Newbies EFHW – An Introduction

What It Is

EFHW is the acronym for "End Fed Half Wave."

It is an antenna, or rather, should be called "An antenna System" as it actually comprises more than what we think of as just the conventional wire radiator and transformer.

It is used as a resonant antenna (using a matching device) so the SWR should be low on its design frequencies.

It is (nearly) half a wavelength long on the lowest frequency it is designed for.

For example a 40m EFHW is about 20m long on the 40m band (7mHz approx).

They are usually designed for the HF bands between 1.8 and 30 MHz. Most commonly they are for 3.5 MHz and up.

EFHW's can often be used on harmonics of theirlowest frequency. So an EFHW for 40m can usually work on 20m, 15m, and 10m – though the bands may not line up all that well but you can use a tuner to help. The SWR should however be reasonably low. There are some nice ways to help them line up better that we use.

This antenna needs a matching device, a transformer or sometimes called an un-un, to match the very high impedance of the antenna wire to the coax for a transceiver to use.

How and Why It Is Used

There are many EFHW antennas on the market ranging in capability and price and intended for different use scenarios.

They can also be home-made quite economically making them attractive for Amateur Radio operators. We have an article on the OZ-Tenna website on how to make a good matching transformer, an optional 1:1 balun, along with test and measurement results and an on-air test description.

Some EFHW's are suitable for base stations and some are aimed at portable use like for camping or SOTA and POTA and field day use. The portable versions are usually much lighter and smaller to suit backpackers etc.

A big part of the appeal of this antenna is that it can be more easily deployed (installed) making it attractive for portable operators where tall fixed supports aren't available.

Why It Is Popular

We believe that an EFHW for portable use can be more easily installed than most other HF antenna systems.

You might ague that a vertical is easier but they do require radials to get the best out of them. Dipoles require 3 supports and the feed point it right up high in the air needing a longer coax.

An EFHW when used with a good transformer and well installed may have similar performance approaching that of a dipole at similar heights.

Sure, some installations result in poorer signal strength, but also some are comparable to a dipole at similar heights. Depending on what you want to do, there are some great installation options.

The inverted-L installation method works well. With a raised feed point, going up at least 8 meters on a squid pole, then tying off the far end to a tree branch or fence post is quick and easy. I've worked Australia wide and DX on this on field days. In my experience, this results in the best signal strengths for portable operation.

The sloper is common also, particularly for SOTA and casual radio fun. I found this less effective than inverted-L, but a very easy install. Because it was much lower to the ground, signal strength was down compared to a dipole. Elevating the feed point and keeping it as high as possible to the far end will help improve signal.

Inverted-V is another common method that does work well.

Flat top where the whole antenna is raised up high suits base station installs. The coax will be longer and the supports more demanding. I've not used it. Anecdotal reports indicate it is a good antenna for signal strength though comparative tests have not been seen. It is *assumed* to be good.

What Problems Can Arise?

This often depends on the make (design) of the matching transformer and how you are using it.

Heating of the core(s) in the transformer can be a huge issue. A low efficiency transformer can cause it to heat up and be damaged if you use "a lot" of power or digital modes. Transmitting using digital modes causes at least 5 times more heating than SSB (voice) so do be aware of the rating of the transformer if using digital. Generally, heating with SSB (voice) should be less and rarely present heating problems if you stay within ratings.

Defining "a lot" – it depends on the transformer. For example a super small yet efficient transformer can easily handle 10W or 20W or more transmit power on SSB, yet on digital transmit it should be limited to 2 watts or 5 watts and short overs – depending on the specification.

Some designs don't use radials and hence the coax cable acts as part of the antenna system. This helps match the antenna to the radio as the coax forms part of the antenna system. Hence different lengths of coax and soil conditions may affect performance.

Common mode current (current on the outer shield of the coax) can be high because the coax is part of the antenna system. It may cause problems tuning the antenna or cause the transceiver to reset or other issues. This can be treated with a 1:1 common mode current balun and using radials to reduce the current on the shield of the coax.

Magic And Dispelling Myths

Probably no antenna has more folk lore attached to it and has supposedly become all things to all people than the EFHW.

There is zero magic in the EFHW and likewise there are some issues with it that are reasonably easy to deal with to make it an effective antenna.

Some of the common myths and misconceptions;

It doesn't need radials. Wrong. It uses the shield of the coax as the radial and that is self evident as the shield radiates and will have high common mode current on it, usually. That is unless a 1:1 current balun is used.

There is no current at the feed point. Wrong. There is some current else the shield wouldn't radiate and there wouldn't be common mode current there.

Low efficiency transformers don't matter. Wrong. The most popular design on the internet that home builders make has about 70% efficiency at best, so 30% of the transmit power is turned into heat. If you use digital modes then you may damage the transformer or worse. At least you'll be radiating a lot less than you expect. On receive, signals will be down a little – you might not notice it till you get to a very low signal you are trying to listen to. Building a transformer with about 90% efficiency or better is not that demanding and compared to a poor design, and is like getting free power.

Caveats – The Use Of Words

Throughout this document I've used the words "almost" and "about" and "reduce" and "less" and "more" advisedly.

For example a 1:1 current transformer will <u>reduce</u> the common mode current on the coax. In my experience there will always be some common mode current because the 1:1 is not "perfect" and also the coax will pickup RF from the antenna.

Similarly for transformer efficiency. I can measure one here with my VNA and then later using a different batch of ferrite toroids, or change the winding in a very small way, the results <u>will change</u>.

Trying to claim it will be exactly "95.4%" is just plain wishful – and when you build one and you get 94.7% and think there is a problem – no – that is measurement accuracy and tolerances happening. Be happy you got over 90%.

As for testing your antenna the variables are many making comparison difficult at the very least. There can be QSB (signal fading). Where a station you are making contact with islocated can affect signal strength if your antenna has some directional qualities. Also and very importantly how you install your antenna can mean more than a few "S" points of difference.

My own testing has used an OCF raised at a similar height to my EFHW. I use a coax switch and swap between antennas quickly then I can say “It is similar to” or “a little down” or in extreme cases, “was 4 or 5 S points down when using a low sloper” – claiming more accuracy is wrong.

Also, there is no doubt that two antennas will interact in some way.

Claiming that comparing antennas is a fantastic test is wrong. It is a good indicator, a suggestion, a help in understanding the antenna(s).