

The End-Fed Half-Wave

A high-performance multi-band HF
antenna you can build

Rich Place – WB2JLR – May 12 2021

Center-Fed Half-Wave (Dipole)

A half-wave dipole is hard to beat – BUT

- Only work on odd harmonics
- Needs to be fed at the center for use without a tuner
- Low to the ground horizontal antennas perform poorly

Vertical Antennas

Verticals work well at low heights – like on the ground – BUT

- They require an extensive network of radials
- As does the “inverted L”, which is basically a top-loaded vertical

Longwire Antenna

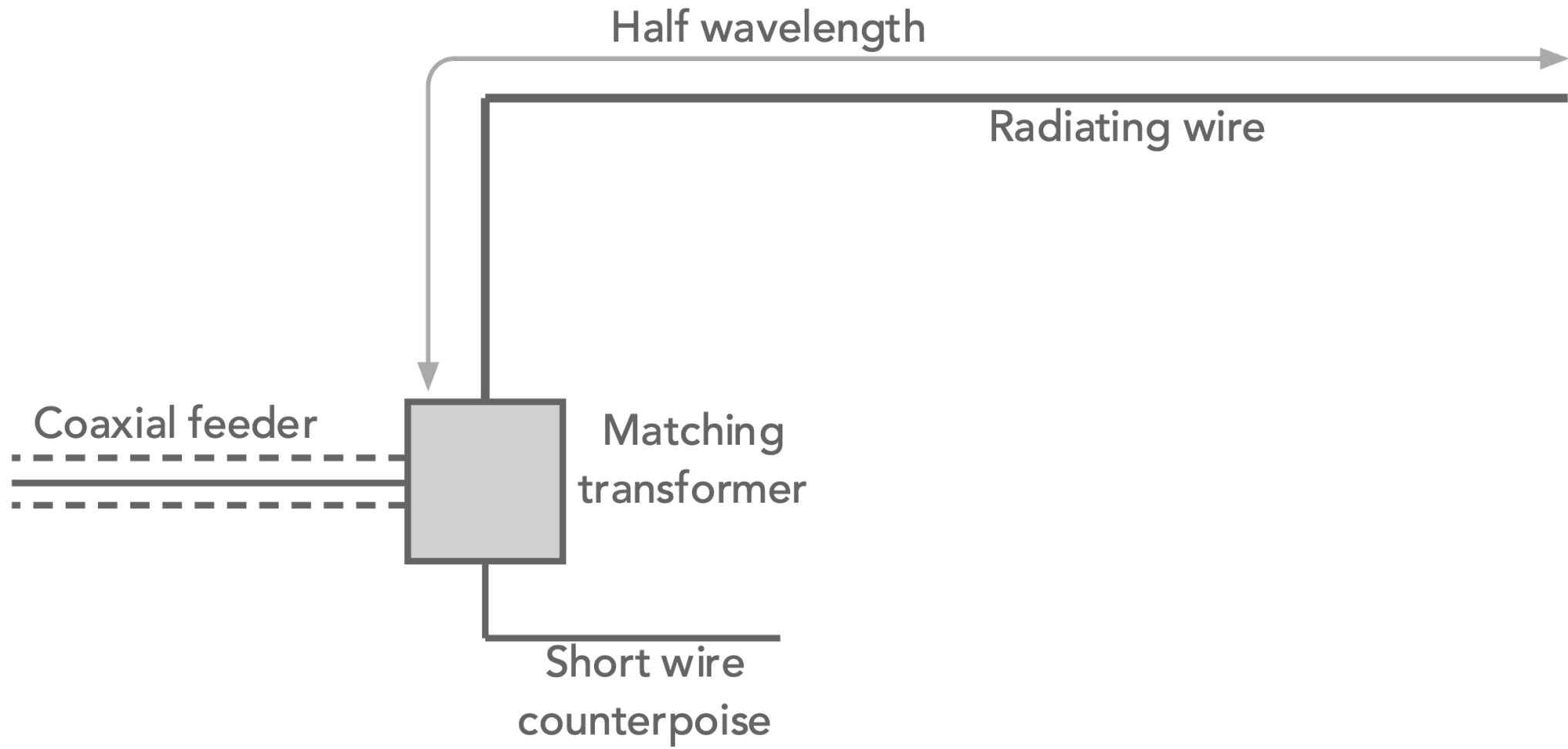
End-Feeding a random-length is simple – BUT

- Impedance is unknown and highly variable (tuner required)
- RFI likely in the shack

The End-Fed Half-Wave

End feeding a half-wave, or multiple half-waves, circumvents the limitations of other antennas

- Works on all harmonics
- Does not require an antenna tuner
- Can be fed at either end
- Is fed at the ground, not high in the air
- Doesn't require an extensive radial network
- RFI in shack can be avoided
- Provides both vertical and horizontal radiation – good for DX and local



Wire Design

- Wire length (feet) = $463/f$ at the lowest operating frequency
 - Starting at feed point, run the wire vertically as high as possible
 - Extend the rest of the wire horizontally as far as possible
 - Either wire can be diagonal too
 - Wire can be bare or insulated.
 - If insulated, shorten it by 1 to 2 percent
 - I used 14 gauge XHHW – stranded & insulated
 - Tree branches can serve as insulators
 - I used 1/8th inch double-braided Dacron rope

Note – While this looks a lot like an inverted-L, it is different due to the half-wave



t to...



**Feed point
55 ft vertical then
ENE 185 feet**

W2GT Antenna Launcher



Counterpoise

Contrary to myths, a counterpoise is required –
But

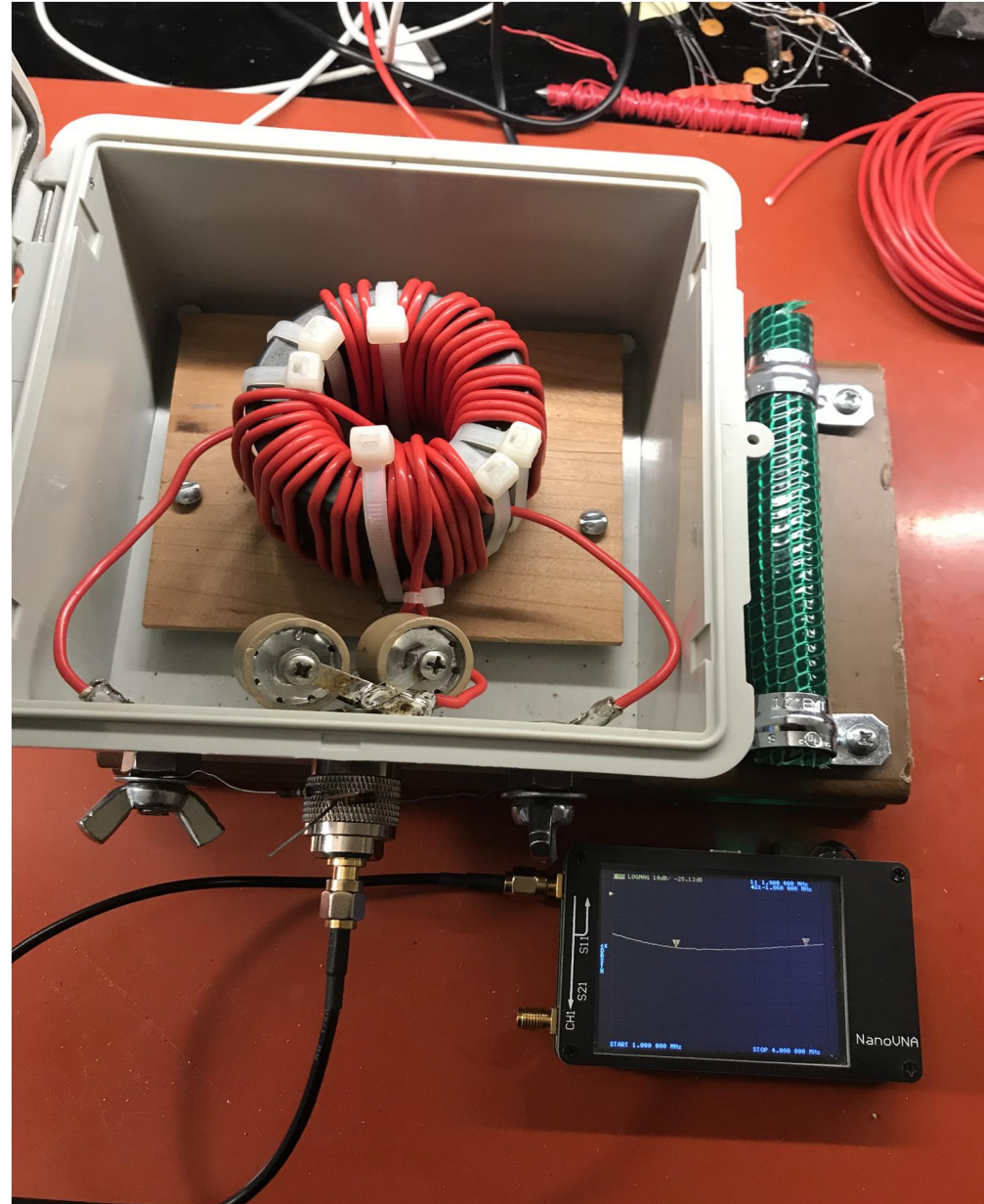
Because the ground currents are tiny, the requirements are minimal

- A single 8 foot ground rod driven in 6 to 7 feet – or
- A 10 foot piece of wire, buried or laying on the ground
- The feedline shield works too – just be sure to add a choke to block RF from the house and shack (Several turns of the coax or add a

Transformer Design

You'll need a transformer with a turns ratio between 7:1 and 8:1

- That steps the antenna impedance down by a factor of 49 to 64, making it close to 50 ohms
- Fair-Rite FT-240-43 is a good toroid core to use for up to 100 watts
- For 1 kW three FT-240-43 cores are recommended
- For QRP the smaller FT-140-43 could be used
- Use a 4-turn primary and 28 to 32 turns for the secondary
- The optimal ratio can be determined with a Nano-VNA,





Roll over image to zoom in



VIDEO

LMioEtool ABS Plastic Dustproof Waterproof IP65 Junction Box Hinged Shell Universal Electrical Project Enclosure Gray 5.9 x 5.9 x 3.5 inch (150 x 150 x 90mm)

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Size: **5.9" x 5.9" x 3.5"**

5.9" x 3.9" x 2.8"

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8.7" x 6.7" x 4.3"

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11.4" x 7.5" x 5.5"

\$35.99

✓prime

- Product Name : Junction box; Waterproof rating : IP65.
- Material: Plastic; Net Weight: 260g; Main Color: Gray.
- This electrical junction box is easy to operate and repair, no cable cutting, more convenient.
- The Enclosure box features two or three plastic latches for added security and locking; moisture proof, sunscreen, anti-corrosion, durable for years use.
- Outer Size(Approx.): 5.9" x 5.9" x 3.5"(150mmx150mmx90m)(L*W*H); Inner Size(Approx.): 5.1" x 5.1" x 3.3"/130 x 130 x 84mm(L*W*H)- -* Tips: in order to confirm the detailed installation dimensions, please refer to our detail image, which shows specific internal dimensions of the product. (Allowable Error: 2mm).

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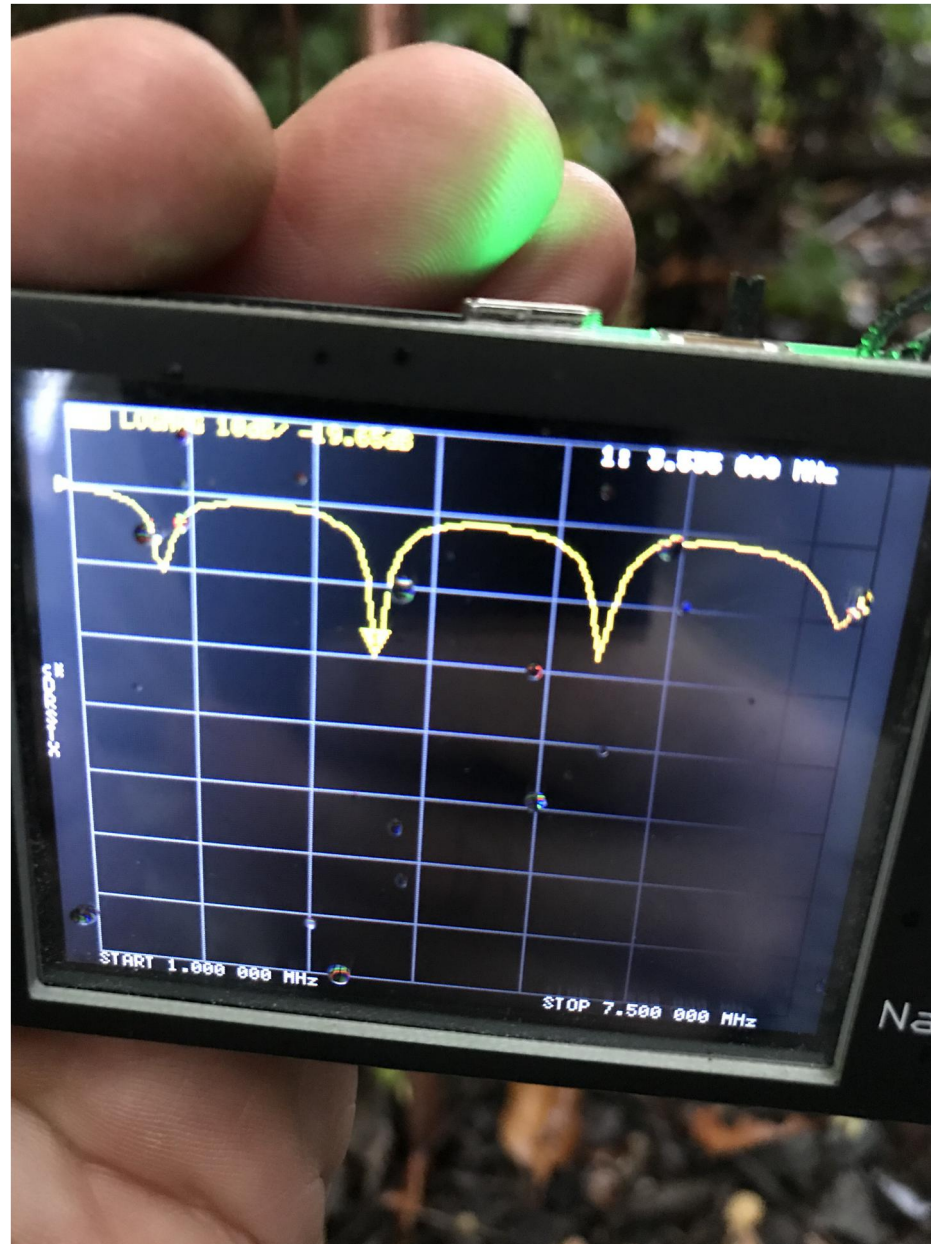




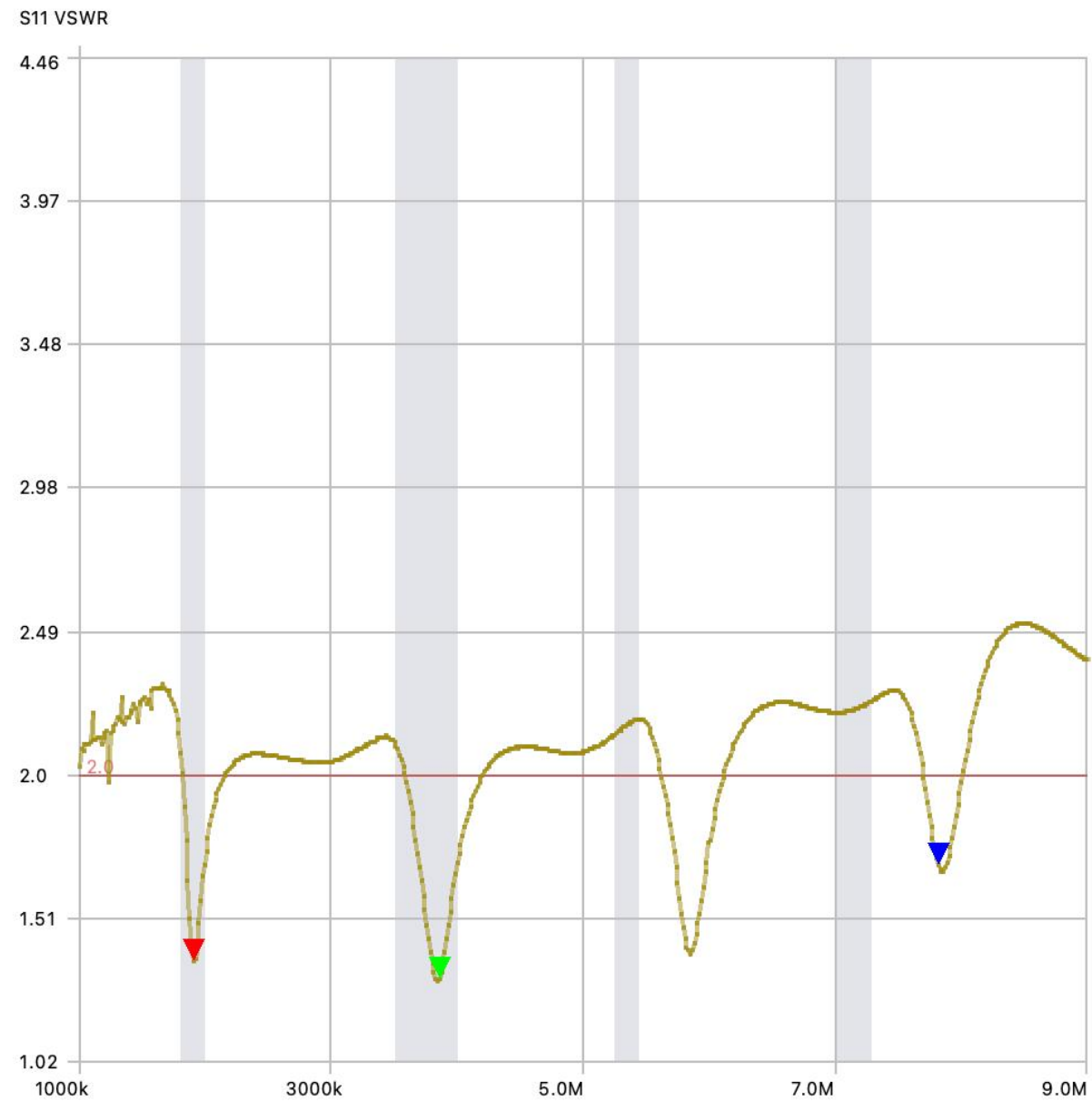
EXAMPLE OF MULTIBAND OPERATION OF AN END FED HALF WAVE ANTENNA

HARMONIC OF FUNDAMENTAL	FREQUENCY (MHZ)	COMMENTS
1	3.55	Fundamental operation at bottom end of 80 metres
2	7.1	Between CW and phone sections of 40 metres
3	10.65	Would need Antenna tuner to operate between 10.1 and 10.15
4	14.2	
5	17.75	Would need antenna tuner to operate between 18.068 and 18.168
6	21.3	Within SSB portion of 15 metres
7	24.85	Not far from 24.89 and 24.990 12 metre band
8	28.4	Within SSB section of 10 metres.

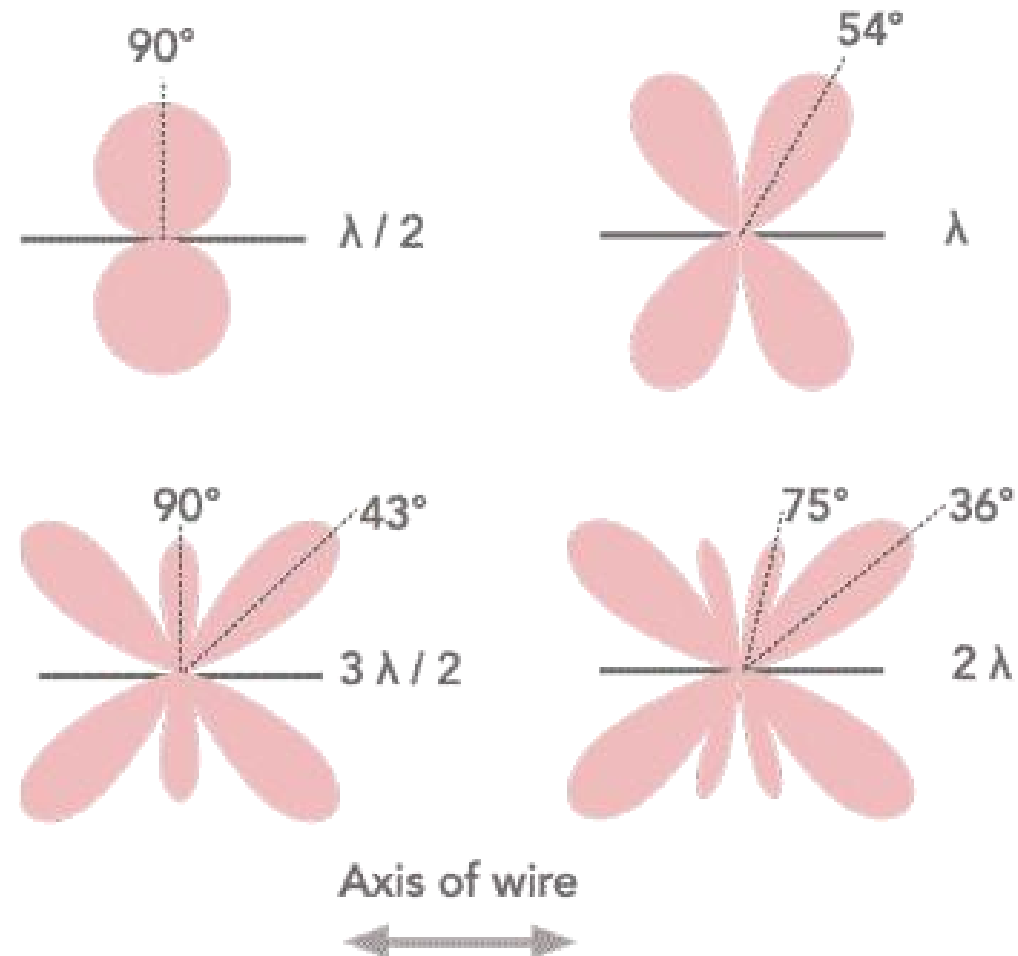
Return Loss versus
frequency (related to
SWR) outside looking into
the transformer box



SWR from 1 to
9 MHz in the
shack



Antenna Pattern varies by band



How it works

The impedance at the end of a half-wavelength wire is resistive and very high Z , typically between 2500 and 5000 ohms

At *all* harmonics it also looks high

But we can make a transformer that steps that high impedance down to about 50 ohms

And at all harmonically related ham bands the impedance will also be about 50 ohms

How it works continued

Since the EFHW impedance is very high, the current into the antenna is very low

Since there's very little current in the antenna at the feedpoint, there's very little current in the ground/counterpoise too.

With so little current in the ground, the quality of the ground or counterpoise is almost irrelevant.

On the air

- My antenna works on 160 and 80 meters without a tuner, and on 60 meters with the help of a tuner
- On 160 meters, EFHW signals are dramatically stronger than on my 80 meter dipole
- VLF and broadcast band reception is also better on the EFHW
- But on 80 meters, the 80 meters the dipole outperforms the EFHW for most stations within 500 miles
- And on 80 meters, the EFHW outperforms the dipole by 1 to 2 s-units into Europe.

More notes

An antenna cut for the cw portion covers more bands.

Some harmonics of 3.55MHz: 7.1 14.2 21.3

But harmonics of 3.65 MHz: 7.3 14.6 21.9

- The internet lists some tricks to improve upper band coverage, like adding a coil a few feet from the feed point or a coil at the antenna center

Two more EFHW features

Can be a stealth antenna

- Easy to hide the feedline unlike a center-fed dipole
- No radials to hide which most verticals require

Works on a smaller lot than a full-size half-wave dipole

- First 30 to 50 feet can be vertical
- Last ~10 feet could be vertical too

Questions?