A portable multi-band End-Fed Half Wave (EFHW) antenna for 40-10m

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Introduction

A few people have asked about the 30m antenna Norfolk Amateur Radio Club used for its International Marconi Day (IMD) operations at Caister Lifeboat this year.

Ten Megahertz (30m) turned out be a useful band for us, allowing CW contact after CW contact, despite poor conditions after a geomagnetic storm and a K index of five.

The antenna we used was a portable multi-band end-fed half wave (EFHW) 40-10m with a 49:1 Unun.

This was 9m vertically metres up a fishing pole and then about 5.8m out.

The novel thing was that I only built it the day before and it uses a Coghlan camping washing line spool with the string taken off and about 21m of wire wound onto it.

I imported my spools from the US, but I have seen them on Ebay in the UK. See http://www.ebay.co.uk/itm/21ft-Coghlans-Laundry-Reel-Coghlans-Camping-Washing-Line-Clothes-Drying-/351692687002?hash=item51e284869a:g:gCIAAOSwZ8ZW~HWP or search for "camping washing line".

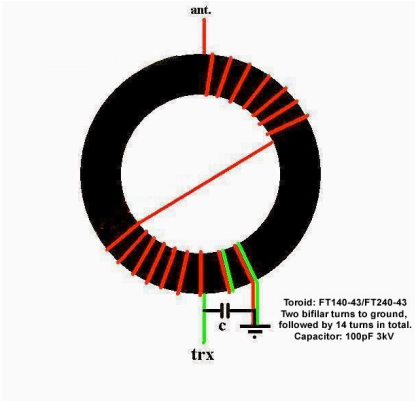
They are not that expensive, typically being under $10/$10 each.

I also used lightweight green antenna wire bought from SOTABeams in the UK (100m for £8.25). They also do other colours.

The antenna

The antenna can be used as an inverted L (or inverted L sloper) using a cheap fibreglass fishing pole to go up vertically 8/9m before the rest goes out at an angle to a suitable fixing point.

This one used a T240-43 toroid in a 49:1 impedance matching unit at the base and a choke on the coax about 12 feet away from the feedpoint to a) help the coax act as a counterpoise and b) stop RF getting back to the station.



The matching unit

The impedance at the end of a half wave antenna is

somewhere between 2000-5000 Ohms. In some designs, my earlier ones included, we make a resonant circuit using a toroid coil and capacitor to resonate at the frequency required.

In the PD7MAA design (which is based on a lot of work done by Dutch amateurs) it uses an FT240-43 as an autotransformer with two bifilar turns followed by 14 turns of the "secondary" to give an impedance step-down of 7 squared or 49:1.

Therefore, 2500 Ohms at the end of the EFHW is transformed down to around 50 Ohms and provides a better match to your coax.

Right: Twisting the wire for the bifilar turns on the toroid

When winding the toroid it is as well to wrap white PTFE tape around the core to stop arcing. This is plumbers' tape and is very cheap on Ebay.

If using an FT240-43, start by measuring out two pieces of 20SWG enamelled copper wire – one is about 1m, long and the other about 22cm. Twist the two together for the first 130mm, ensuring that you do this neatly. The twisted section then makes up the two bifilar turns on the primary.

Then add a further seven turns on the core before passing the wire across and under to the other side of the core and winding seven more, back in the opposite direction (see image). The wire should exit roughly opposite where you started.

Adding a 100pF high voltage capacitor across the centre pin and the earth on the input should improve the match at the top end. Some reports recommend a 150pF capacitor, but I found that this gave slightly higher SWR readings. A 100pF 3kV high voltage one is better and they are very cheap on Ebay.

An alternative is to use an FT140-43 toroid, which is smaller (the "140" refers to the diameter, so 1.4 inches), which is good for at least 50-100W.

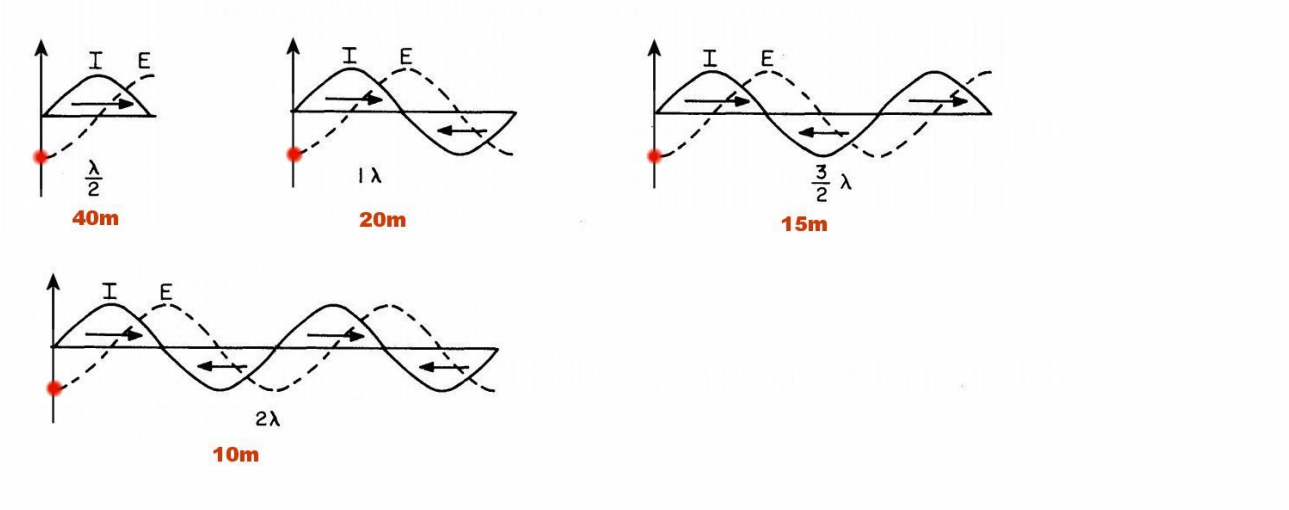
But if you want to make an antenna that can run up to 200W and/or operate on 80m I suggest you use the larger FT240-43.

Save the FT140-43 for 40-10m QRP, or 50-100W, maximum versions of the antenna. I only used the FT240-43 balun for this 30m operation as my FT140-43 version was in use at home.

If you want to make a 500W version use two FT240-43s stacked together.

Once you have made the balun put it in a plastic box, add an SO-239 connector for the radio connection and two sockets for the antenna and the earth.

How the antenna works as a multiple of half wave lengths on the higher bands:



How do you use it?

To use the antenna connect the spool of wire to the matching unit by soldering a plug on the end. Then tape the first 8-9m of the wire vertically up the pole. You can put a few light turns on the pole to stop it flapping about, but don't overdo it as you'll start to add inductance.

Then take the remainder of the wire and spool it out horizontally or at an angle to the nearest fixing point.

It is better to be as horizontal as possible, but I anchored it to the ground via a nylon cord when it was used at Caister and it worked.

Tuning the antenna

This is very important and worth doing before you actually need to use it!

Connect the earth side of the balun to an earth stake (I have a screw in ground stake that supports the fishing pole and have put a bolt and wing nut on it).

Don't forget the choke on the coax feedline about 10ft back from the feedpoint.

Connect your SWR meter/ analyser to the balun and see where it resonates. With 20.5 metres of PVC-coated wire it is likely to be under 7MHz. Now wind the antenna wire in a bit, hook it over the end of the spool to secure it, put it back up and test again.

When the wire is wound back in it acts as a choke or end-loaded inductance so effectively doesn't become part of the radiating element.

You are looking for a low SWR point below 1.5:1 in the 40m band. If you work on both SSB and CW aim to put it at about 7.1MHz.

If you have to wind a lot of wire in you might want to consider shortening it a little as that much wire can be a bit of squeeze to get on the spool.

Once you have the low SWR point where you want it, mark the wire where it enters the spool with a Sharpie or other indelible black ink pen.

Now you can repeat the process on 30m (10 MHz) and even 20m (14MHz), marking the wire as you go.

This means that when you actually use the antenna you don't have to waste any time measuring anything. You just spool the wire out to the mark.

You may find that you can use the antenna on 20m, 15m and 10m when tuned to 40m as it becomes a multiple of a half wavelength long, although the SWR may be a bit higher. The radiation pattern will be different, but you can experiment.

To earth or not

Conventional wisdom has it that you must have an earth on a vertical antenna. This is true with a quarter wave antenna, which needs an extensive ground plane. With the EFHW the earth (or a counterpoise) is still important, but not quite as crucial.

Without an earth the antenna will try and use the coax as the return path. The best way to resolve this is to fit a choke, such as eight turns of RG58 through an FT240-43 ferrite toroid about a 10 feet or so from the matching unit.

With a choke fitted there is no sign or RF on the feed line at the operating position, with or without an earth stake.

Performance

In other tests I found the performance of an EFHW is pretty much dipole-like on 40m and 20m.

I haven't done any back-to-back tests on this version, but we used it on 30m on International Marconi Day in 2017 and worked 19 countries with 100W CW. Not bad for something that took 10 minutes to deploy!

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Sources:

http://pa-11019.blogspot.co.uk/2012/04/149-transformer-for-endfed-antennas-35.html

http://nuke.ik0ixi.it/Antenne/LOlandesina/tabid/606/Default.aspx

SOTA Beams

http://www.sotabeams.co.uk/antenna-wire-lightweight-100m/