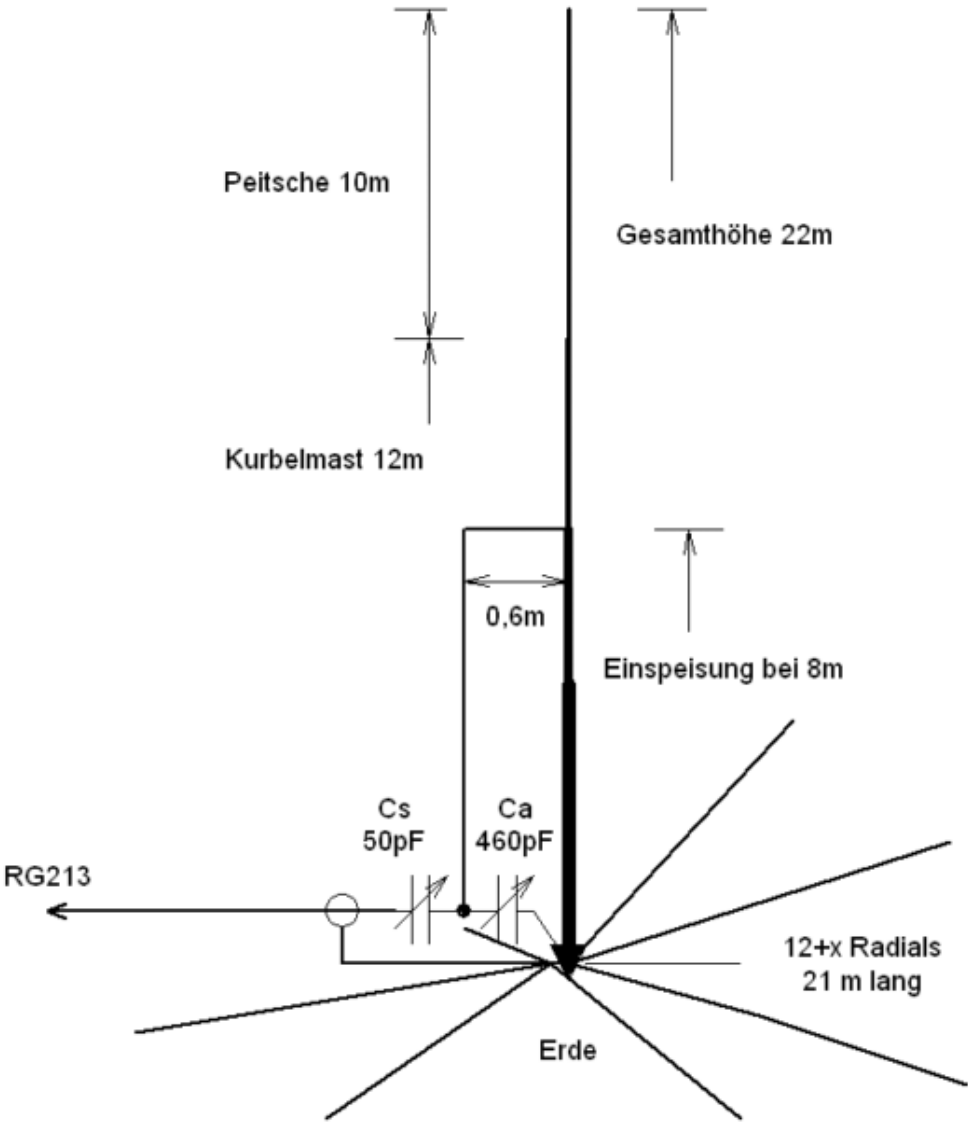
Fig 9-87—SWR curves for gamma-fed towers using a 10-mm OD gamma wire and a spacing of 50 cm, for electrical tower lengths varying from 90° to 160°. The SWR of the longer vertical can be tuned over a wide bandwidth using a motor-driven variable series capacitor.

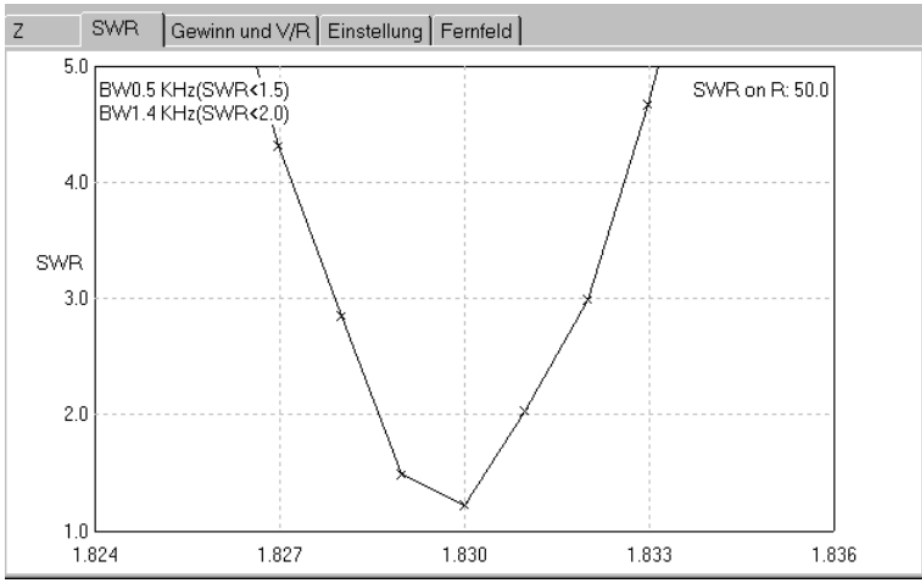
Mast i resonans

- Et effektivt shunt føde system kan lages
- Litt av resonans gir to dip på SWR kurven, gir et bredere SWR område
- Et 50 ohm uttakspunkt er nærmest jord for en mast i L/4 resonans, kun 8m over bakken for 160m.
- 2:1 SWR området er størst for mast i resonans
- RF spenningene er lavest på gamma kondensatoren.

Gammatråden

- Økende avstand til mast, kortere tråd
- Elektrisk lange master krever et høyt gamma punkt, typisk 20-30 m. Dette gir lave verdier for kondensatoren og høye spenninger.
- Dersom gammatråden blir beregnet til lengre enn masten, kreves en Omega tuner. Omega tuner benyttes også når gammatråden er mye kortere enn design tilsier. Omegatuning gir mer tap av energi og smalere båndbredde.
- Tykkelse på gamma tråd har mest innflytelse på kondensator verdien, mindre på gammapunktets høyde, lengde på tråd (tykkere-kortere) og SWR.


Peitsche 10m
Gesamthöhe 22m
Kurbelmast 12m
0,6m
Einspeisung bei 8m
Cs
50pF
Ca
460pF
RG213
12+x Radials
21 m lang
Erde


Z
SWR
Gewinn und V/R
Einstellung
Fernfeld
BW0.5 KHz(SWR<1.5)
BW1.4 KHz(SWR<2.0)
SWR on R: 50.0
SWR
5.0
4.0
3.0
2.0
1.0
1.824
1.827
1.830
1.833
1.836

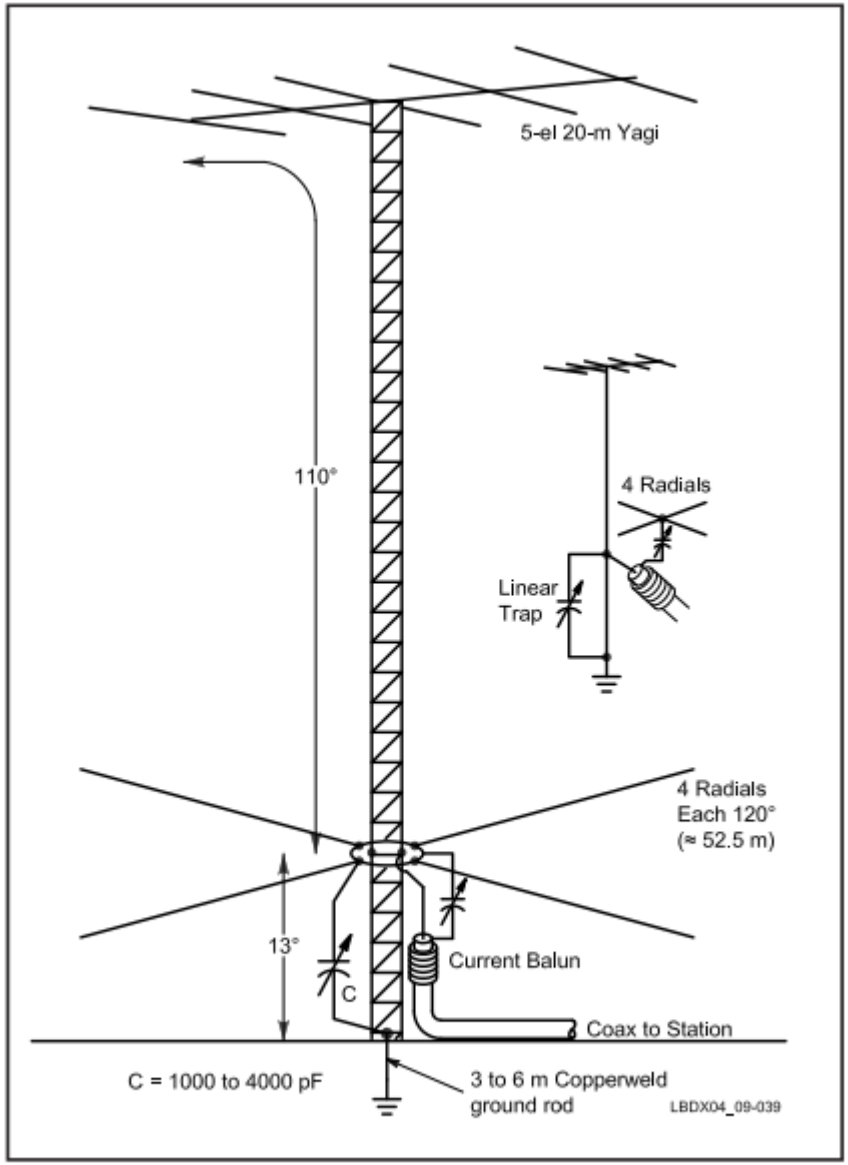


Fig 9-39—Design example of a grounded vertical using an elevated-radial system (see text for details).

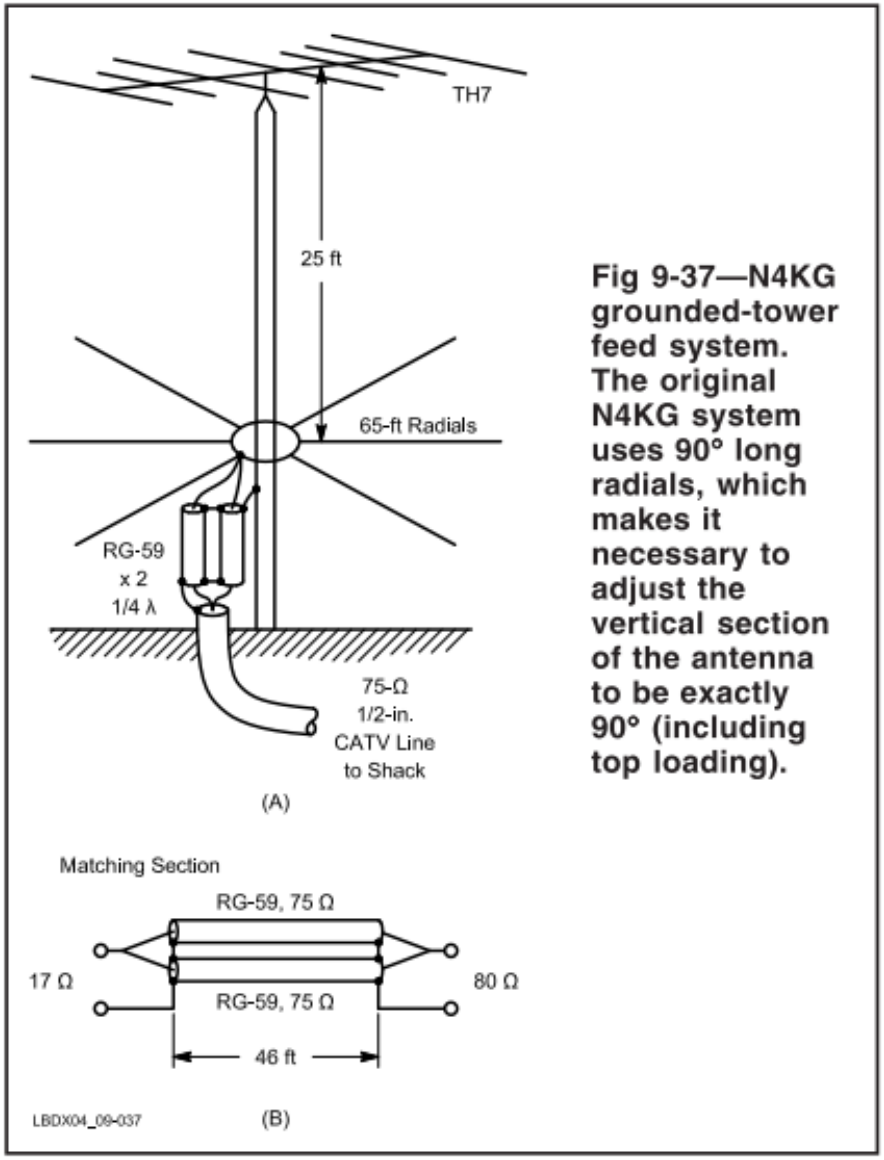


Fig 9-37—N4KG grounded-tower feed system. The original N4KG system uses 90° long radials, which makes it necessary to adjust the vertical section of the antenna to be exactly 90° (including top loading).

Foldet monopol

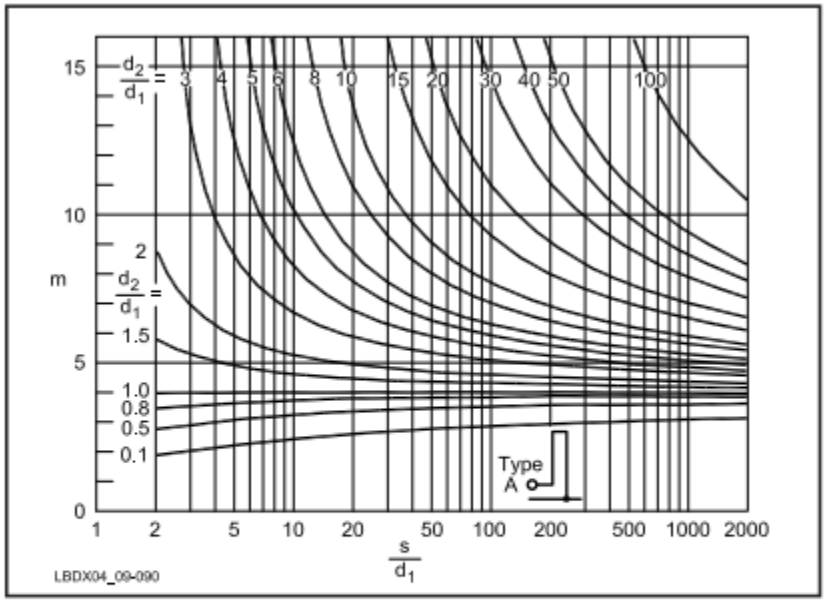


Fig 9-90—Transformation ratio (m) of a two-wire folded monopole, as function of the wire spacing (S/d1) and the ratio of the conductor diameter (d2 = diameter of the grounded conductor, d1 = diameter of the fed conductor). (*After Gerd Janzen*, Kurze Antennen.)

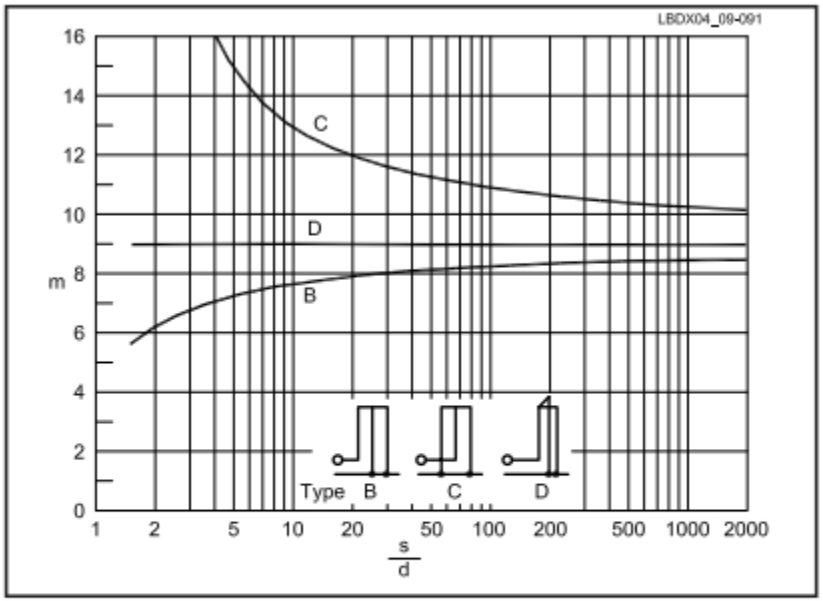
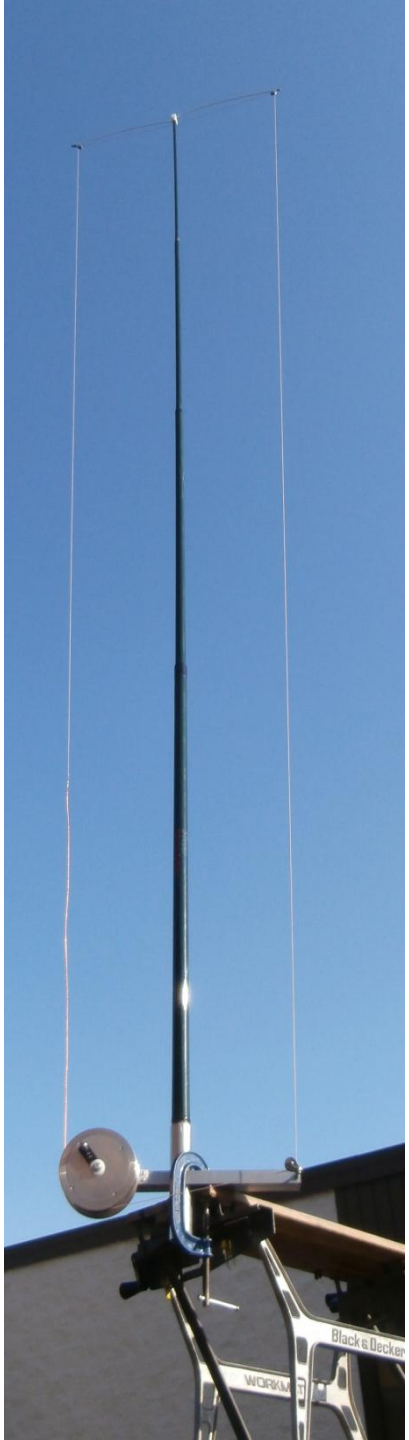


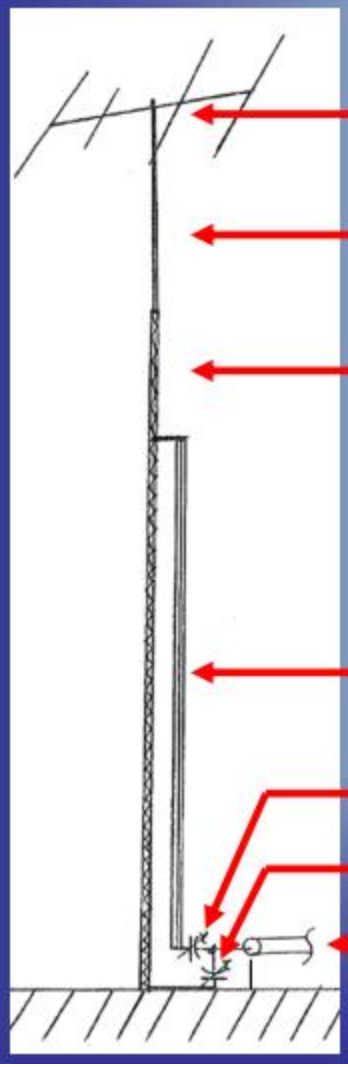
Fig 9-91—Transformation ratio (m) of a three-wire folded monopole, as function of the spacing between the wire (S/d) and the configuration B, C or D). In this case three conductors of equal diameter are assumed. (*After Gerd Janzen*, Kurze Antennen.)

CrankIR Vertical



W8RA

160 M Shunt Fed Tower



SteppIR MonstIR 36 ft boom
3 full size 40M elements (retracted)

Mast 30 ft tall
8 5/8" diam base, 4" @ top

Tower 100 ft tall
2'x2' base, 1'x1' @ top

8 Wire Cage
82 ft tall, 12 ½" diam.
31" spacing center to tower

C Series

C Shunt

50 Ohm Coax to Shack

Equivalent Circuit

Measured at bottom of cage feeder (AIM 4170)

1.80 MHz: R=40.1 X=261.8
1.85 MHz: R=40.7 X=285.2

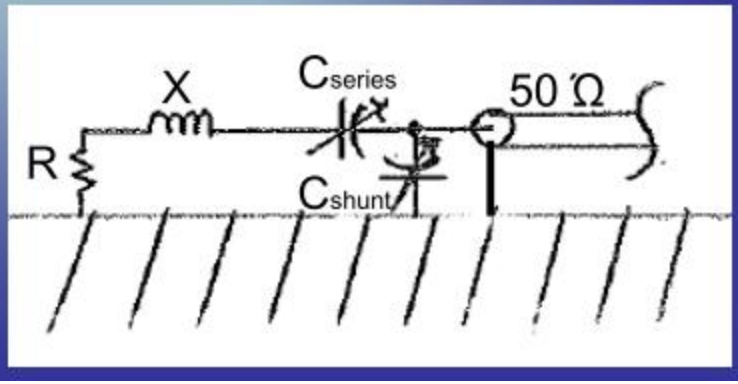
Network Design Software
L Net matching calculations:

1.80 MHz: C_{shunt}=884.2pF C_{series}=365.4pF

1.85 MHz: C_{shunt}=806.1pF C_{series}=323.7pF

Caps measured after tuning for min SWR:

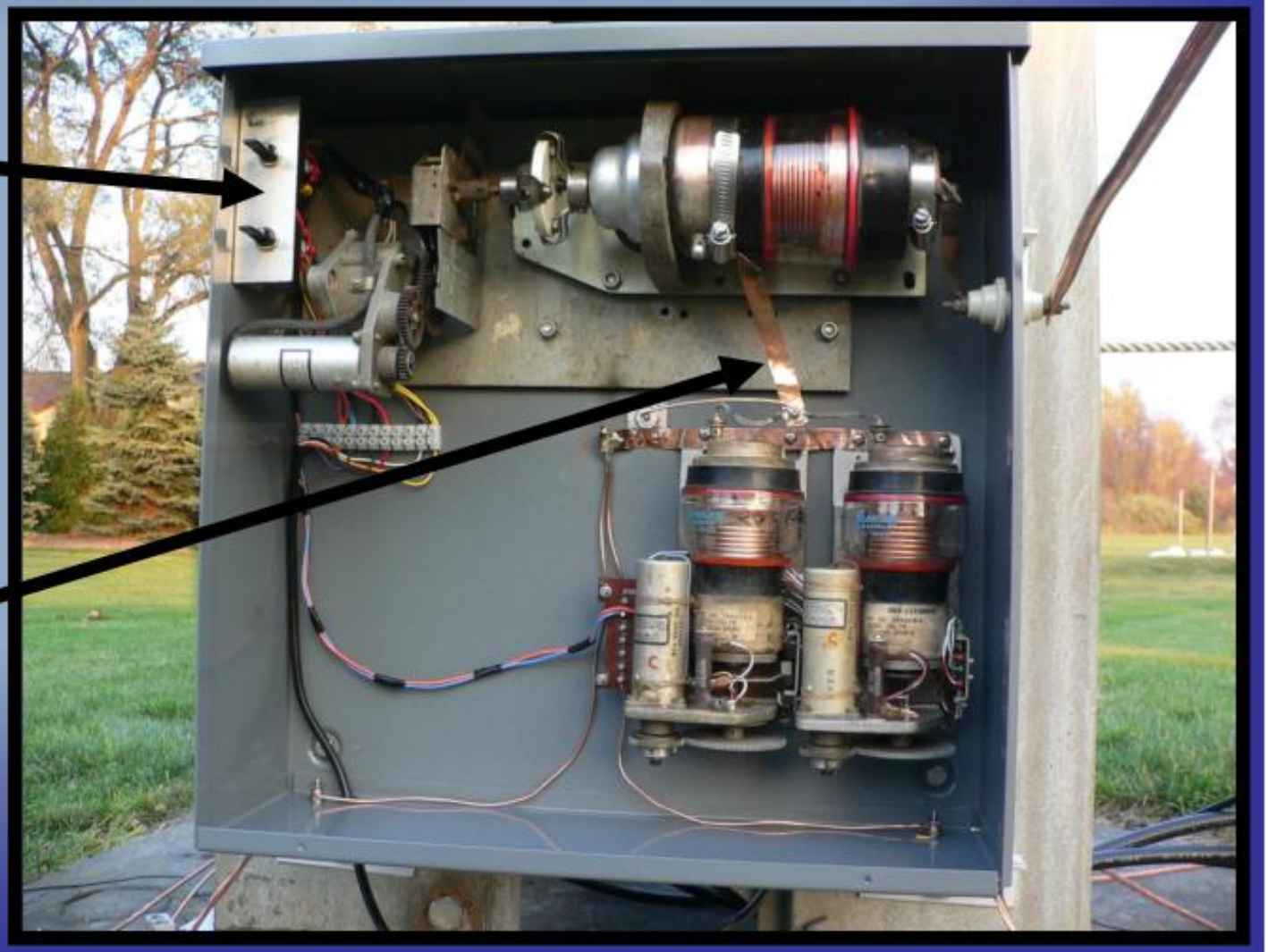
C_{shunt}=654pF C_{series}=338pF

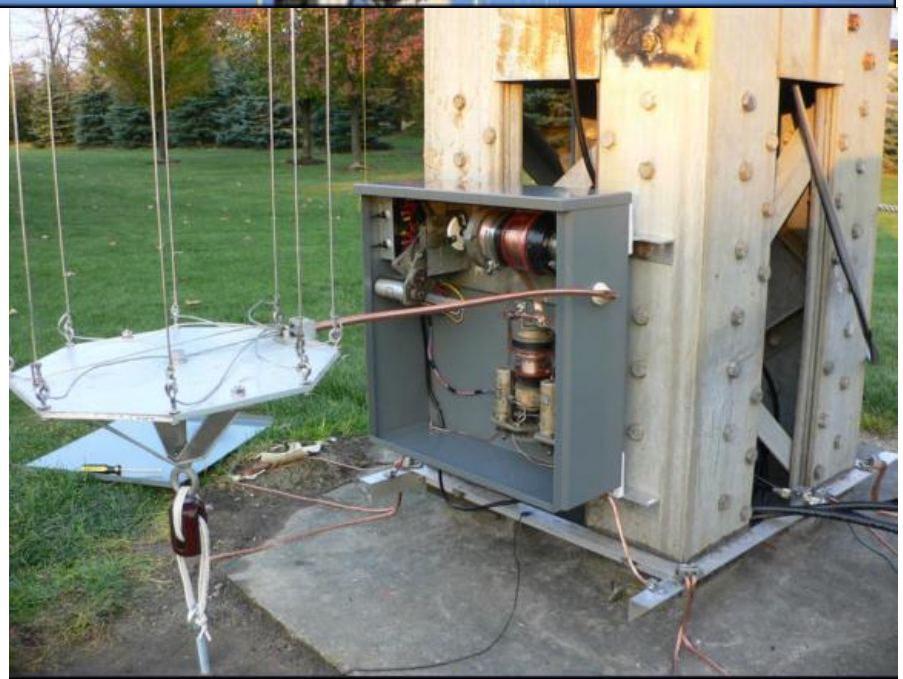


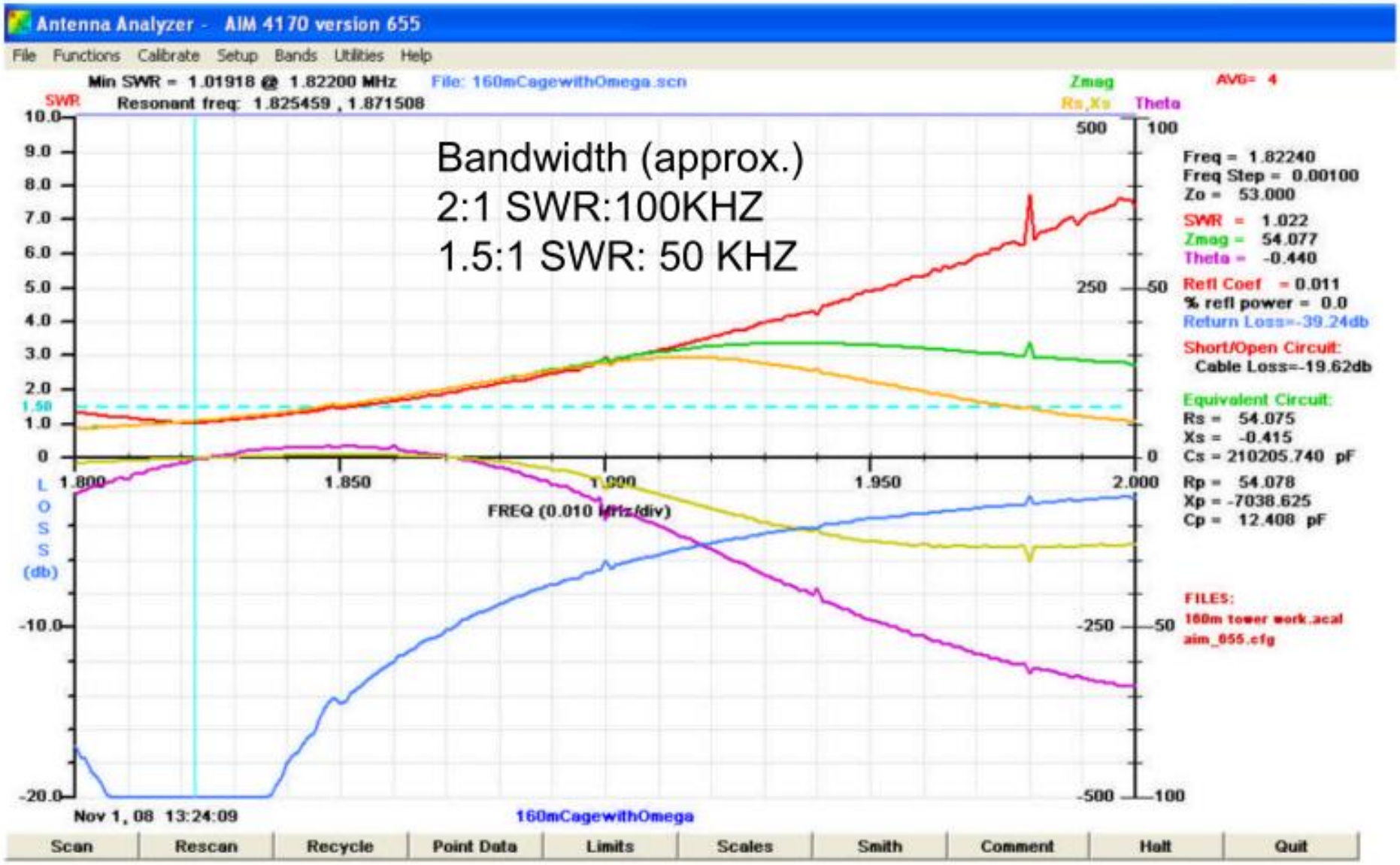
Omega Match

Motor operated for both local and remote tuning

Connected as shunt-series rather than series-shunt






Antenna Analyzer - AIM 4170 version 655
File Functions Calibrate Setup Bands Utilities Help
Min SWR = 1.01918 @ 1.82200 MHz
File: 160mCagewithOmega.scn
Resonant freq: 1.825459 , 1.871508
AVG= 4
SWR
Zmag
Rs,Xs
Theta
Bandwidth (approx.)
2:1 SWR:100KHZ
1.5:1 SWR: 50 KHZ
Freq = 1.82240
Freq Step = 0.00100
Zo = 53.000
SWR = 1.022
Zmag = 54.077
Theta = -0.440
Refl Coef = 0.011
% refl power = 0.0
Return Loss=-39.24db
Short/Open Circuit:
Cable Loss=-19.62db
Equivalent Circuit:
Rs = 54.075
Xs = -0.415
Cs = 210205.740 pF
Rp = 54.078
Xp = -7038.625
Cp = 12.408 pF
FILES:
160m tower work.acal
aim_655.cfg
LOSS (db)
FREQ (0.010 MHz/div)
Nov 1, 08 13:24:09
160mCagewithOmega
Scan
Rescan
Recycle
Point Data
Limits
Scales
Smith
Comment
Halt
Quit

Høy mast
(for høy)

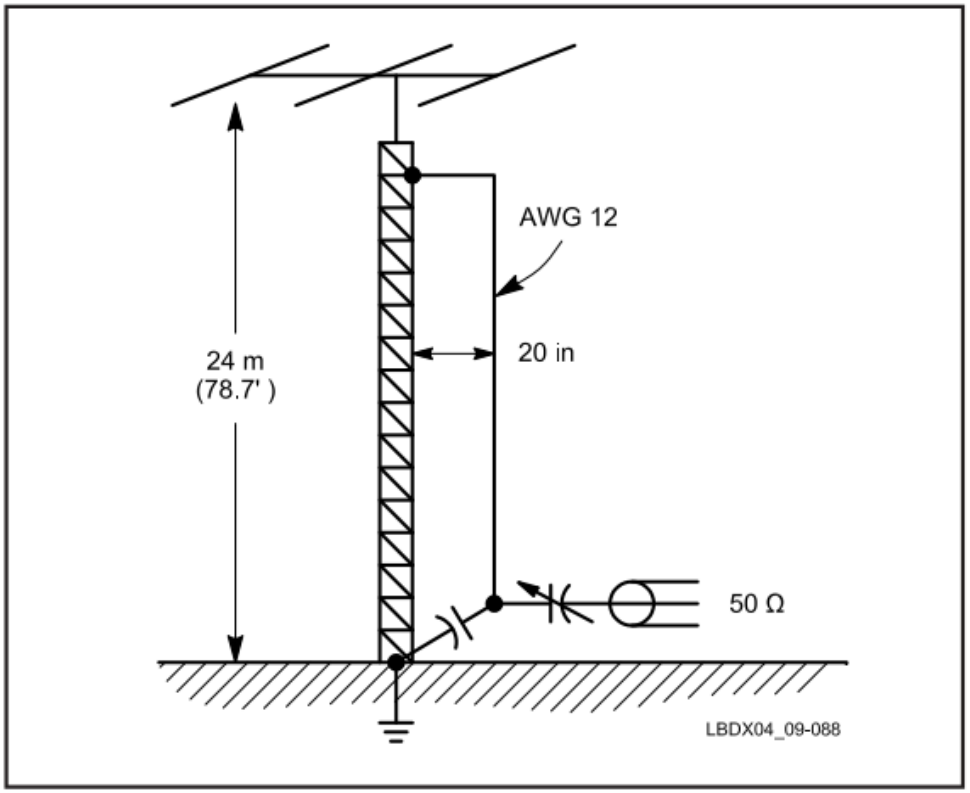


Fig 9-88—A shunt-fed tower using an omega matching system. The tower is electrically 140° long. An omega match is required, since the tower is physically too short to accommodate a gamma match with a 2-mm gamma wire. Table 9-11 lists the impedances at the end of the gamma wire before and after transformation by the capacitors of the omega-match system.

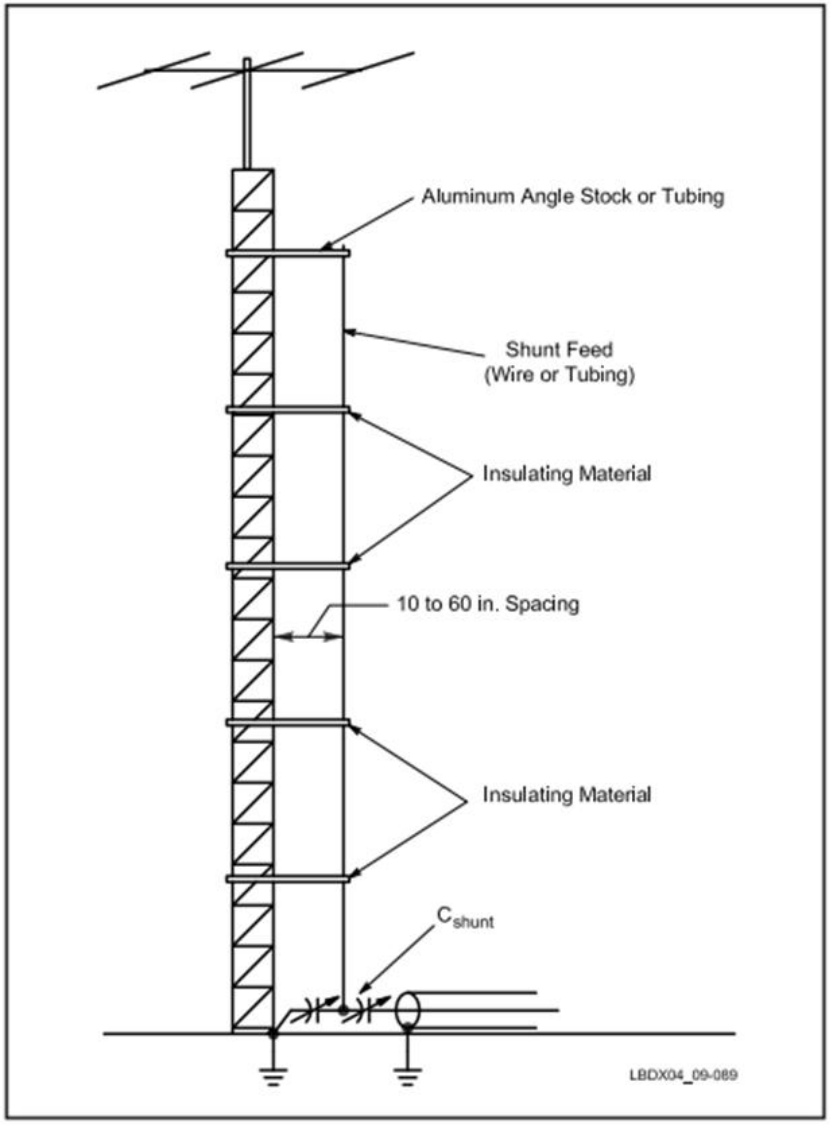
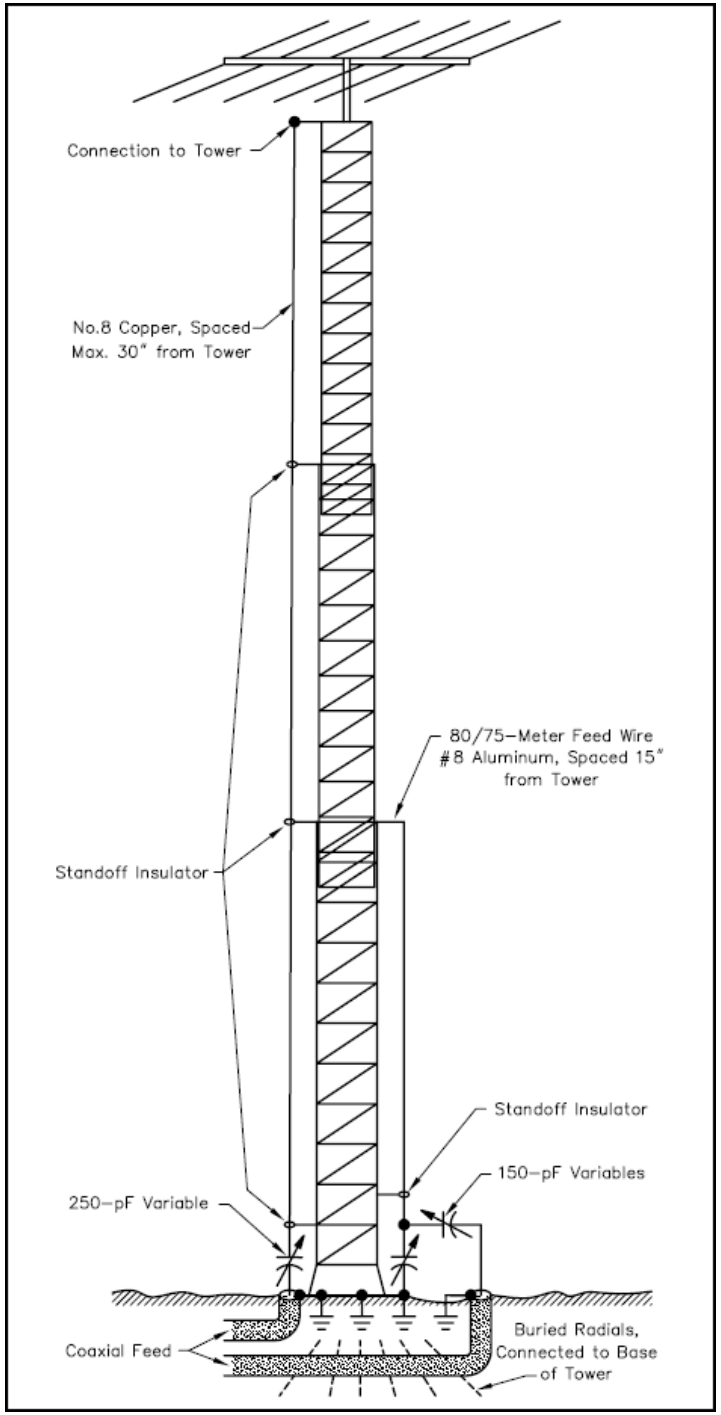
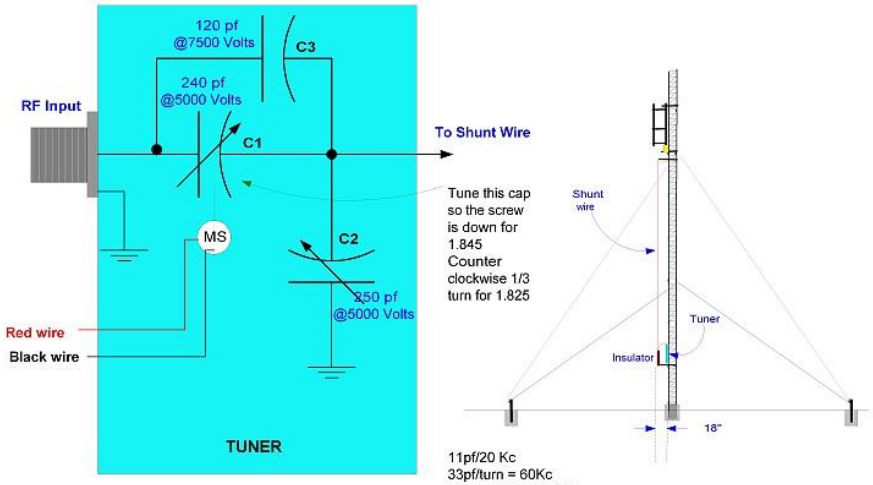


Fig 9-89—The omega-matching system (a gamma match with an additional shunt capacitor) adds a great deal of flexibility to the shunt-fed-tower arrangement. To maintain maximum bandwidth make the gamma wire as long as possible. If the antenna is electrically longer than 120°, a variable series capacitor will make it possible to obtain a very low SWR over a wide bandwidth.


Connection to Tower
No.8 Copper, Spaced
Max. 30" from Tower
80/75–Meter Feed Wire
#8 Aluminum, Spaced 15"
from Tower
Standoff Insulator
Standoff Insulator
150–pF Variables
250–pF Variable
Coaxial Feed
Buried Radials,
Connected to Base
of Tower


Hochspannung
Vorsicht !
Lebensgefahr

160 Meter Shunt Tuner

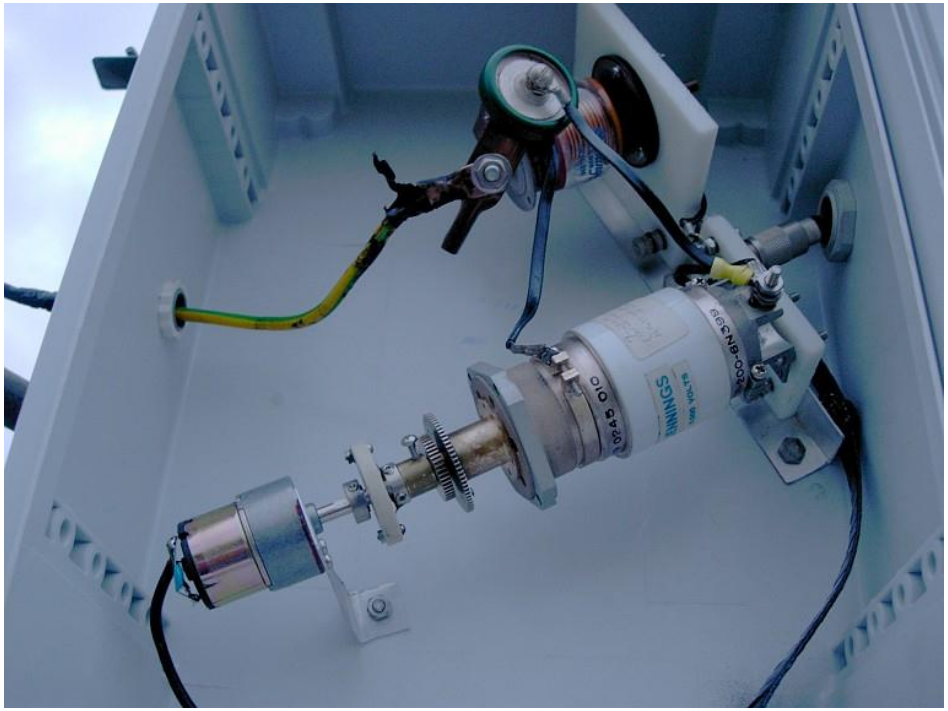


Tune this cap so the screw is down for 1.845
Counter clockwise 1/3 turn for 1.825

11pf/20 Kc
33pf/turn = 60Kc
1.910-1.810 = 100Kc
5 x 20kc = 100 K c
5 x11 pf = 55pf
1 2/3 turn

C1 = 260 pf C2 = 108 pf

W7EJ: 07/04/2005




1000
1.0

Linker

- A N4BAA
- B OK7XX
- C 160m tuning
- D KE7TRP coil
- E 26m Spiderbeam mast
- F VY2ZM
- G OH8X 160m beam roteres
- H EA1DVY
- I W5JGV
- J EA1DVY spidermast
- K
- L
- M
- N

Det var det hele! Lykke til med egen mast på lavbånd!


Takk for meg, Håvard, LB9RE