End Fed Half Wave Antennas

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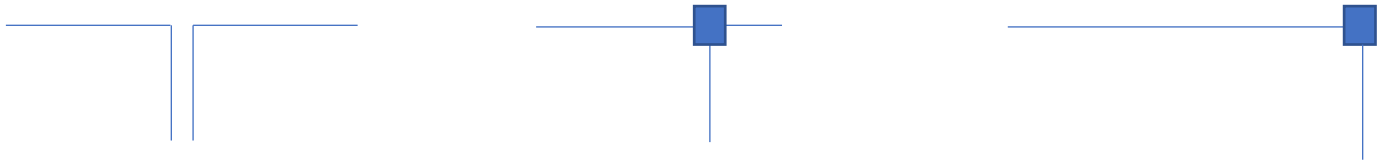
W6QR


Hi!
I'd like a wake up call please
You have a $10,000 radio
A 1500 watt amplifier
and an End Fed Half Wave
at 15ft above the ground

Half Wave Dipoles



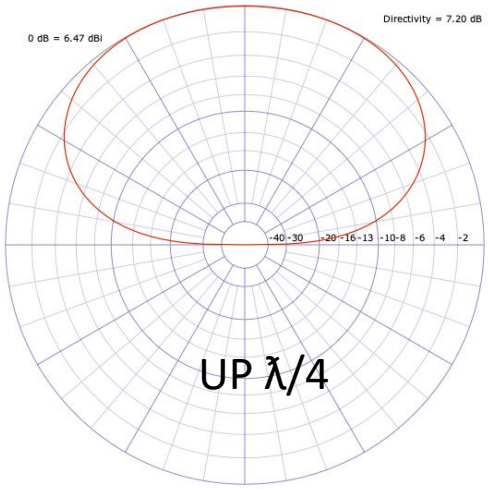
Center Fed

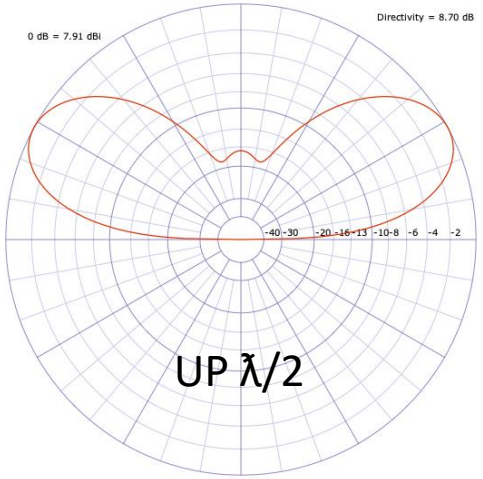
Offset Fed

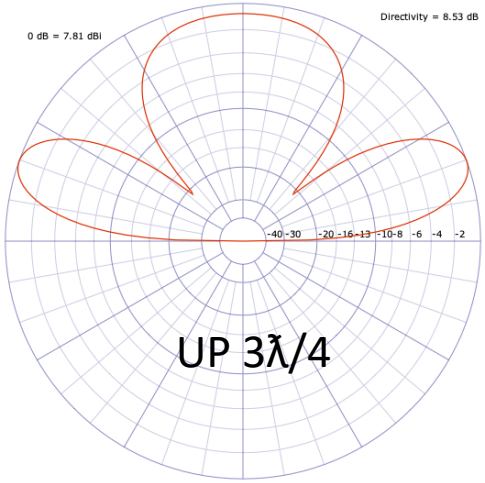
End Fed

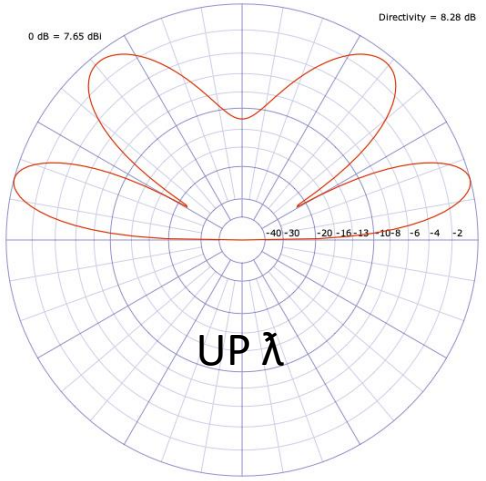
- At its half wave frequency, a dipole will have the same radiation pattern independent of feed configuration
- It's more a matter of convenience at your installation for selecting a feed type
- Offset and end fed dipoles require matching transformers
- Dipoles are probably the most popular HF antenna
  - At a height of ƛ/4 they are good for local contacts
  - At a height of >ƛ/2 they are good DX antennas

20M Dipole Performance vs. Height

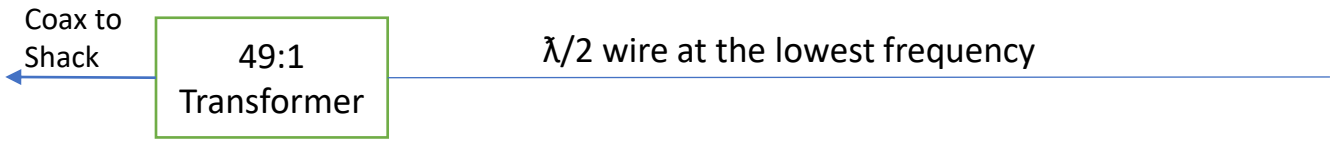








What is an End Fed Half Wave (EFHW) Antenna?



- An EFHW is a wire antenna resonant on its ƛ/2 frequency and harmonics
  - A 40M EFHW is resonant on 40/20/15/10M
- The end impedance is ~2500Ω and varies a bit due to wire orientation
- To get proper resonance on the harmonics a coil and capacitor are required
- A counterpoise is required. If you don't install one, the coax will act as the counterpoise
- The radiation pattern is dipole like on the fundamental frequency and multi-lobed on harmonics

EFHW Counterpoise Configuration

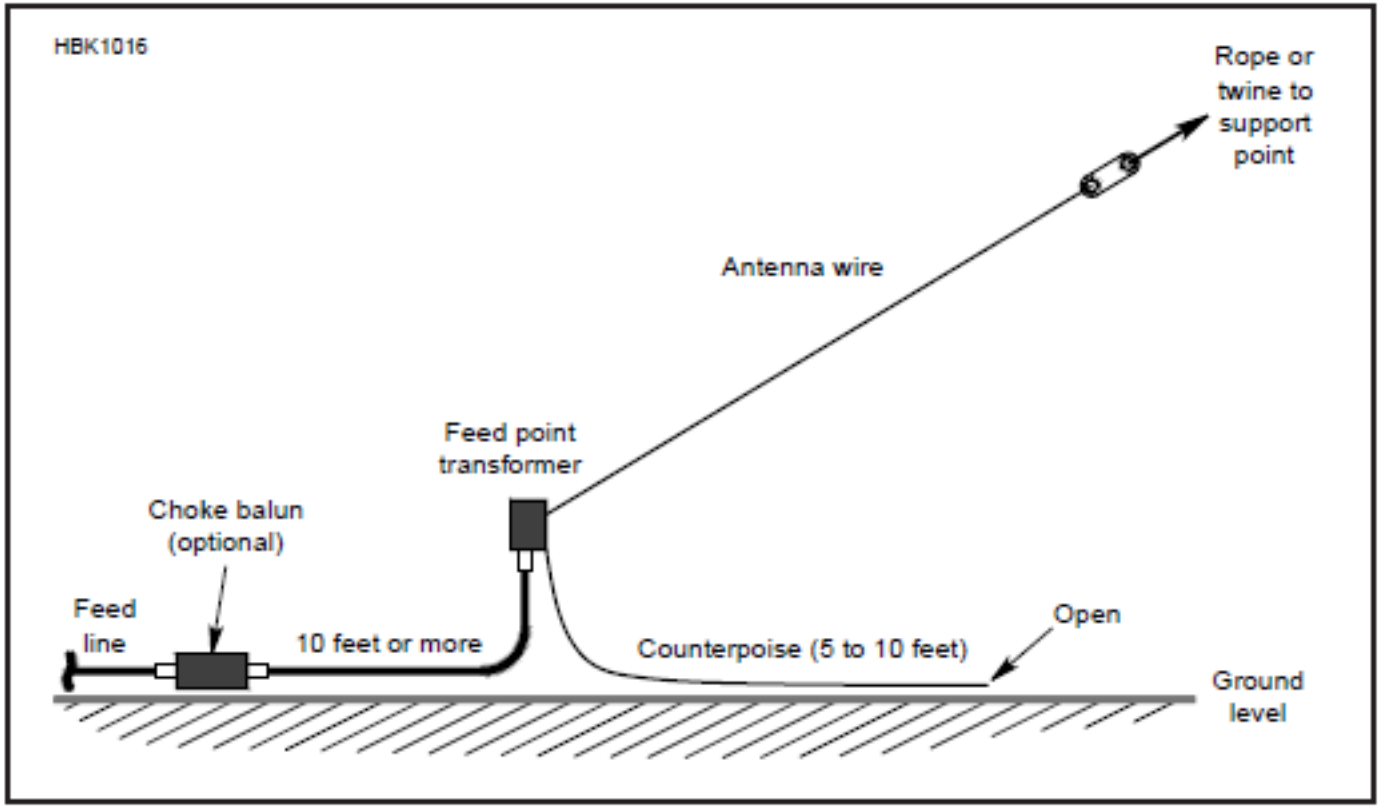


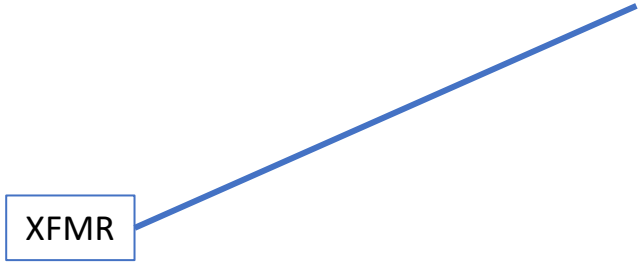
Figure 21.17 — The end-fed half-wave (EFHW) antenna. For permanent use, it can be installed horizontally with both ends well above ground. For portable or temporary use, it is common to keep the feed point near ground level and support the other end with a multi-section fiberglass mast or with a rope over a tree branch.

End Fed Half Wave Antenna (EFHW)

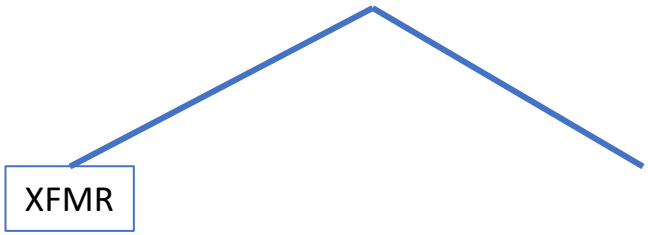
- The EFHW antenna is very popular for many reasons
  - Flexible installation
    - Straight Horizontal
    - Straight Vertical
    - Inverted-V
    - Inverted-L
    - Sloper
  - Operates on harmonics. A 40M EFHW will have a low VSWR on 40/20/15/10M with an appropriate loading coil
  - End feeding allows smaller wire to be used since you don't have to support the feedline
  - Low cost, easy to home brew
- *The EFHW is not the popular multiband offset fed wire using a 9:1 balun*

EFHW Configuration – cont'd

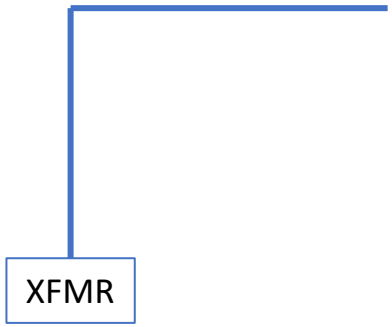
Horizontal Wire



Sloping Wire

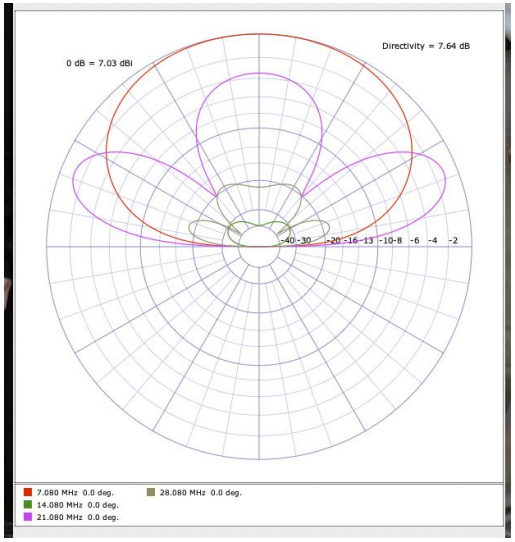


Inverted V

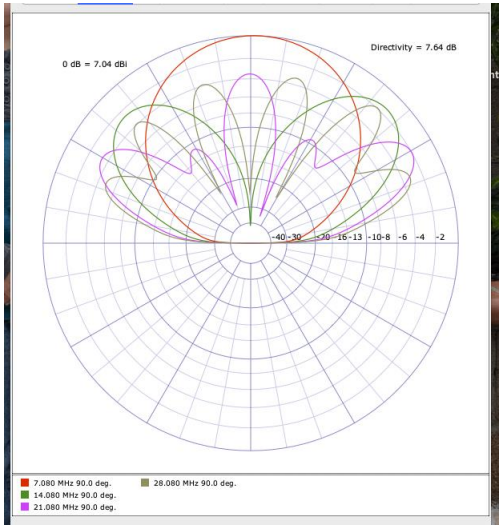


Inverted L

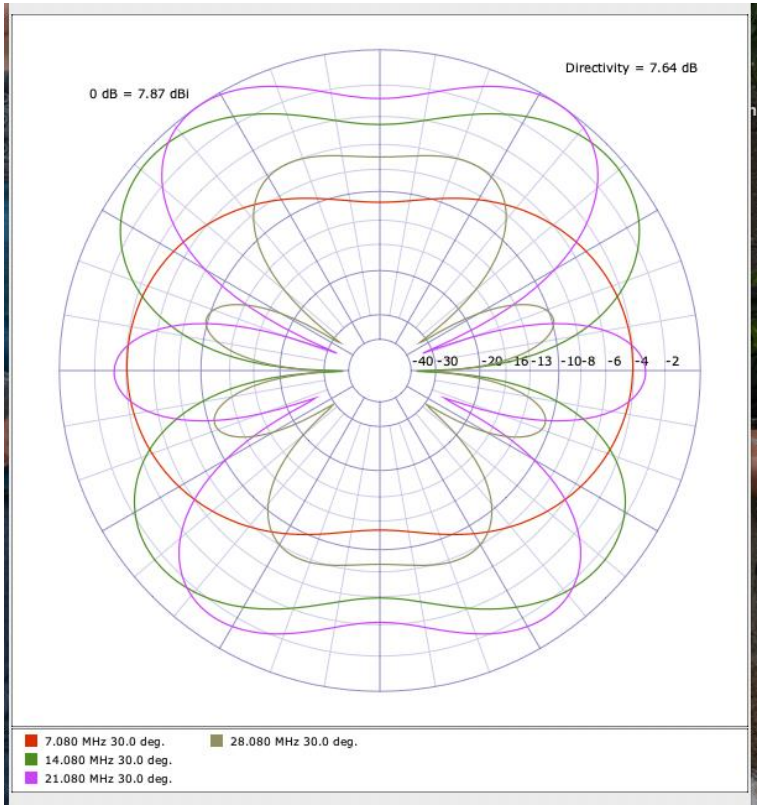
EFHW Radiation Patterns: Horizontal 40M EFHW at 30’



Broadside

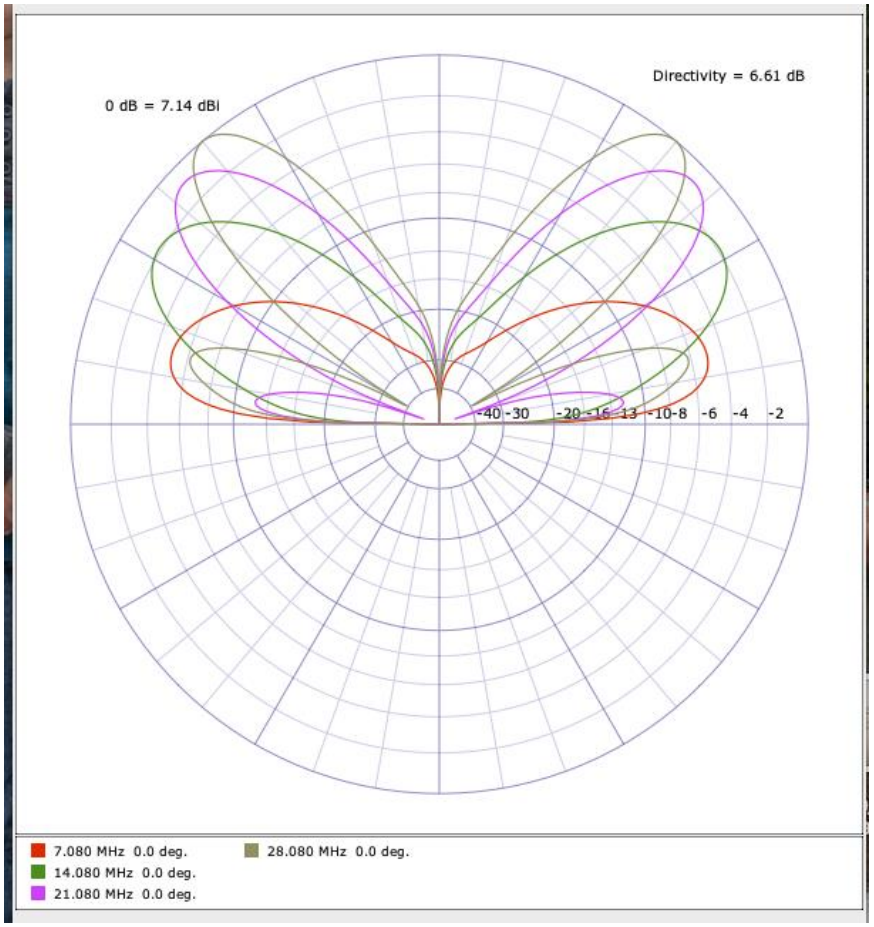


End Fire

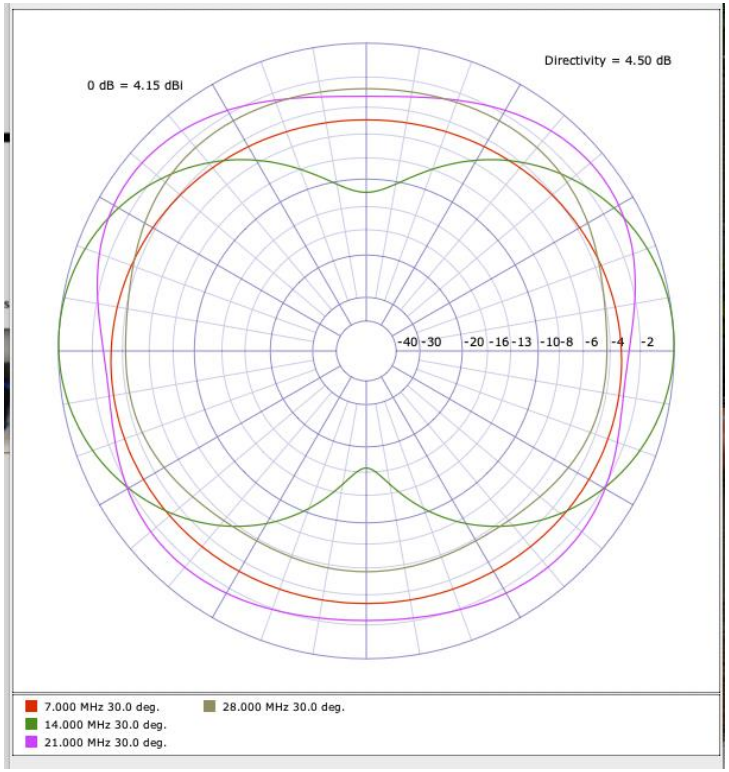


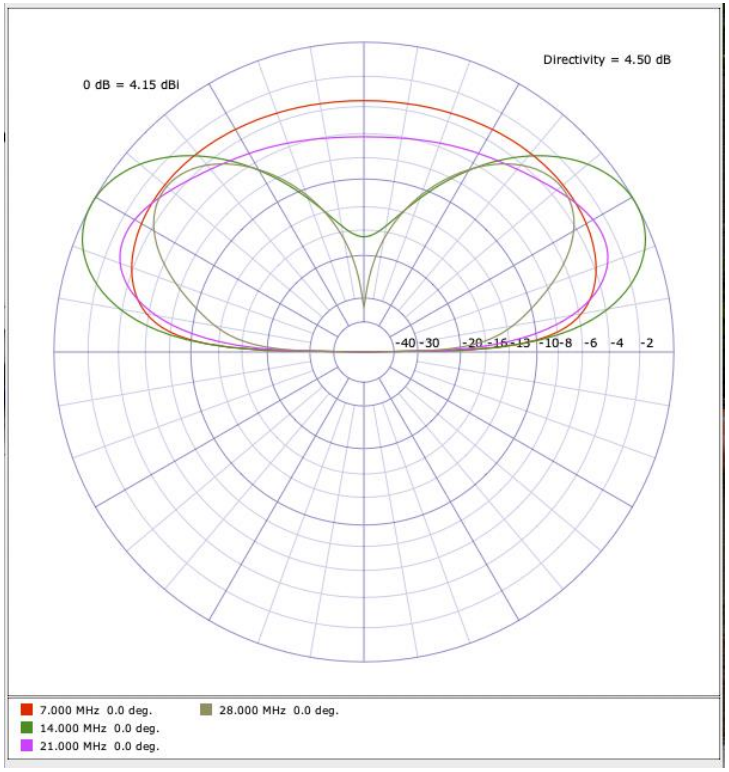
Azimuth pattern at 30º elevation
Antenna Oriented up/down

40M EFHW Vertical



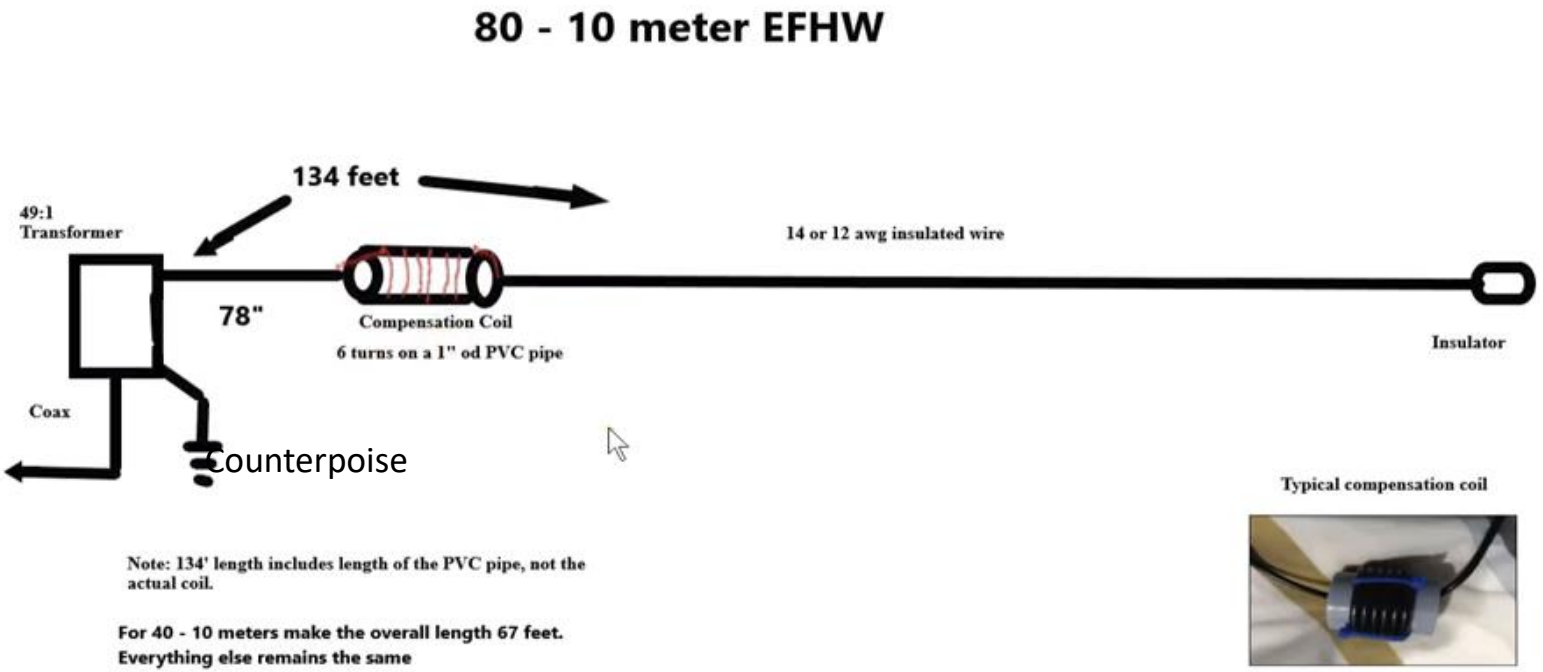
40M EFHW Inverted L





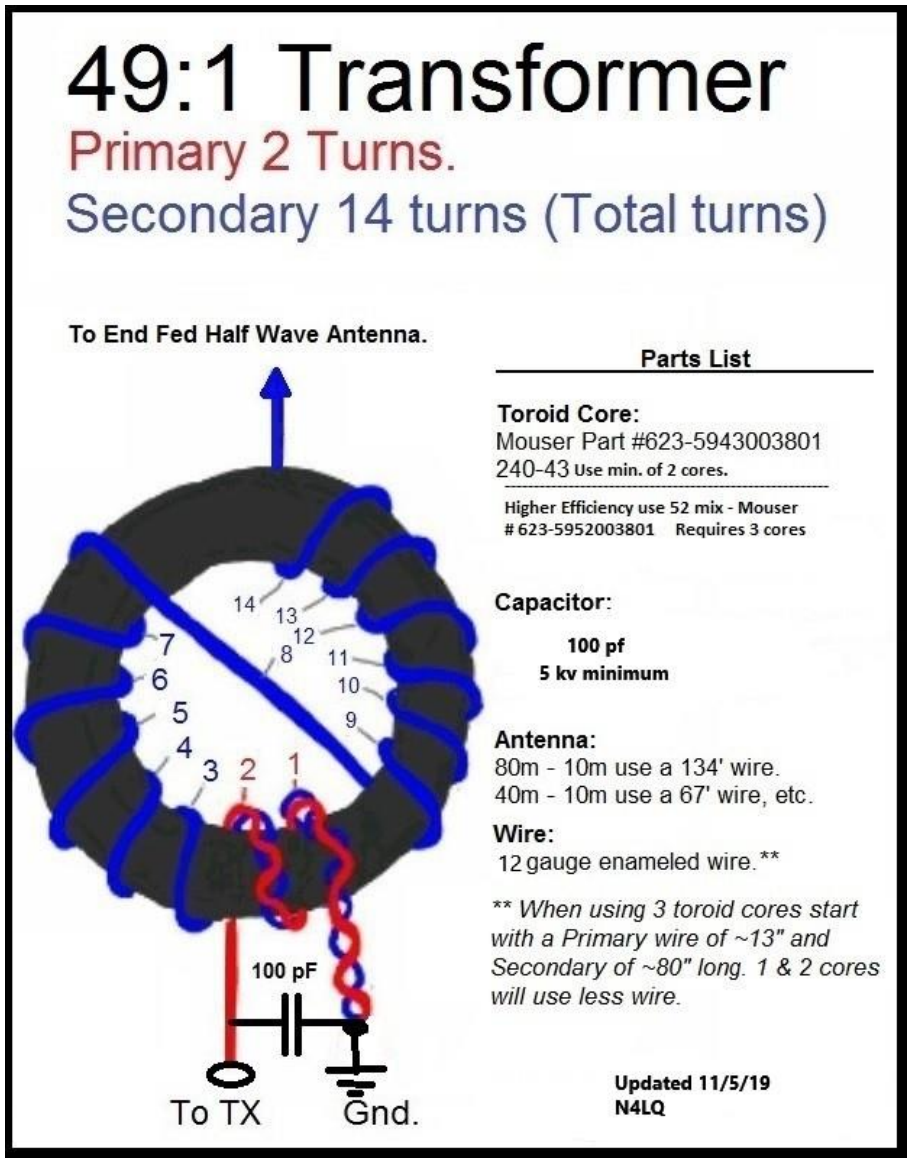
The Inv-L configuration is particularly good. The 20M peak occurs broadside to the top wire. There is a very good balance of low and high angle radiation.

What is an End Fed Half Wave Antenna



- The compensation coil is required to have a proper resonant frequency at harmonics, it compensates for end effects
- N4LQ, Steve Ellington, has a lot of data on his Face Book and You Tube pages.
- Commercial versions are available for those who don't like building things
- LDG sells an inexpensive low power transformer
- The ARRL has a very nice Kit available

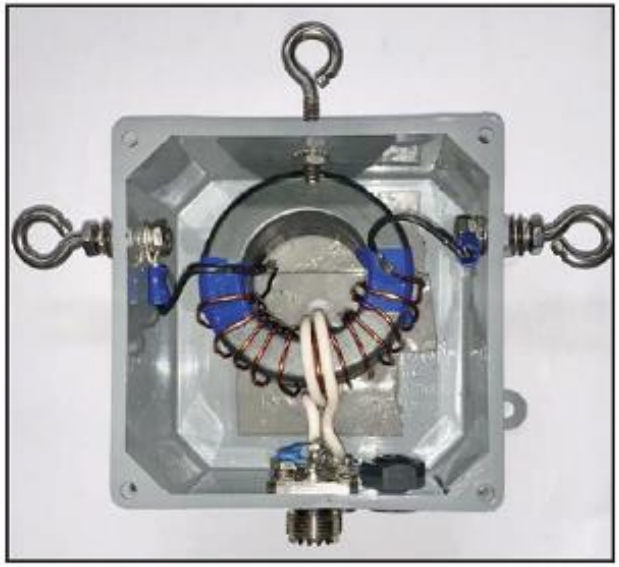
EFHW Components are easy to build



- A single FT-140-43 core will handle 100W CW/SSB
- Two FT-240-43 cores will handle 500W
- Three FT-240-52 cores will handle 1500W
- Careful layout is required for high power operation since the voltage at 2500Ω is quite high, several KV.
- This configuration works best if you are using the coax as a counterpoise

EFHW Transformer – alternative designs

Separate Primary Winding



- The 14T secondary winding can use #18 wire since its current is low. A separate primary winding of 2T #14 wire near the center of the 14T coil will handle the higher current, 5.5 amp at 1500W
- See *CQ Magazine* December 2021: *A Deep Dive Into End Fed Half Wave Antennas* by Bob Glorioso, W1IS, and Bob Rose, KC1DSQ, pp 66-74.
- This configuration requires a wire counterpoise

Alternative End Impedances

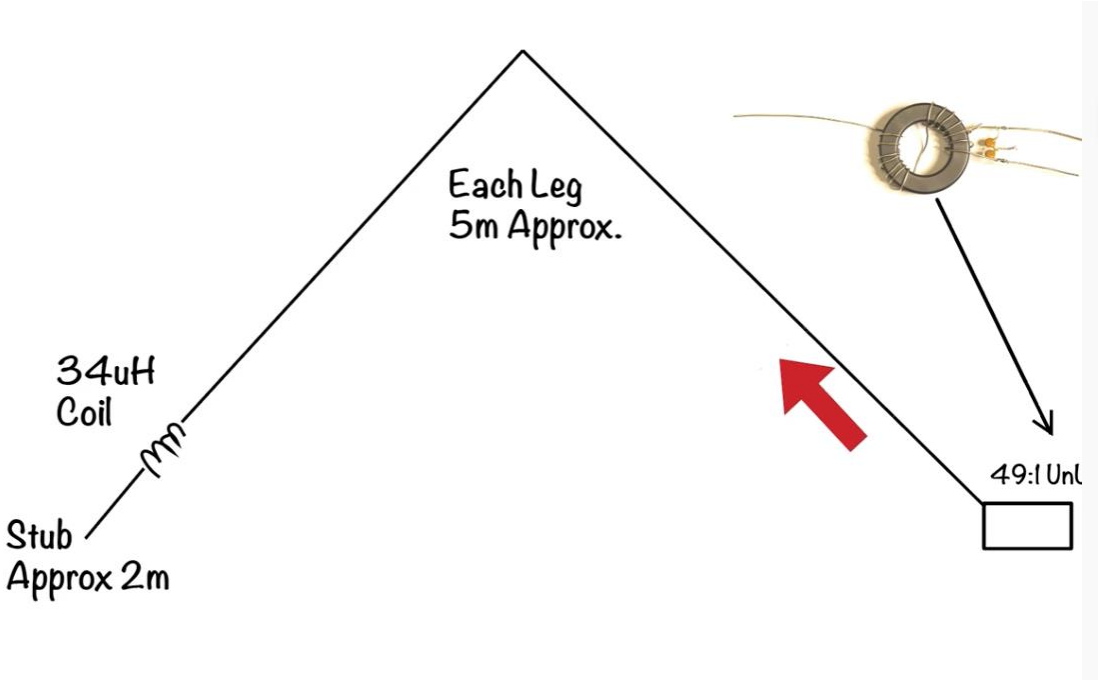
- Some designs use 36:1 or 64:1 transformers, this will change the length a little
- Mount the transformer in a non-metallic box to avoid arcing

EFHW Counterpoise Options

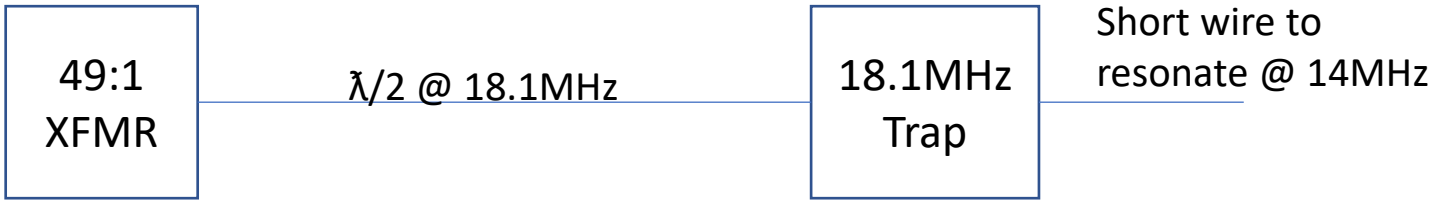
- Some folks will tell you that a counterpoise is not required. That is not true. You may not notice it at QRP power levels, but the coax shield will be RF hot.
- There are two alternatives:
  - Add a high isolation balun or line isolator 0.05ƛ from the transformer. This provides a termination for the end fields.
  - Add a counterpoise wire >0.05ƛ long at the transformer coax ground. Run it away from the coax.
  - I would also add a line isolator at the radio if you are operating above QRP levels
- The EFHW is the extreme case of an offset fed antenna. Loading the high impedance end of the wire with the transformer does not provide the very high impedance of an open circuit that the antenna requires.
  - This is also why alternative transformers work

Other EFHW Thoughts: 40/20/10M Design

- Peter Waters, G3OJV, has several designs on his You Tube Channel. His emphasis is antennas for small yards.
  - https://www.youtube.com/user/watersstanton
- The sketch below is for a 20M EFHW with a 40M add on



17/20M EFHW Variant



- I wanted a half wave vertical with a length of <35’ to use with my telescoping mast (actual 32’)
- I enjoy both 20 and 17M during my daytime portable outings
- This is another G3OJV design I built and works well

Summary

- End Fed Half Wave Antennas are a good choice for hams with limited space who want multi band coverage
- They are stealthy and can be installed in a variety of configurations
- They have a good VSWR on their resonant bands
- A short counterpoise or line isolator close to the transformer is recommended
- A line isolator should be used at the transmitter.

Questions?

Addendum: Propagation Outlook

- I thought I'd summarize what to expect on the HF bands as Solar Cycle 25 goes up
- A good place to get more detailed information is on the Contest University website. Look at the files for the 2021 Propagation Summit: https://www.contestuniversity.com/files/
- I've attempted to summarize the predictions and provide guidance on what to expect on the HF bands
  - Every day will be a little different
- Remember, propagation prediction is statistical.
  - The Reverse Beacon Network (RBN) provides up-to-the-minute signal reports: http://www.reversebeacon.net/main.php
  - VOACAP for Ham Radio can be used for specific predictions: https://www.voacap.com/hf/
  - The NOAA Space Weather Prediction Center web page contains the latest data on Ionospheric storms, Solar Flux and the K-index: https://www.swpc.noaa.gov
- The best propagation report is from Dr Tamitha Skov, WX6SWW. https://www.youtube.com/c/TamithaSkov

Band-by-Band Summary

- 80M (3.5-4MHz)
  - 80M continues to be a nighttime band
  - Most urban hams don't have the space for effective DX antennas
    - Mostly a local contact band
    - Atmospheric noise is high, especially in Summer
  - Local, single hop, contacts can be made anytime
  - D layer absorption is present all day until late afternoon
  - E layer absorbs low angle F2 propagation until early evening
- 40M (7-7.3MHz)
  - 40M is an early morning and nighttime band
  - Antennas are difficult to get up high enough to be effective for DX
  - Local, single hop, contacts can be made anytime
  - D layer absorption is present all day until late afternoon
  - E layer absorbs low angle F2 propagation until early evening
  - Early morning DX to Asia is enhanced by atmospheric tilt and multiple ocean hops
  - European contacts pass through the auroral oval which is lossy

Band-by-Band Summary – cont'd

- 20M (14-14.35MHz)
  - Improved longer distance DX, except in summer
  - Mid-day F1 layer absorption degrades DX in summer
  - Nighttime openings when Solar Flux goes over 135
  - DX can be worked with antennas up over 35' (ƛ/2)
- 15M (21-21.45MHz)
  - Daytime DX band when the Solar Flux is consistently >105
  - Occasional Sporadic E (Es) enhancements during summer
- 10M (28-29.7MHz)
  - Daytime DX openings when the Solar Flux is consistently >115
    - Not as good in Summer
  - Occasional Es enhancements during summer
- The higher frequency bands provide longer distance DX when they are open

Generic Propagation Guidelines

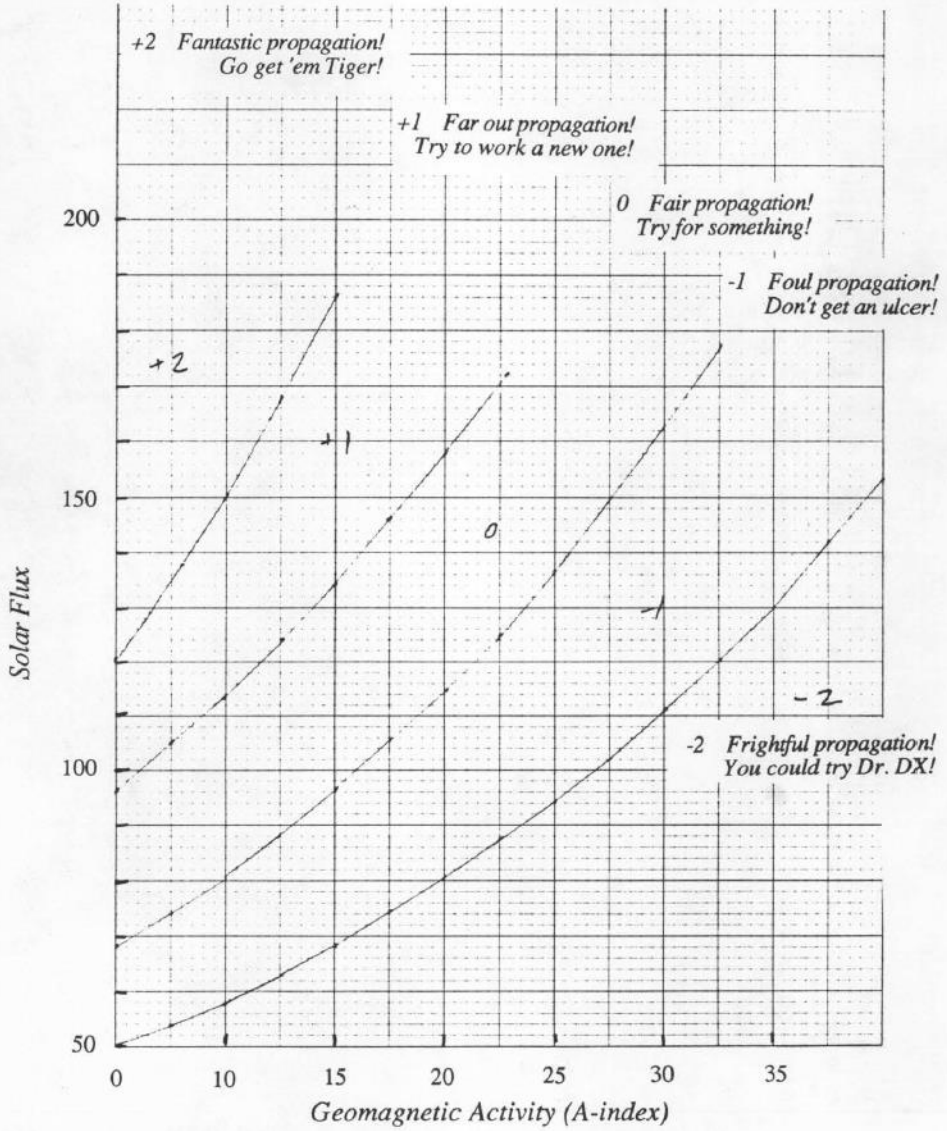
Band	Solar Flux	Day	Night	Summer	Winter
80M		One Hop Local	DX	Noisy T-storms	Best
40M		One Hop Local	DX	Good	Best
20M	<130	DX	No Prop	Poor mid-day	Best
	>130	DX	DX	Poor mid-day	Best
15M	>105	DX	No Prop	Occasional Es	Best
10M	>115	DX	No Prop	Occasional Es	Best

- The best DX will be on the highest band that is open
- Equinox is best for contacts between hemispheres

QRPer's Propagation Predictor

by Bob Brown, NM7M

Plot Solar Flux and geomagnetic activity A-Index as broadcast hourly by WWV beginning at 1818 UTC. Points falling in the upper-left corner of this scatter-plot correspond to good HF band conditions, while points in the lower right represent poor conditons. The scatter-plot is divided into five regions representing different observed band conditions, labeled from +2 (excellent) to -2(poor). A fuller discussion of the use of this chart is given in The QRP Quarterly, January 1986, page 11.



Questions?

If you think of something later, you can email me at:
W6QR@arrl.net