Easy Antennas for HF

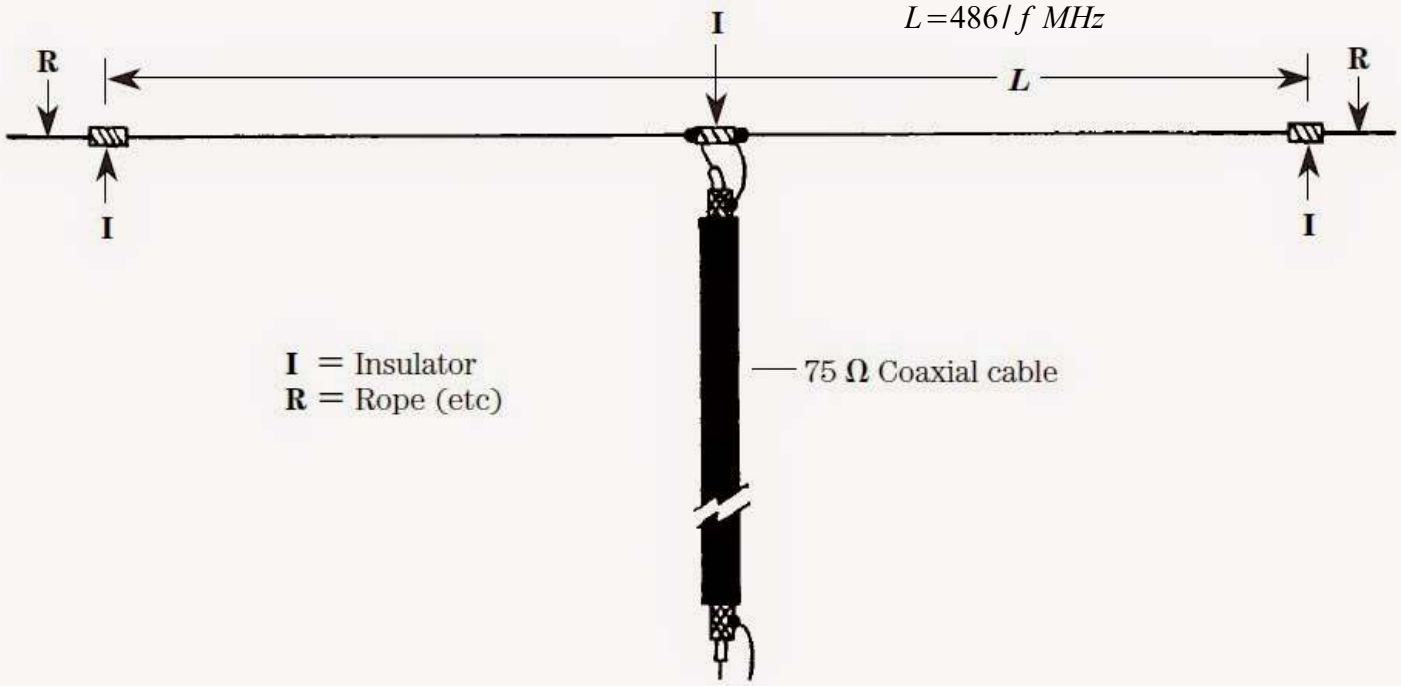
Kelby Davis
AD7VO

- HF contacts are a lot of fun.
- HF antennas need not be complex or expensive.
- Building is cheaper than buying.
- DIY antennas can work as good and sometimes better than commercial ones.

Simple Wire Antennas

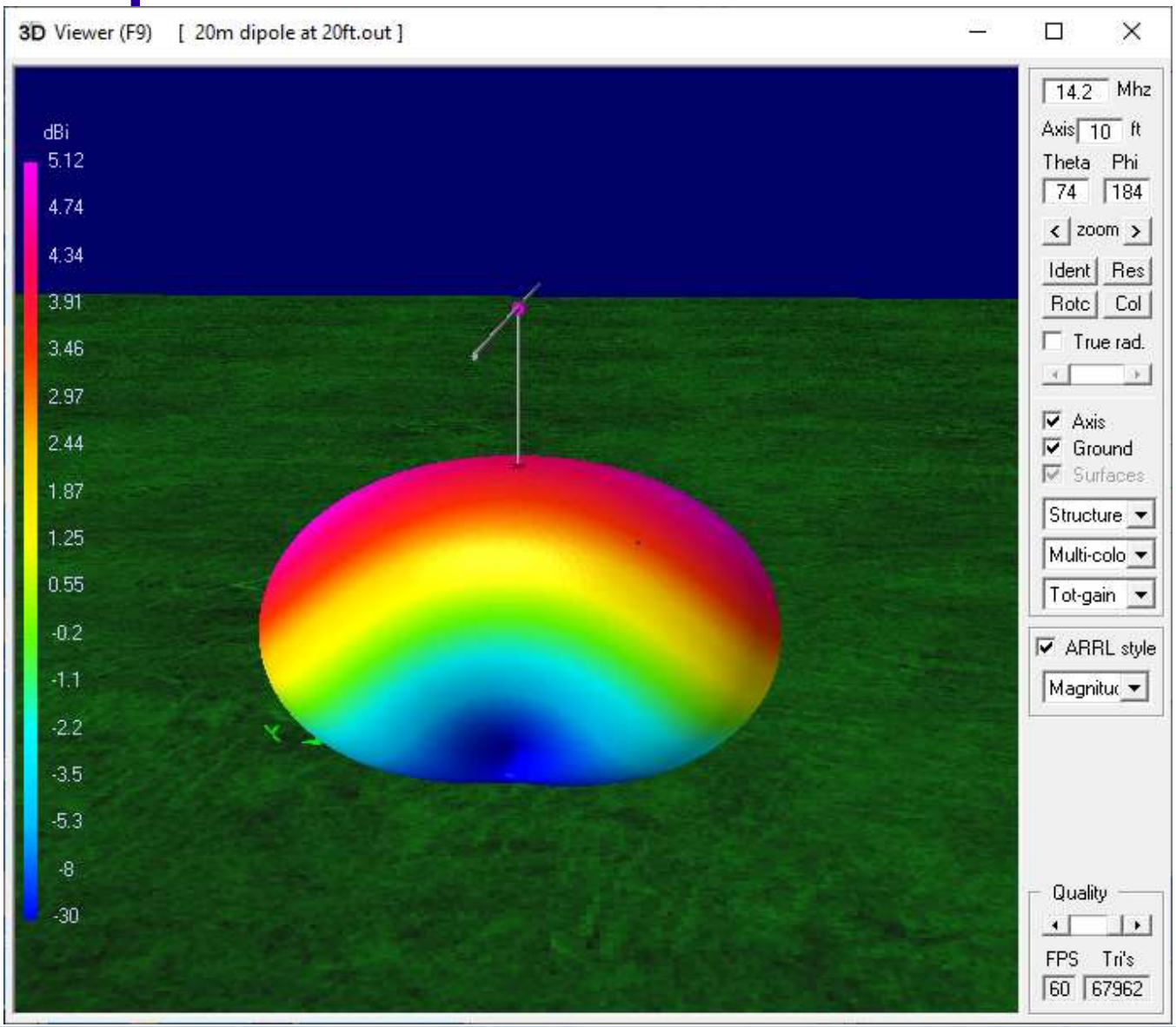
- Horizontal tuned half wave dipole.
- Horizontal untuned dipole.
- Inverted “V”.
- Inverted “L”.
- End fed half wave wire.
- End fed random length wire.
- Vertical coax sleeve dipole.

Horizontal tuned half wave dipole

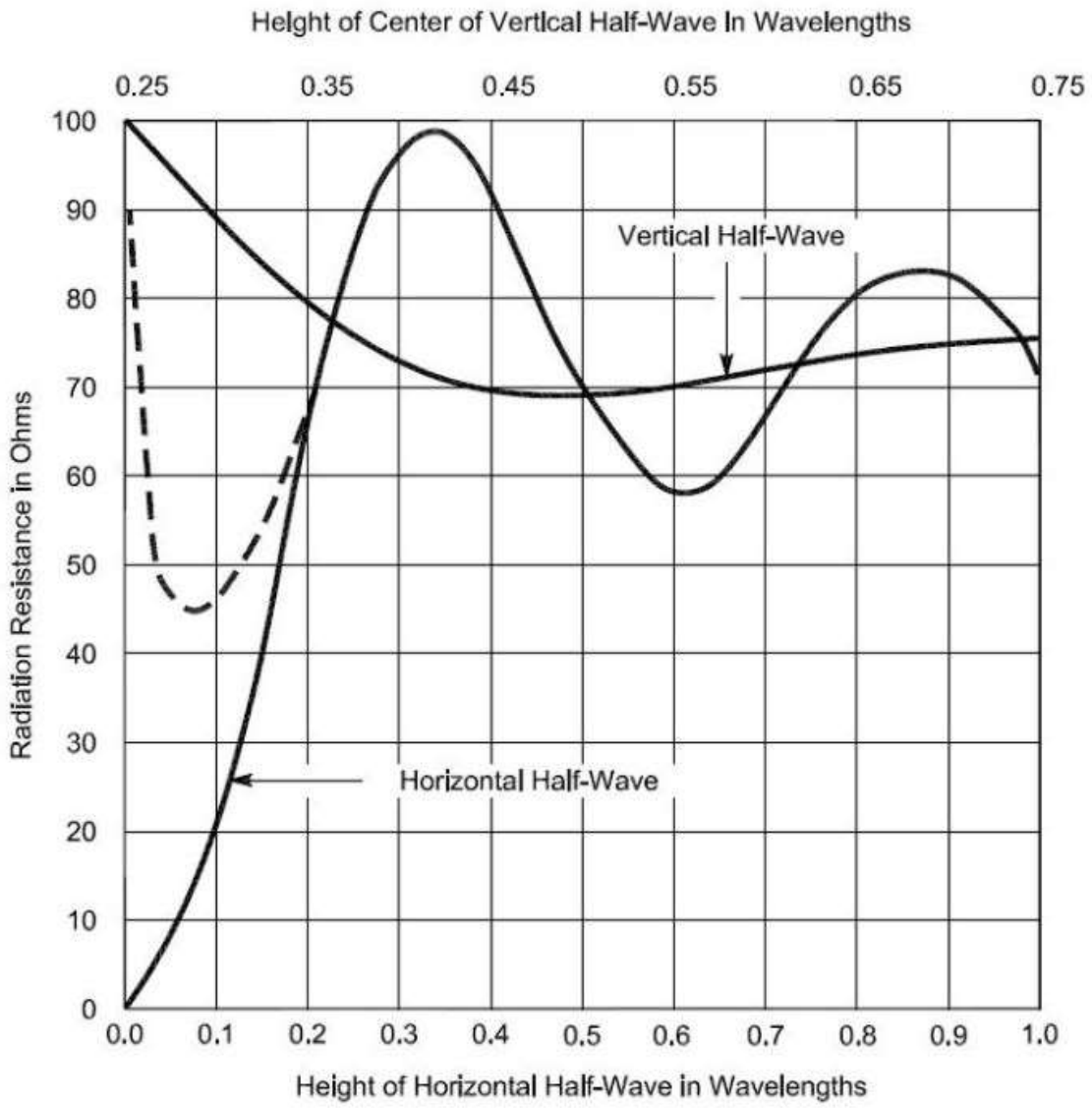


Simple half-wave dipole antenna.

Dipole Radiation Pattern



Effect of Height on Impedance



Horizontal untuned dipole

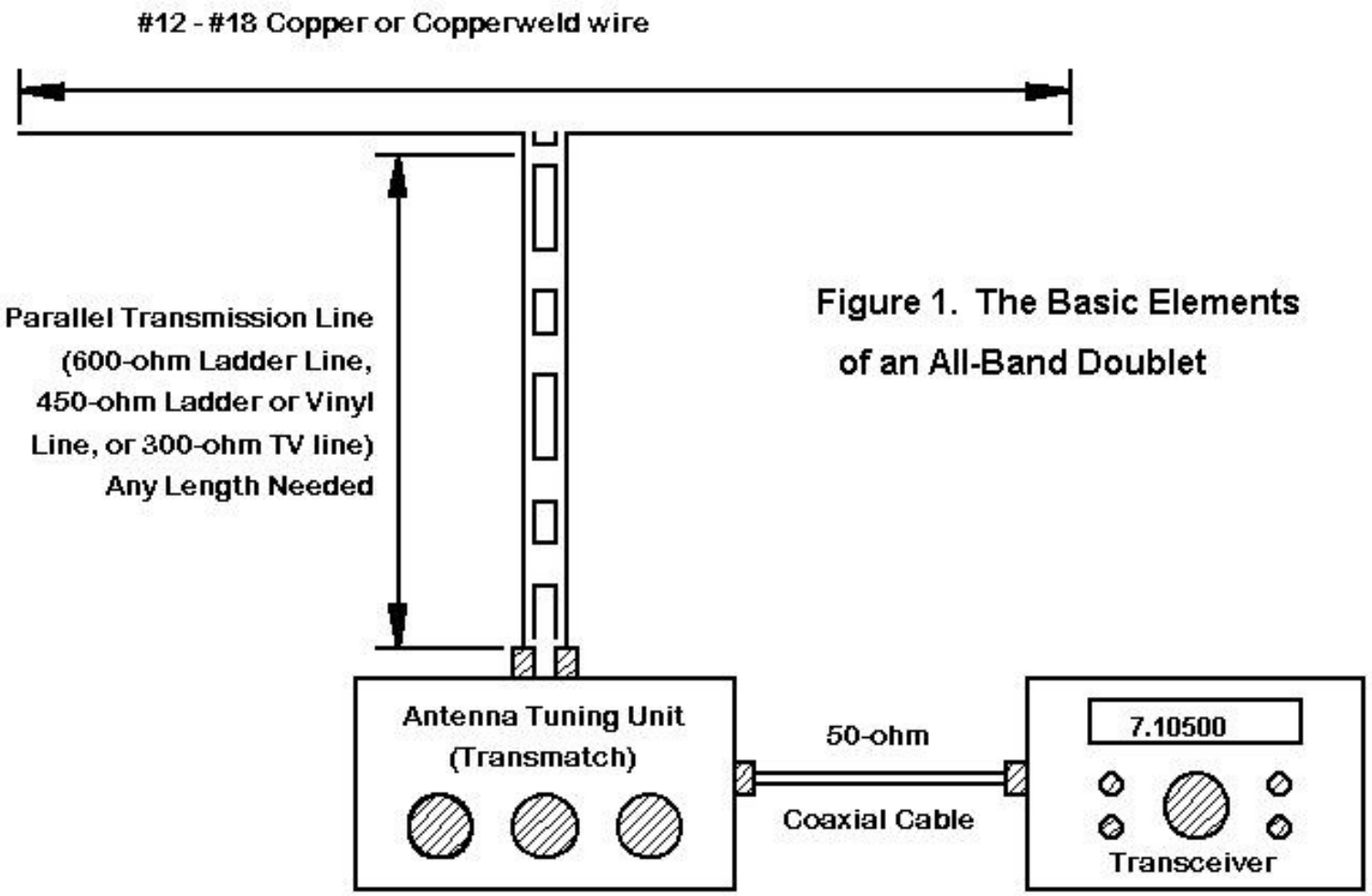
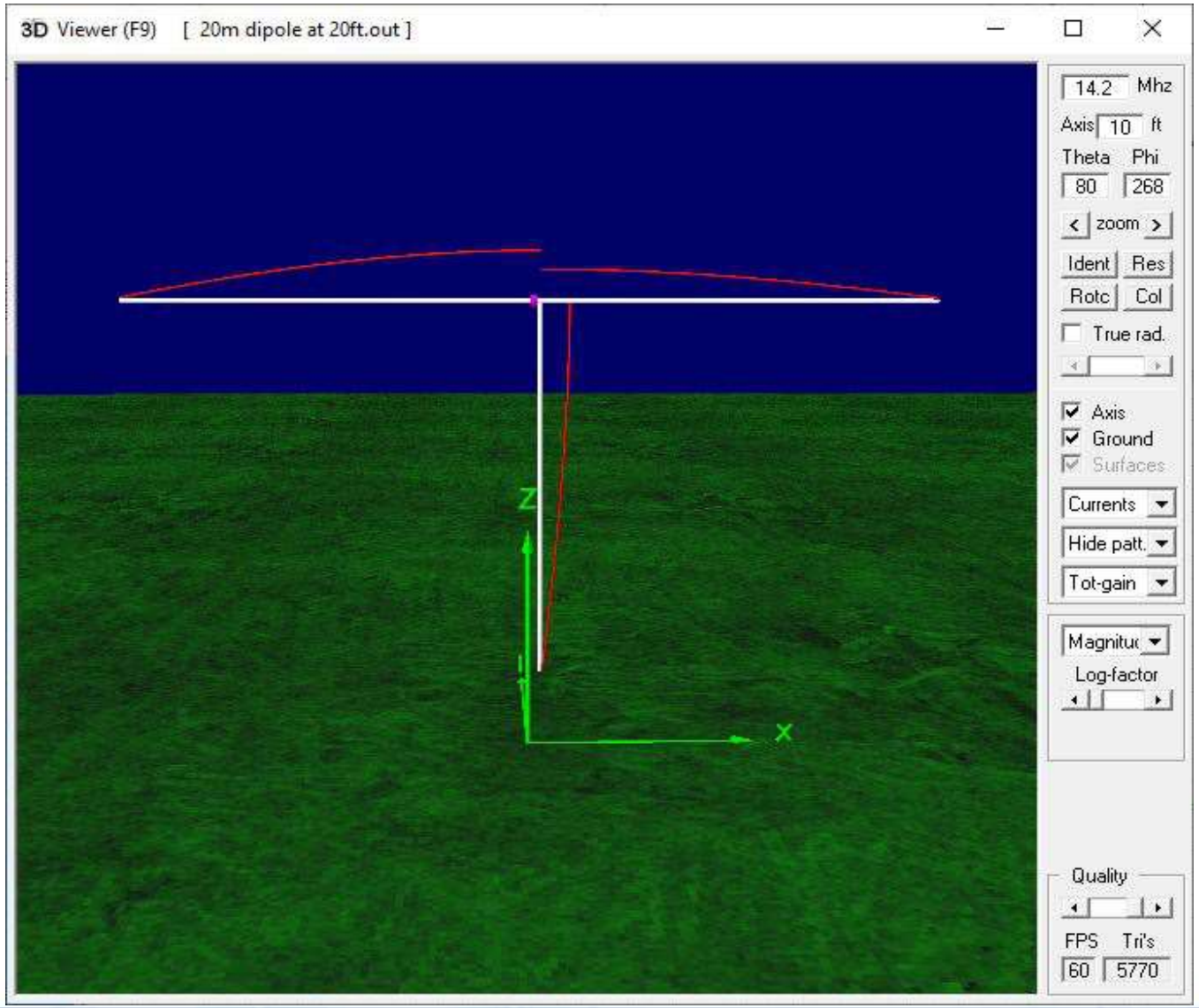
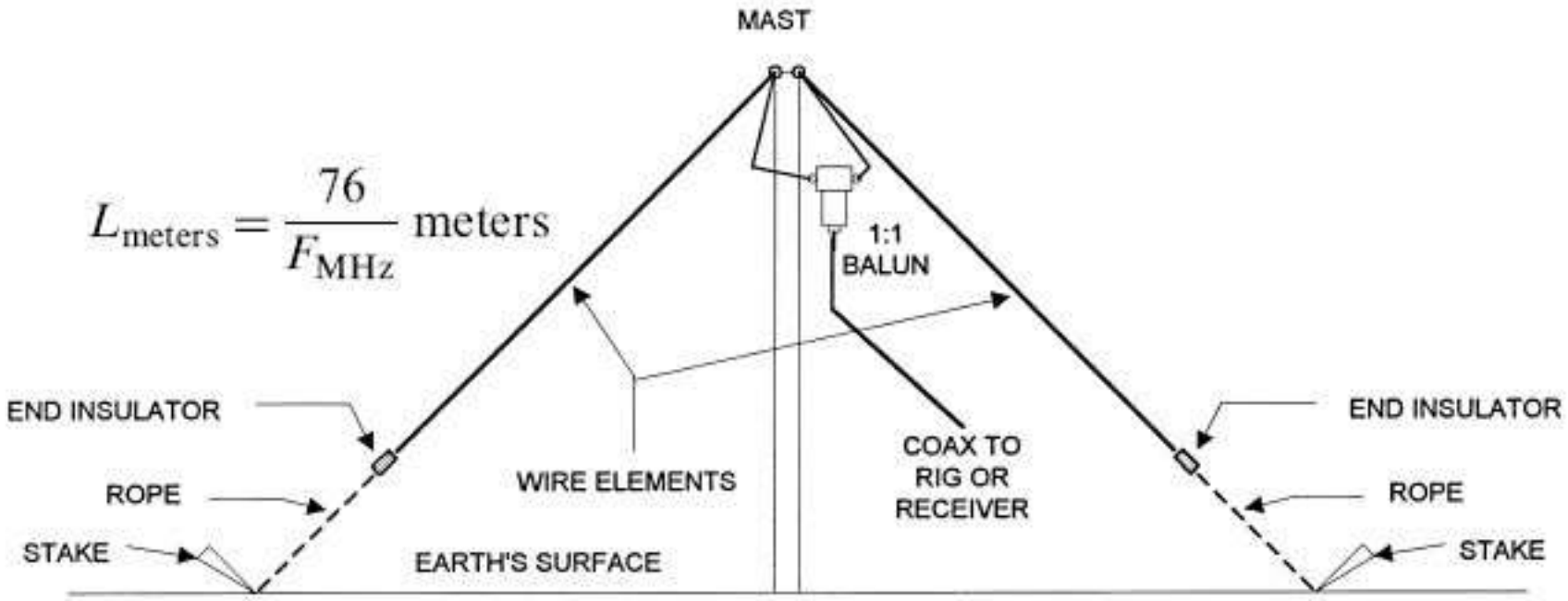


Figure 1. The Basic Elements of an All-Band Doublet

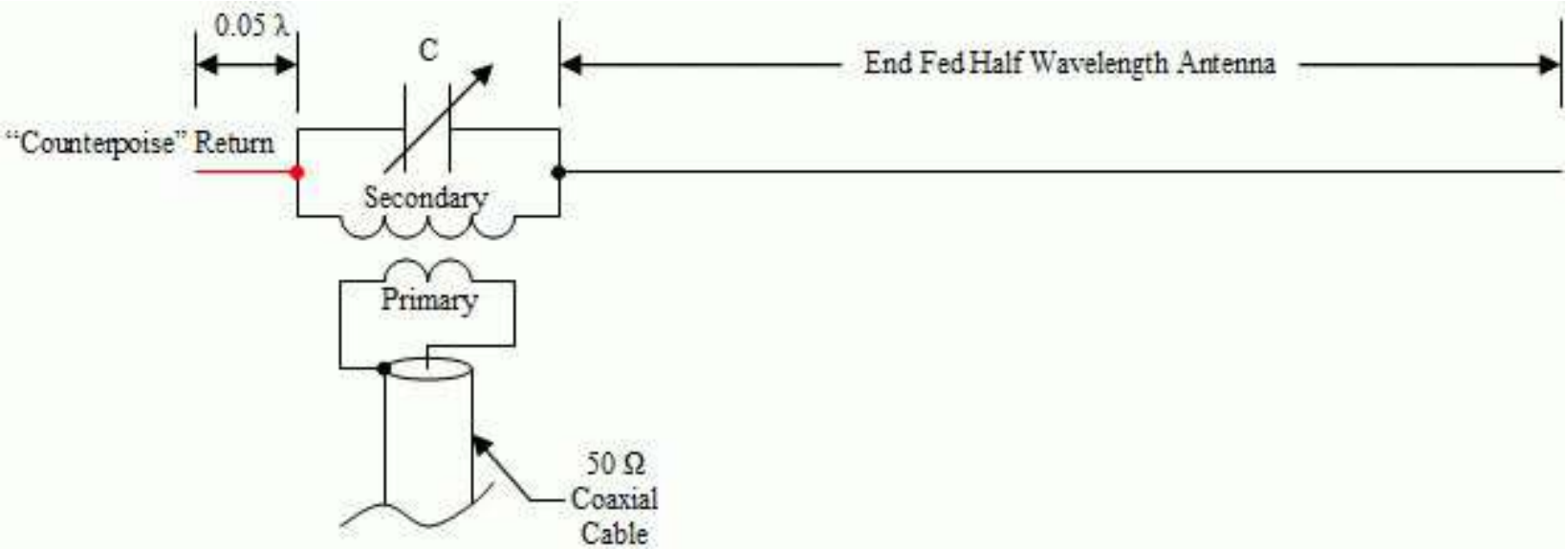
Antenna current



Inverted “V”


$L_{\text{meters}} = \frac{76}{F_{\text{MHz}}}$ meters
MAST
1:1
BALUN
END INSULATOR
ROPE
STAKE
WIRE ELEMENTS
COAX TO
RIG OR
RECEIVER
EARTH'S SURFACE
END INSULATOR
ROPE
STAKE

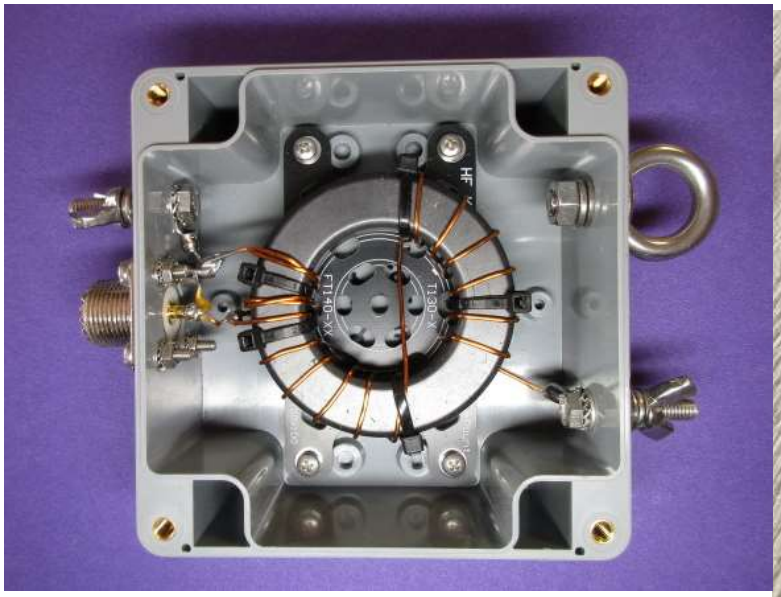
End fed half wave wire



EFHW transformer

Refer to https://aa5tb.com/efha.html for more information

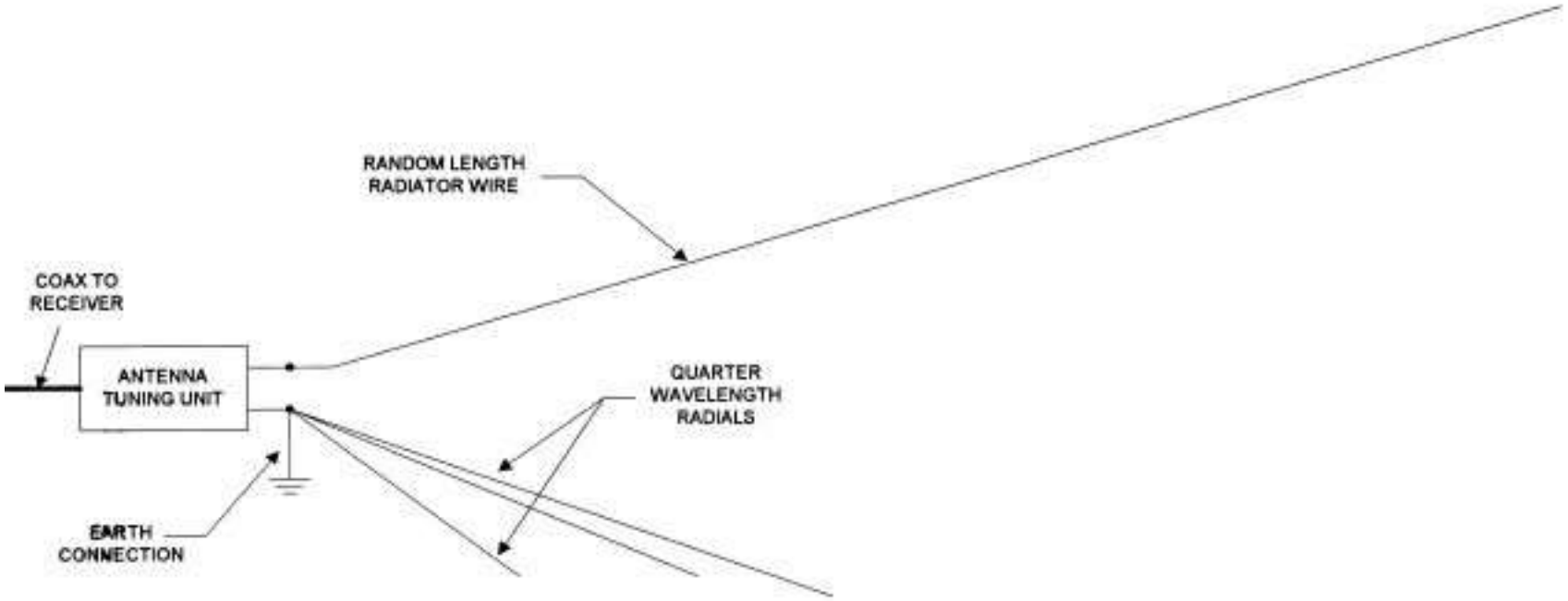
ARRL EFHW Kit



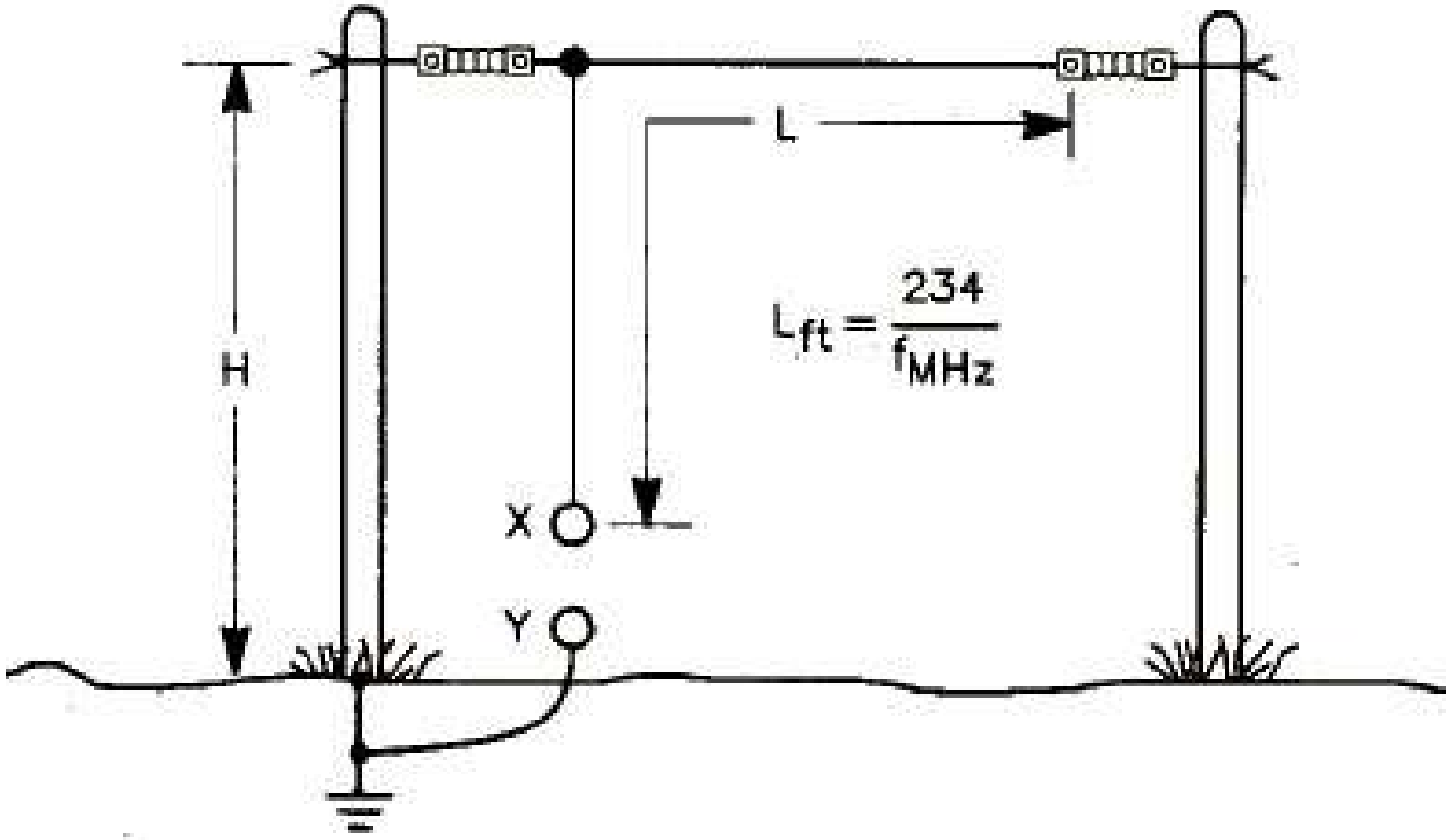
40 through 10 meters
$79.95

https://forums.qrz.com/index.php?threads/the-arrl-end-fed-half-wave-antenna-kit-and-doing-it-cheaper-and-better.770104/

End fed random length wire



Inverted “L”



Buried radials
or on–ground radials

Tuners

Icom HS-4

Yaesu FC-40

LDG RT/RC-100

Wire lengths to avoid

Avoid wire lengths which will resonate at operating frequencies

Auto-Tuner antenna wire lengths

These are recommended wire lengths for use with an auto-tuner to avoid resonance on an amateur band according to Martin Ehrenfried G8JNJ.

Wire length	Wire length	3.8 MHz	7.2 MHz	14.2 MHz	21.3 MHz	29.0 MHz
7.2 meters	23.62 feet	9 – j062	20 – j308	154 + j545	1920 –j1484	97 – j126
9.2 meters	30.18 feet	12 – j701	33 – j81	1174 + j888	109 – j320	470 + j500
19.4 meters	63.64 feet	47 + j48	2360 +j1104	698 + j761	372 + j467	347 + j442
22.8 meters	74.8 feet					
34.3 meters	112.53 feet					

Martin uses an LDG-11 Pro tuner.

For longer wire (sloper or inverted L)

19.4 meters = 63.64 feet

22.8 meters = 74.8 feet

34.3 meters = 112.53 feet

Vertical Antennas

- ¼ wave ground plane vertical, ground mounted.
- ¼ wave ground plane vertical, elevated.
- Use telescoping aluminum tube as the element, or use a wire suspended by a fiberglass mast or a tree.

- Coax sleeve dipole.

Ground mounted ¼ wave Vertical

- ¼ wave vertical antennas require a ground connection for operation.
- A ground rod alone will work but is quite inefficient.
- Radial wires improve the function of the required ground plane.
- A typical AM broadcast antenna may have 120 radials.

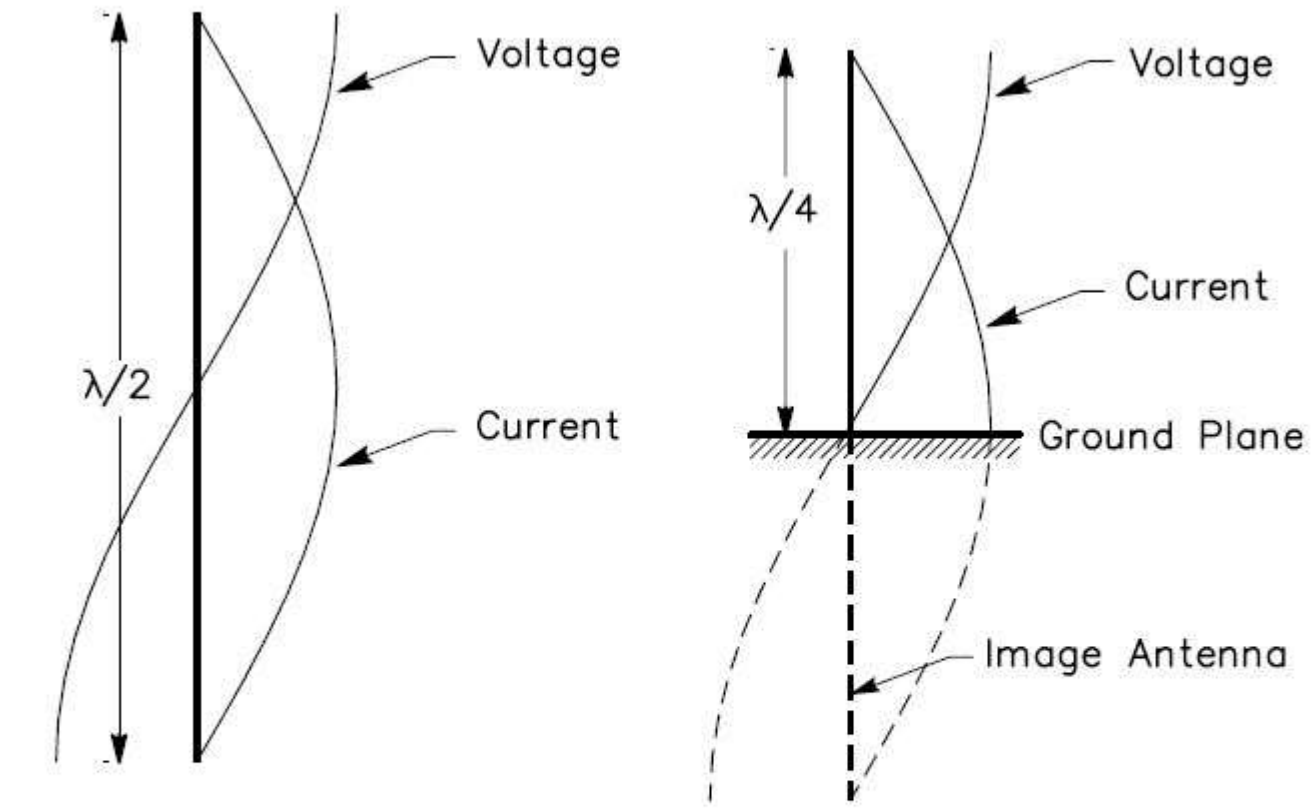
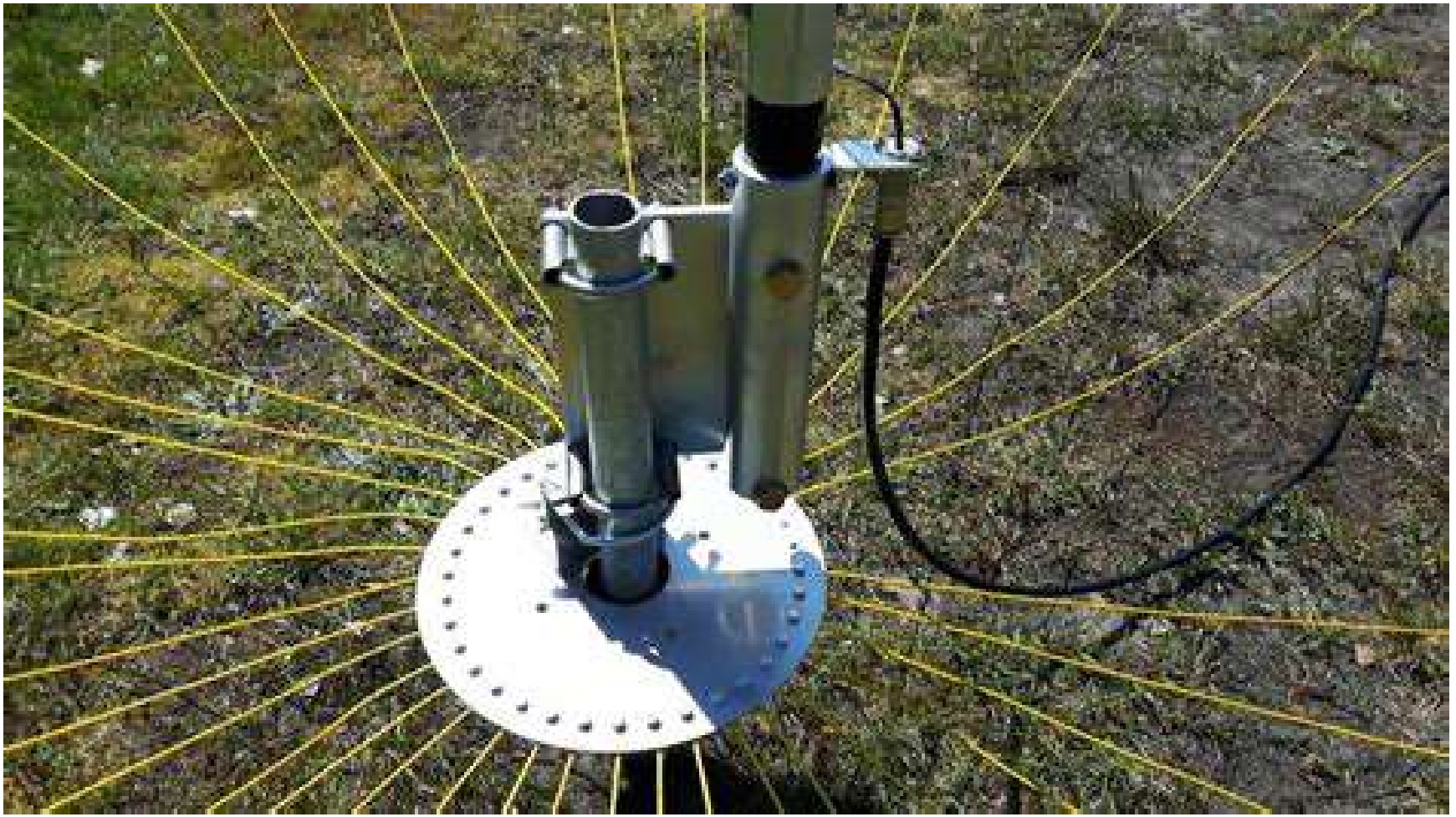


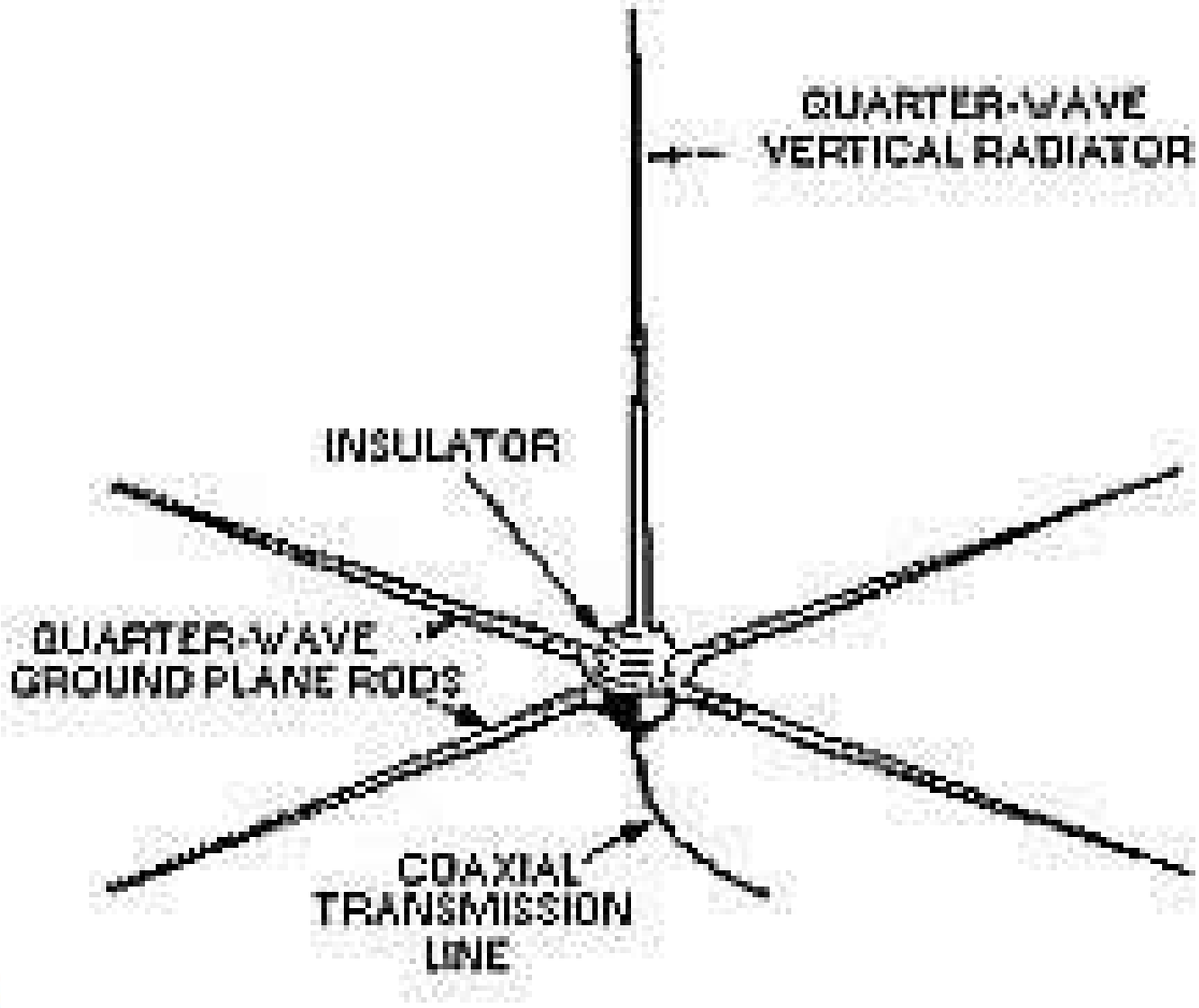
Fig 21—The λ/2 dipole antenna and its λ/4 ground-plane counterpart. The "missing" quarter wavelength is supplied as an image in "perfect" (that is, high-conductivity) ground.

Typical Amateur Ground Radials



Do you want to go to this much effort?

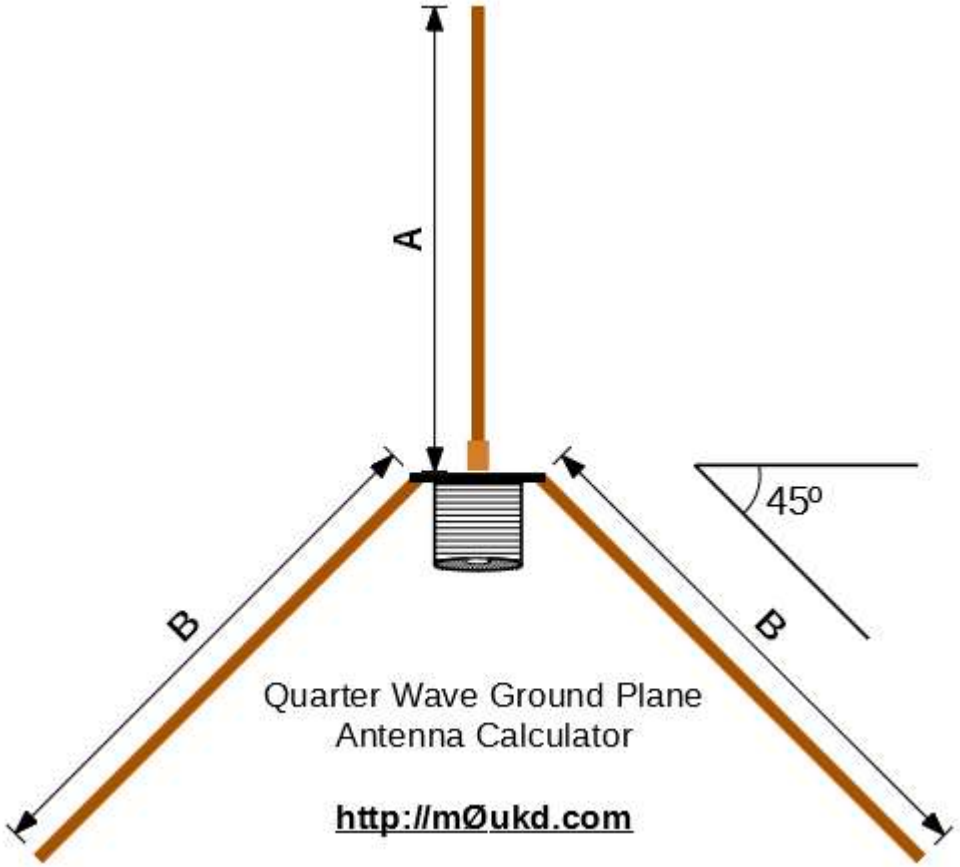
Elevated ¼ wave vertical



Elevated vs Ground radials

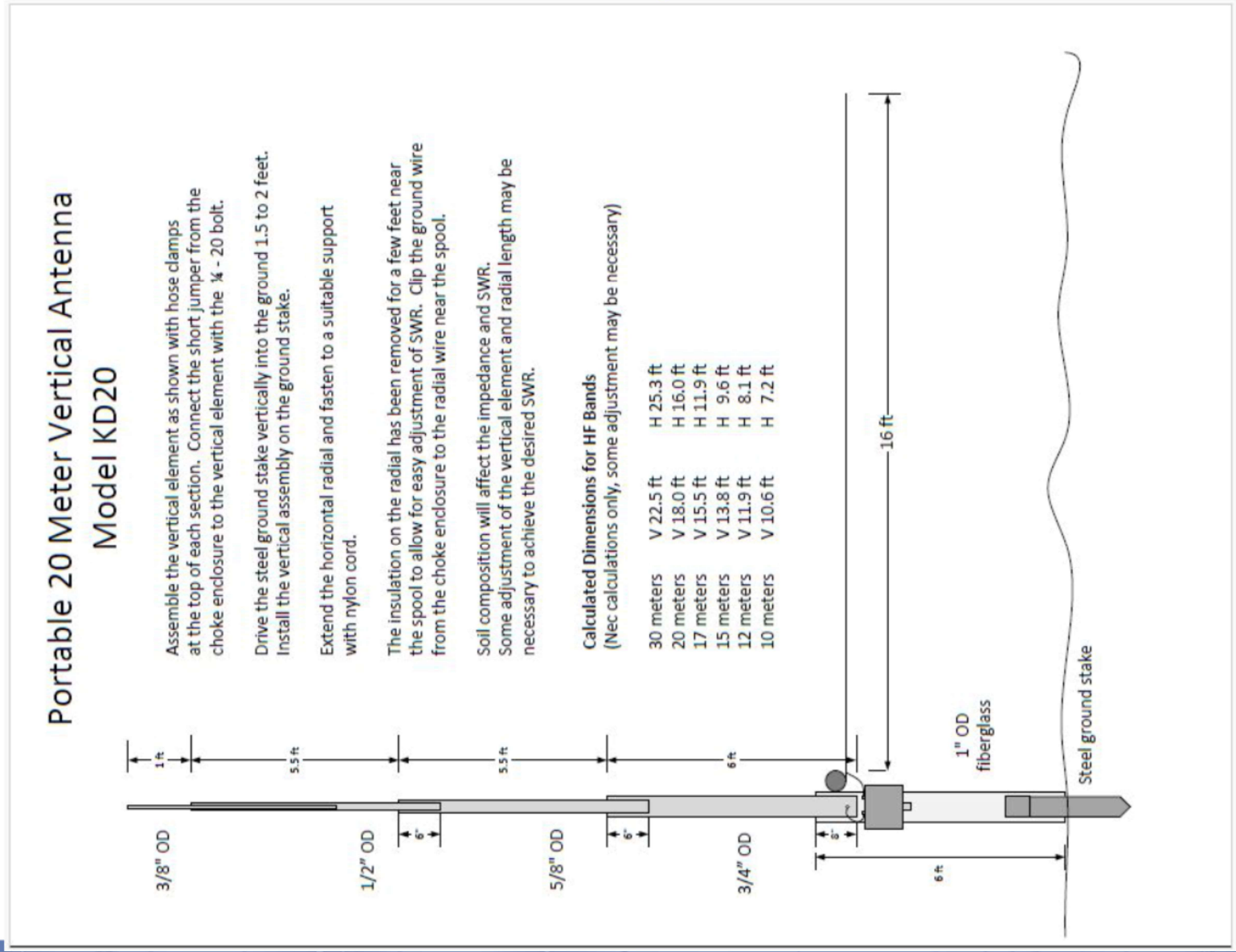
- Several radials, on the ground or buried, are required for efficient operation.
- Elevating the radials four feet or more above ground reduces ground loss tremendously.
- Four elevated radials work as well as dozens of buried radials.
- Length of ground radials is not critical, but more the better.
- Length of elevated radials should be tuned for frequency at ¼ wavelength.
- Sloped radials can improve the impedance match.
- Sloped radials can also double as guy wires.

Ground plane Impedance match

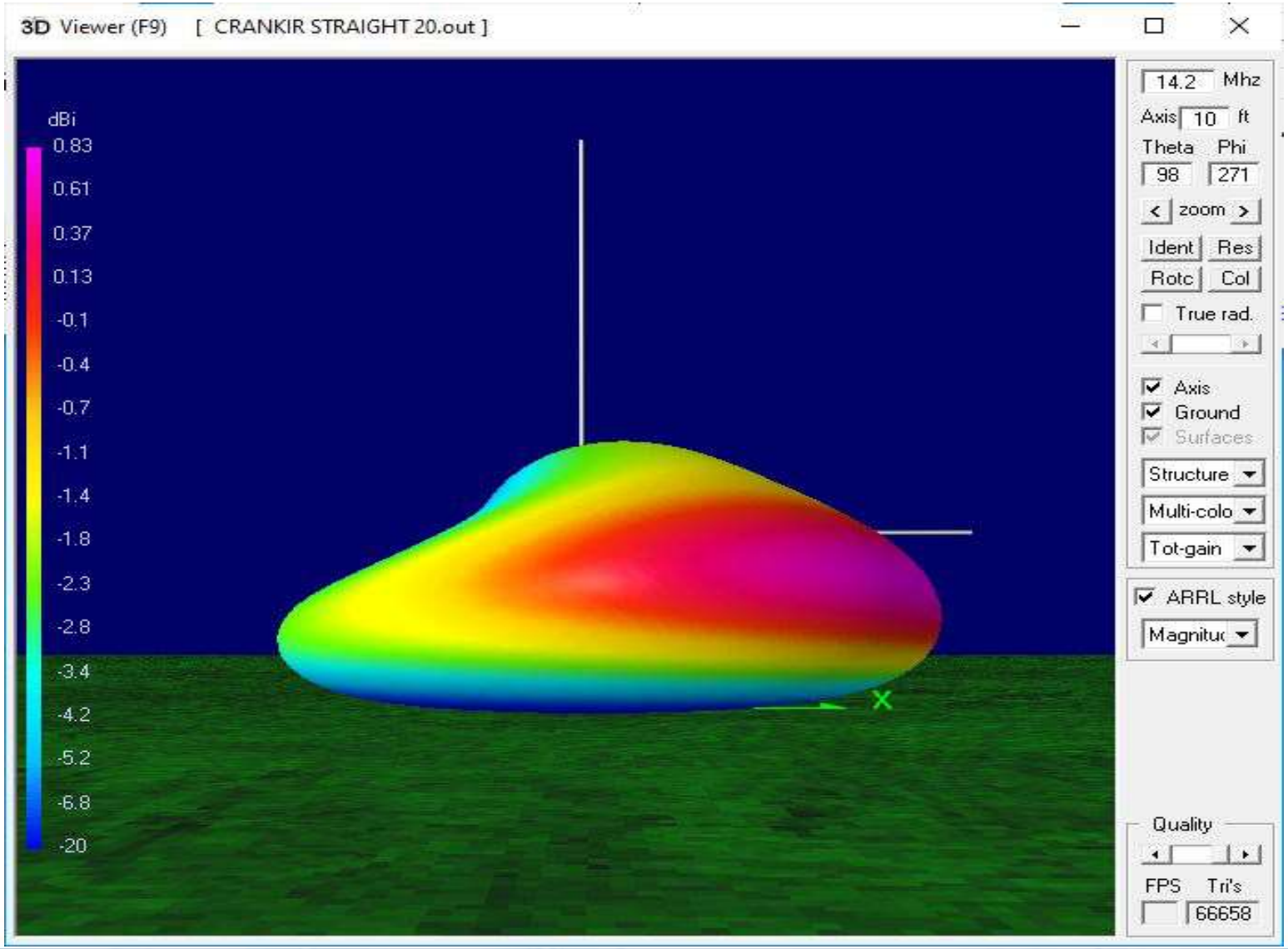


A typical vertical normally has an impedance of about 70 ohms.
Sloping the radials down can lower the impedance to 50 ohms.

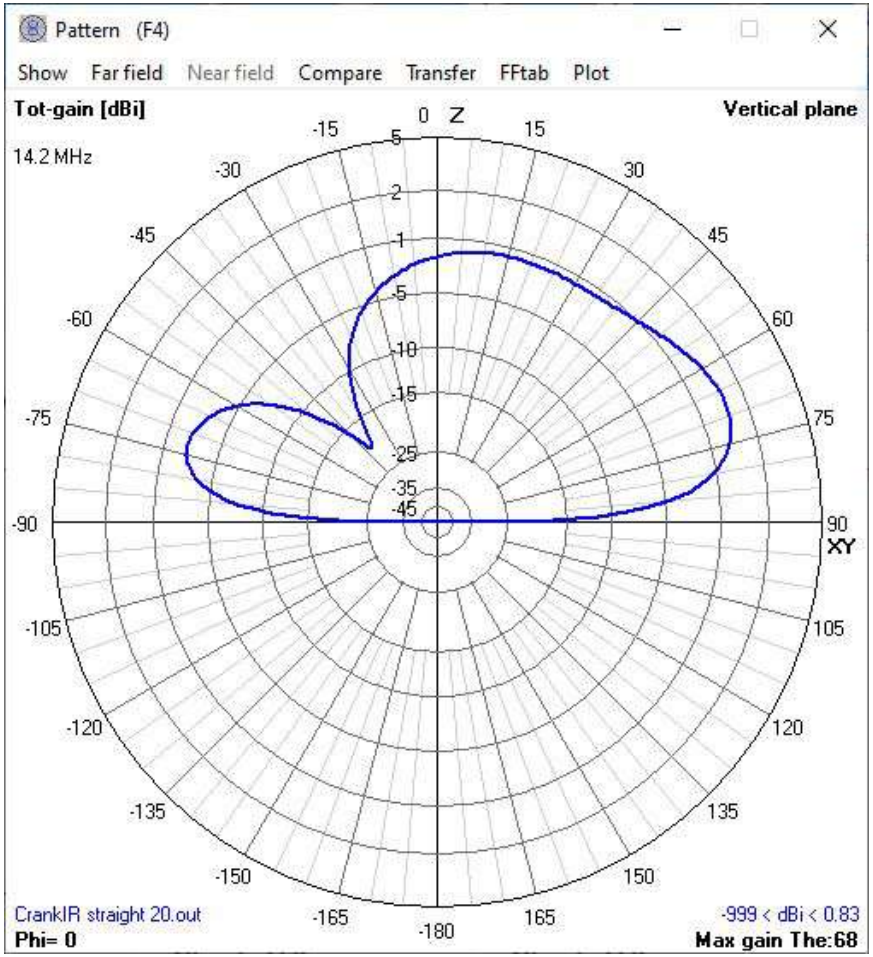
Even Easier, one radial

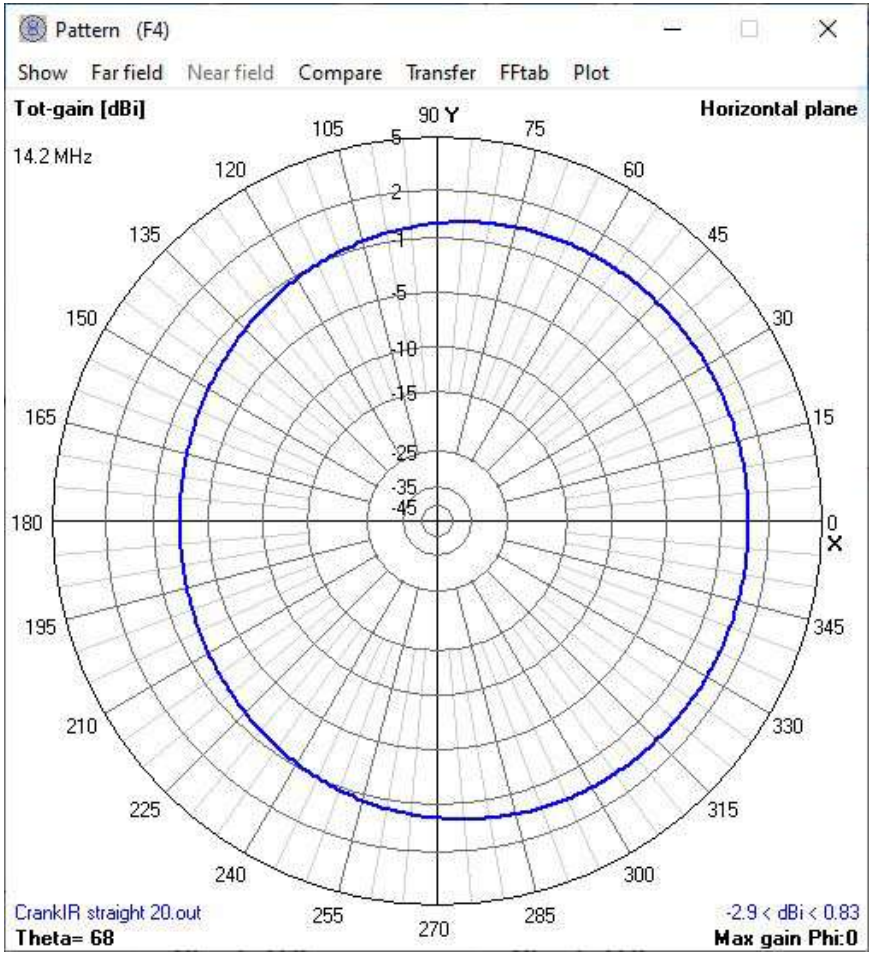


Radiation pattern with one radial

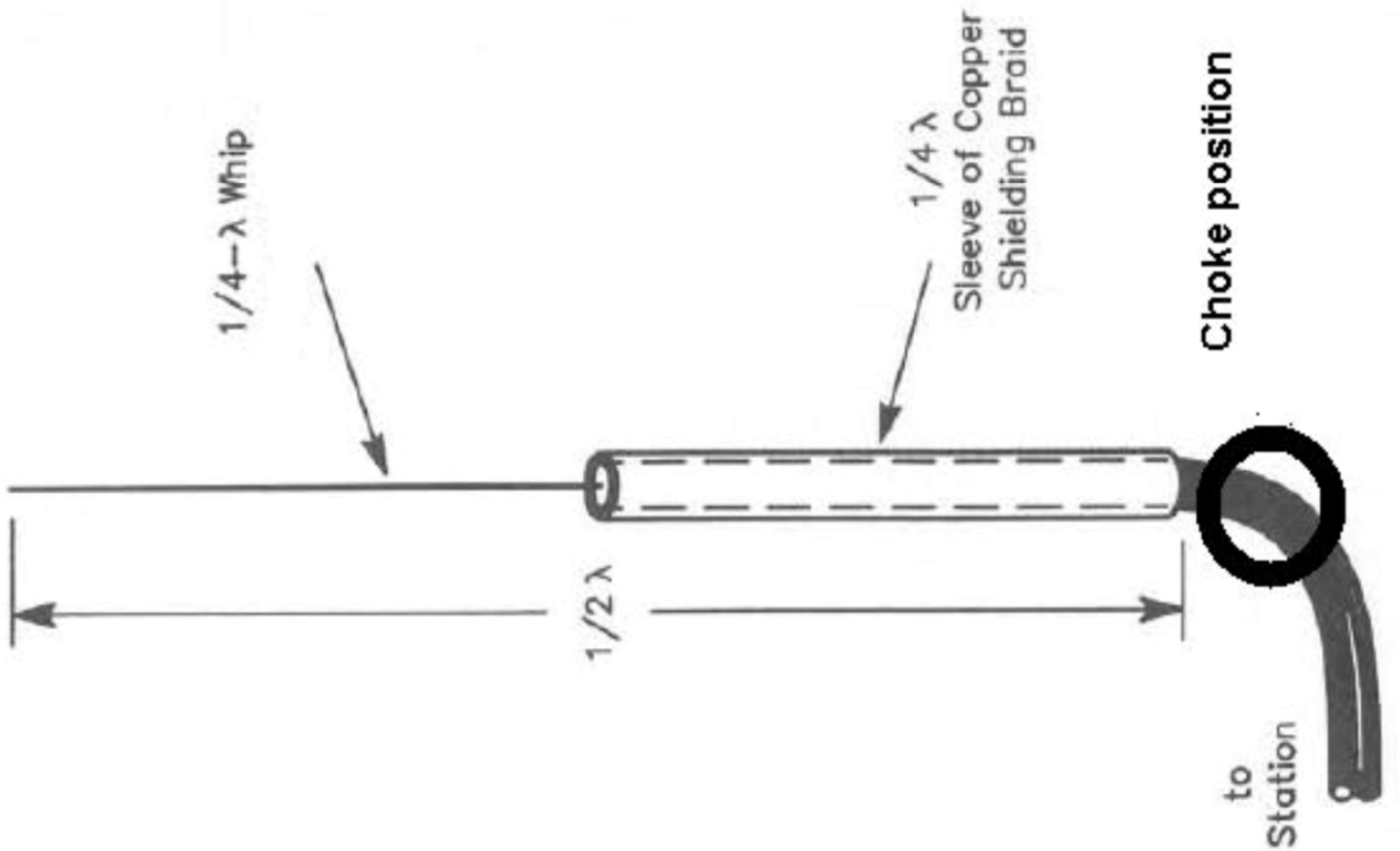


Radiation pattern with one radial





Coax Sleeve dipole



Skin effect of RF current

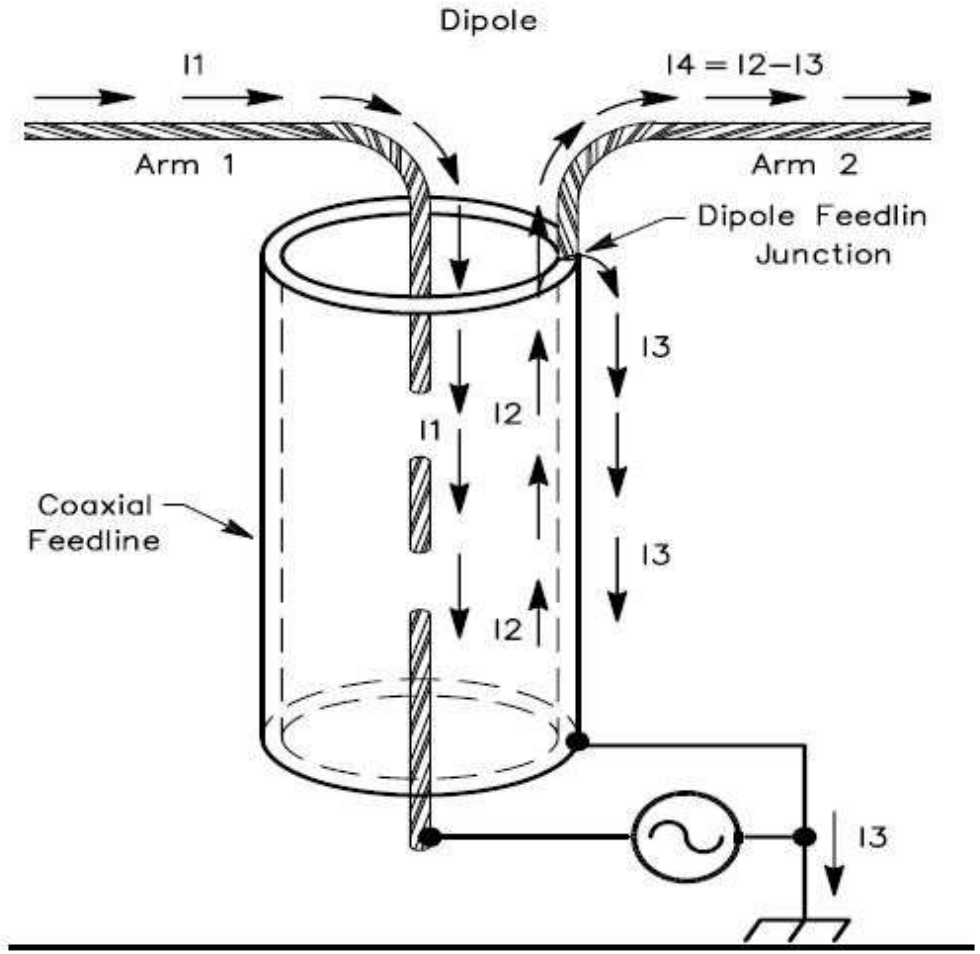
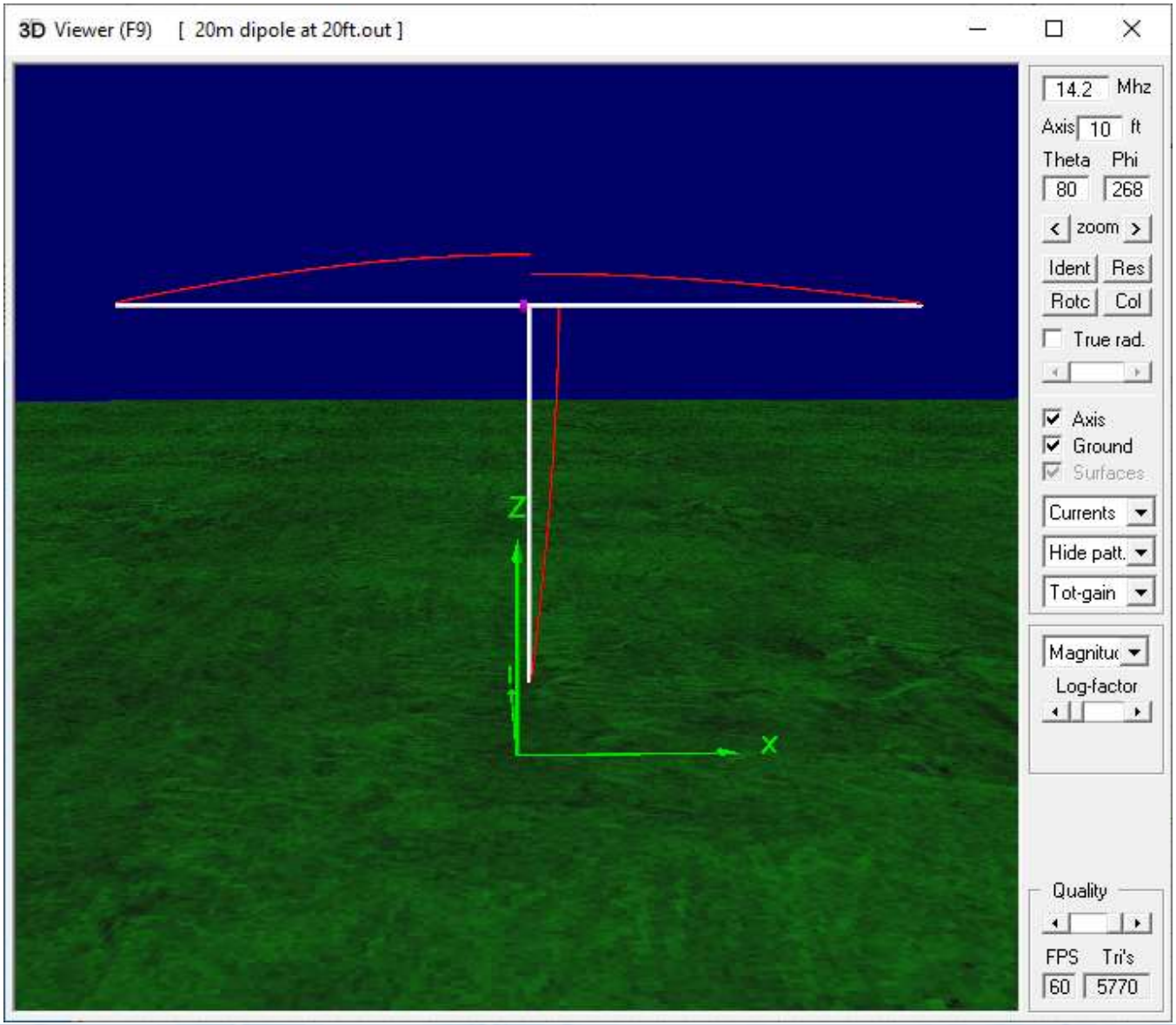


Fig 24—Drawing showing various current paths at feed point of a balanced dipole fed with unbalanced coaxial cable. The diameter of the coax is exaggerated to show currents clearly.

Common Mode current

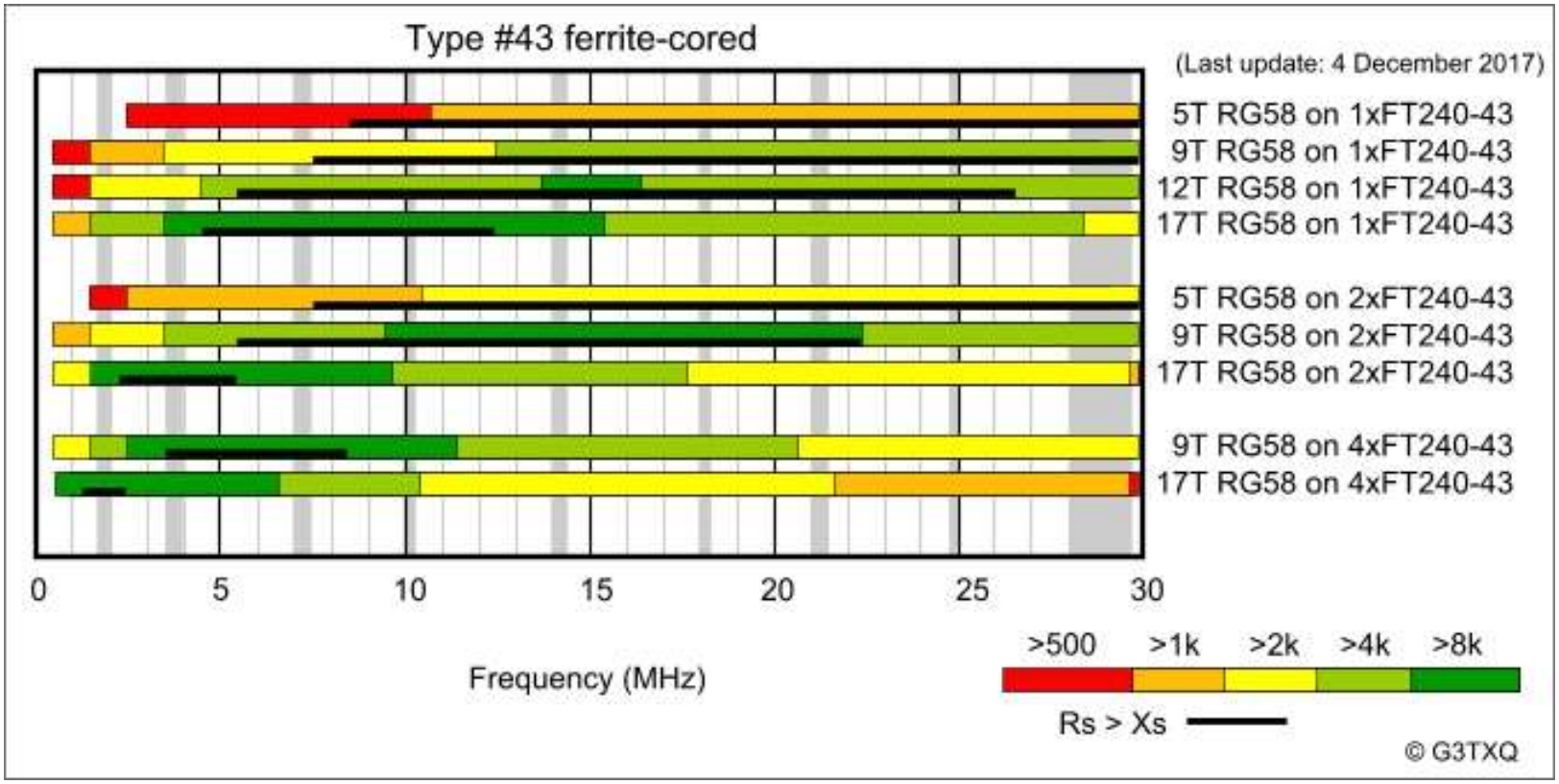


Common Mode Choke

- Common mode current can cause undesireable effects such as RF in the shack or wild SWR measurements.
- A common mode choke or balun is beneficial.
- A good choke eliminates common mode current on the transmission line.
- DIY is cheaper than commercial items.
- Refer to http://karinya.net/g3txq/chokes/ for more information.

Easy Common Mode Chokes

Type 43 or 31 ferrite



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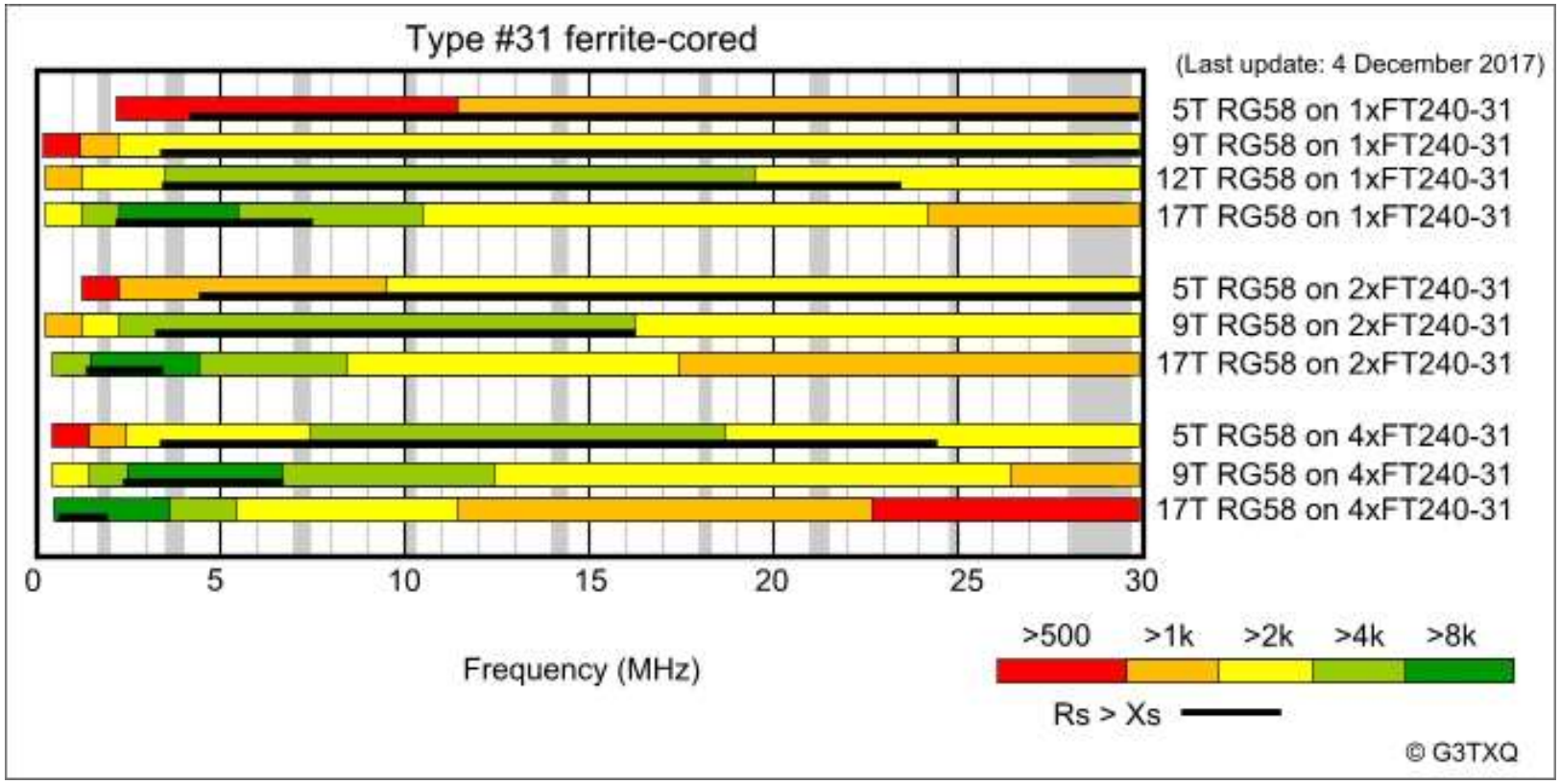


Refer to http://karinya.net/g3txq/chokes/ for more information.

Limited Space Antennas

- Short center loaded verticals.

  Raising the loading coil from the base to the center, increases the effective radiation capability.

- Magnetic loop antennas.

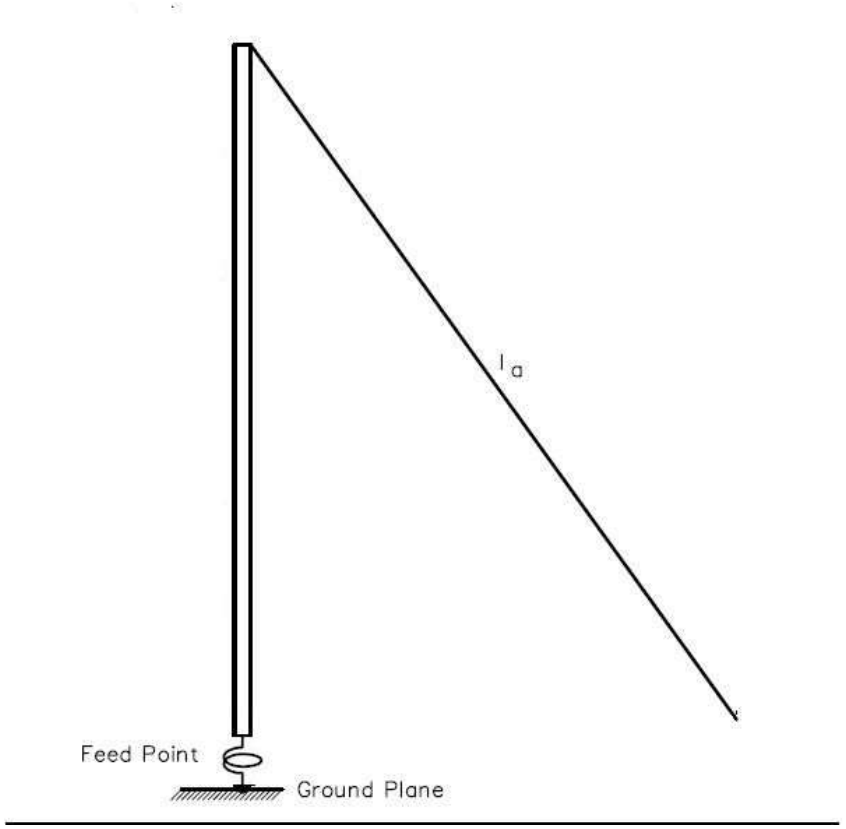
  The most frequent defficiency of most DIY mag loop antennas is the tuning capacitor.

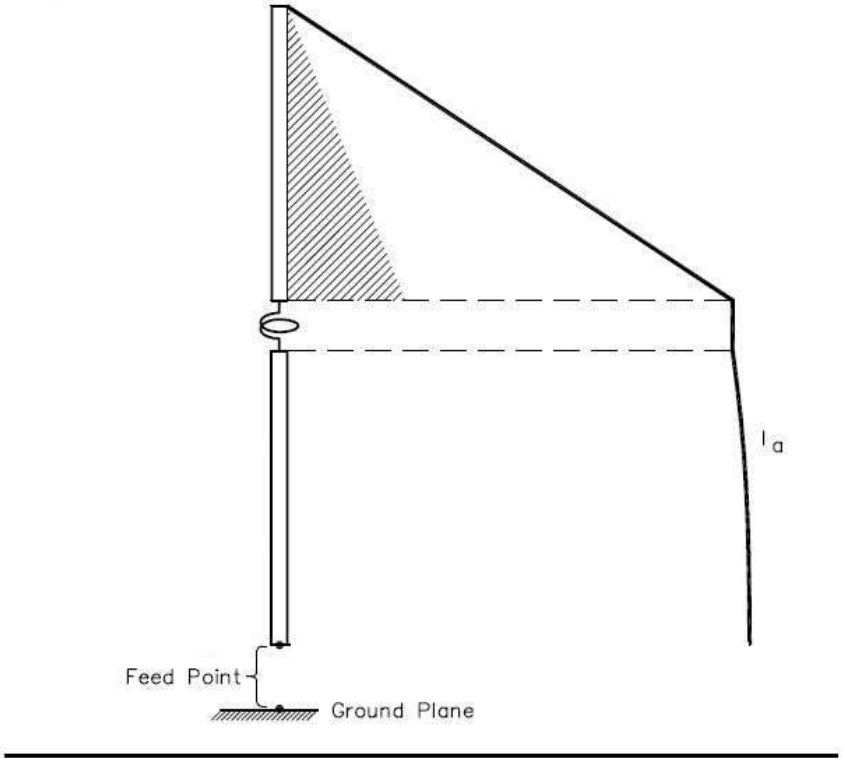
MFJ Hamstick

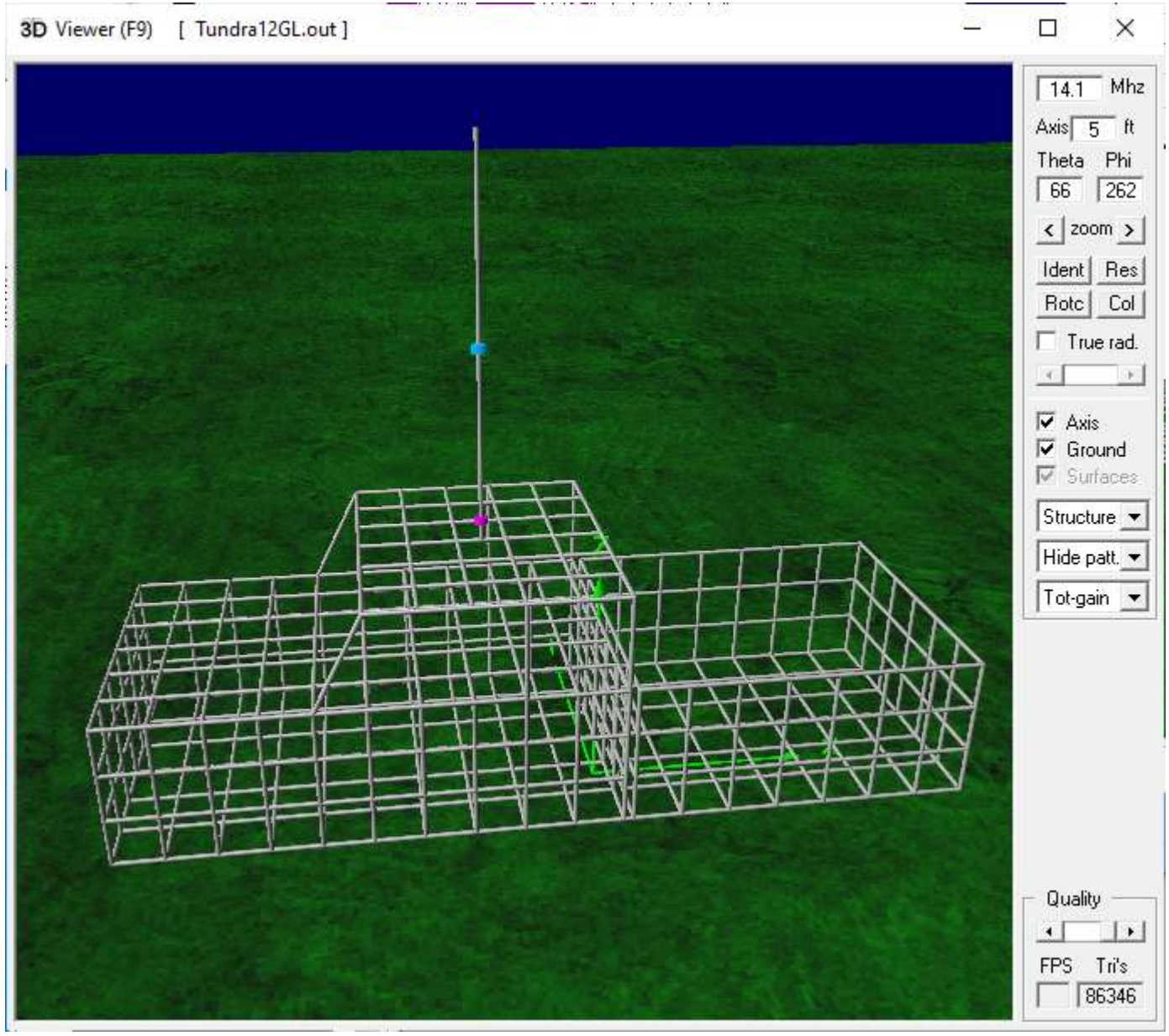
$21.95

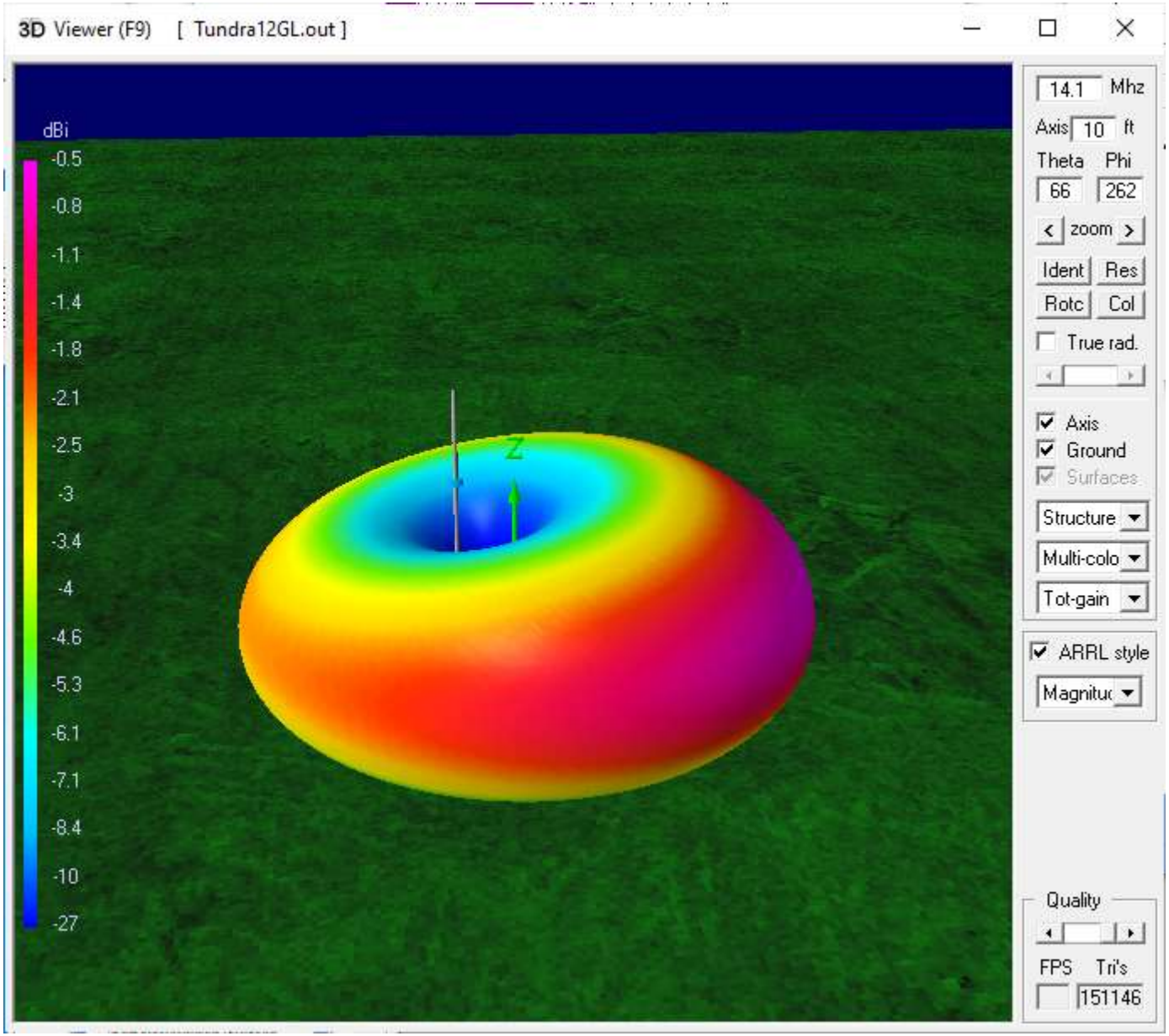
Works very well on 20 meters
$49.95

Loading Coil Position



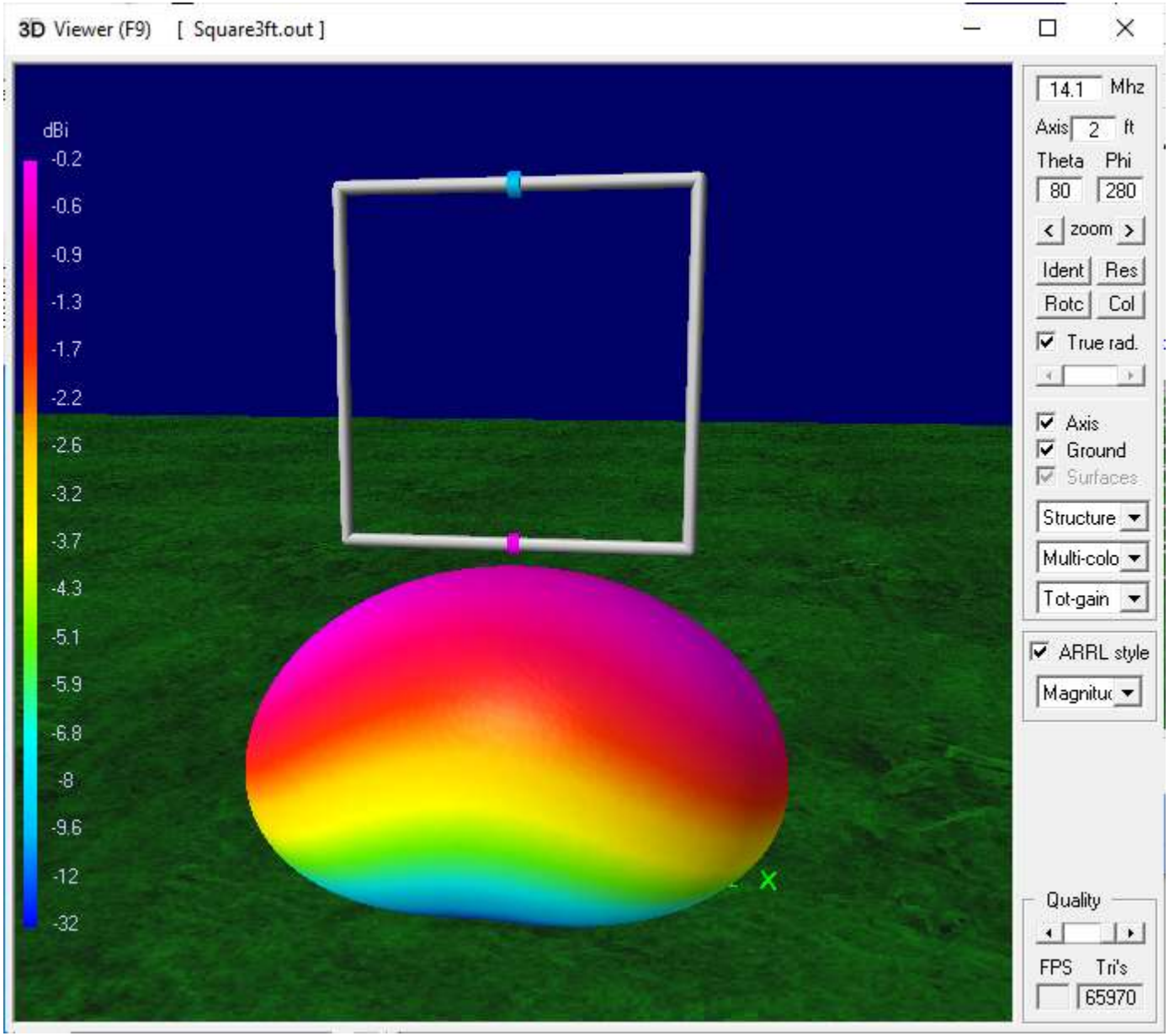



3D Viewer (F9) [Tundra12GL.out]
14.1 Mhz
Axis 5 ft
Theta Phi
66 262
zoom
Ident Res
Rotc Col
True rad.
Axis
Ground
Surfaces
Structure
Hide patt.
Tot-gain
Quality
FPS Tri's
86346


3D Viewer (F9) [Tundra12GL.out]
dBi
-0.5
-0.8
-1.1
-1.4
-1.8
-2.1
-2.5
-3
-3.4
-4
-4.6
-5.3
-6.1
-7.1
-8.4
-10
-27
Z
14.1 Mhz
Axis 10 ft
Theta Phi
66 262
zoom
Ident Res
Rotc Col
True rad.
Axis
Ground
Surfaces
Structure
Multi-colo
Tot-gain
ARRL style
Magnitud
Quality
FPS Tri's
151146

Easy Magloop Antenna

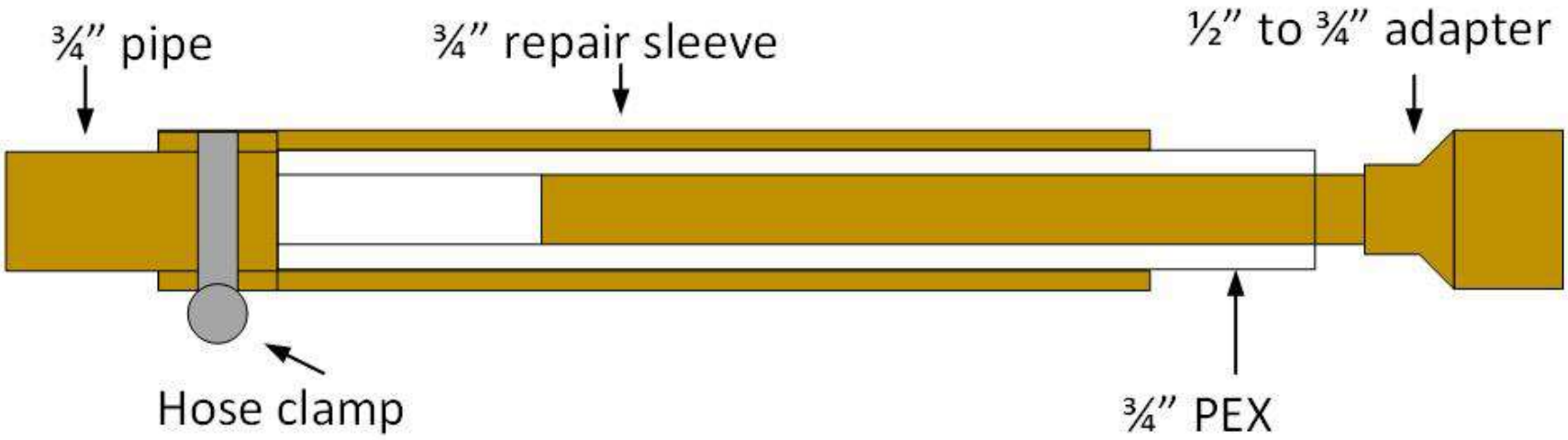
- A single band magloop for 20 meters is quite easy to build.
- The required high voltage tuning capacitor is constructed of copper pipe and PEX tubing.
- No ground radials are required.
- Tall mast or tower is not required. One or two loop diameters elevation works fine.


3D Viewer (F9) [Square3ft.out]
dBi
-0.2
-0.6
-0.9
-1.3
-1.7
-2.2
-2.6
-3.2
-3.7
-4.3
-5.1
-5.9
-6.8
-8
-9.6
-12
-32
14.1 Mhz
Axis 2 ft
Theta Phi
80 280
zoom
Ident Res
Rotc Col
True rad.
Axis
Ground
Surfaces
Structure
Multi-colo
Tot-gain
ARRL style
Magnitud
Quality
FPS Tri's
65970

High Voltage Tuning Capacitor

- 3/4” copper pipe
- 3/4” copper repair sleeve
- 1.2” copper pipe
- 3/4” PEX pipe
- 3/4” to 1/2” adapter

Capacitor Construction



- The PEX pipe OD is the same as the 3/4" copper pipe OD.
- The copper repair sleeve slides over the 3/4" copper pipe and the PEX pipe.
- The 1/2" copper pipe is inside the PEX pipe.
- The overlap between the repair sleeve and the ½" copper pipe forms the capacitor.
- The left end of the repair sleeve is slotted and the hose clamp holds it in place.

Antenna Building

- An antenna analyzer is indispensible when building and tuning antennas.
- An SWR meter can be used with some difficulty but an analyzer provides more information such as resonant frequency and actual impedance.
- An analyzer which scans and plots the SWR curve over a range of frequencies makes tuning much easier.
- NanoVNA units are very good and inexpensive although the learning curve may be daunting.


RigExpert
AA-55 ZOOM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Sweep Center
A.P-Off Bandwidth
Graph ON/OFF
COMET
ANTENNA


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WIDTH
FREQ
ON
OFF
HOLD
RUN
AEA


Times Technology
MFJ
MFJ-225
Graphical Impedance Analyzer


PORT1
S11
S21
PORT2
NanoVNA


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INPUT
EXIT
OUTPUT
POWER SOURCE
MODE
CHARGER
MFJ GRAPHICAL ANTENNA ANALYZER
1 TO 180 MHZ MULTI-FUNCTION ANTENNA ANALYZER
MODEL MFJ-225


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RUN


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Useful Internet references

- https://aa5tb.com/efha.html
- https://www.aa5tb.com/index.html
- https://www.nonstopsystems.com/radio/frank_radio_antenna_magloop.htm
- http://dt.prohosting.com/hacks/antenna/magloop.html
- http://www.karinya.net/g3txq/chokes/
- https://forums.qrz.com/index.php?threads/the-arrl-end-fed-half-wave-antenna-kit-and-doing-it-cheaper-and-better.770104/