

The SPARC NEWSLETTER

March 2026

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E. F. H. W.
by
W3IHM

Well, have you tried the latest magic antenna? These antennas can do almost anything, and have 6 dB gain, even when underwater. All the hip-hams are using them to bust the DX and POTA pileups. Throw away that SB220 amp, and get the EFHW, pronounced “EeeeFeeeHuhWah” by those in-the-know. You need to get in on the latest!

We hams tend to fall for outrageous claims. Especially when it comes to antennas.

Sorry to put on the coffee, but give it a sniff and wake up. It’s time for a sobering discussion of the end-fed half wave. Let’s start this discussion with the basics:

$$\begin{aligned}\text{curl } \mathbf{H} &= \dot{\mathbf{D}} + \mathbf{i} \\ \text{curl } \mathbf{E} &= -\dot{\mathbf{B}} \\ \text{div } \mathbf{D} &= \rho \\ \text{div } \mathbf{B} &= 0\end{aligned}$$

Where these are Maxwell’s point equations with the typical variable definitions, immersed in a particular $\epsilon, \mu, \sigma \in \mathbb{R}$ reality, such that:

$$\begin{aligned} \mathbf{D} &= \epsilon \mathbf{E} \\ \mathbf{B} &= \mu \mathbf{H} \\ \mathbf{i} &= \sigma \mathbf{E} \end{aligned}$$

and in a corner of a particular galactic time-space, where it just so happens that:

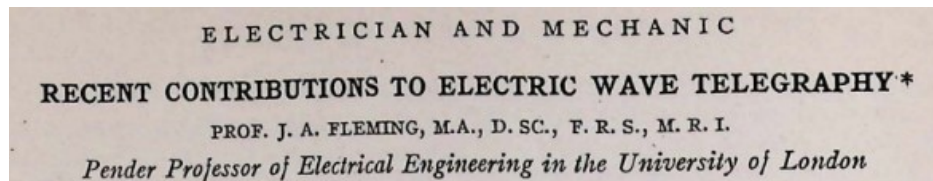
$$c = \frac{1}{\sqrt{\epsilon_0 \mu_0}}$$

and c is the speed of electromagnetic wave propagation. The EFHW derivation is left as an exercise for the student.

(...humph!)

OK, OK, hold on. Let's go maybe not *that* basic. Let's not talk fundamental principles, but go a little bit nearer to radio development, and crack open some fun old papers from the beginnings of practical radio time.

Let's have a read around, just a little after James Maxwell. Like, here's a paper by J. Fleming from 1904 (?) I found in the "Electrician and Mechanic" periodical, that has some good diagrams.



Hey! Fleming's the guy who sorta came up with the Fleming valve, right?. What's that? Well, it was actually an application of something Edison came up with, that he thought "...no commercial value", and tossed it. Also, another german guy came up with it, and probably lots of others, but Fleming was the first to use it for radio. It looked like this:

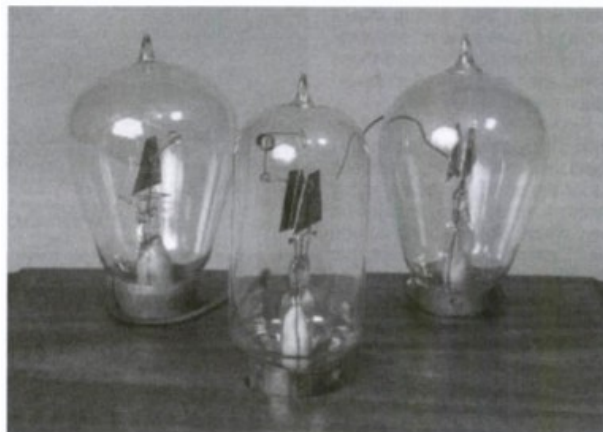
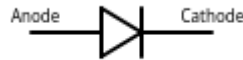


Figure 1. Three different American Marconi Fleming Valves.

It currently has its own schematic diagram element. Maybe you have seen it in radio circuit diagrams?



Unlike cat whiskers and carborundum crystals, he found that these “Fleming Valve” things could be easily used to detect radio signals without adjustment, even on a rolling, pitching, yawing ship. That’s important, especially when one suffers from “mal de mer”, so he gained some notoriety, and thus, many capital letters were attached after his name. But we don’t care about that, because he was doing radio stuff. So he also wrote some papers on antennas.

In the paper above, he had some diagram that showed how an alternating current, when attached to the end of a wire, would cause a current to run up and down the wire, and by the above equations, would create a three dimensional Poynting vector of energy radiation of the Herzian wave into the “ether”, apparently an early conception of the quantum foam we all know occupies complete vacuums.

In other words, an alternating current was fed into the end of a wire. Where have I heard of something like that, before? Oh, I know! That is what us hams do with our transmitters, when using an end fed antenna. So from 1904 we have:

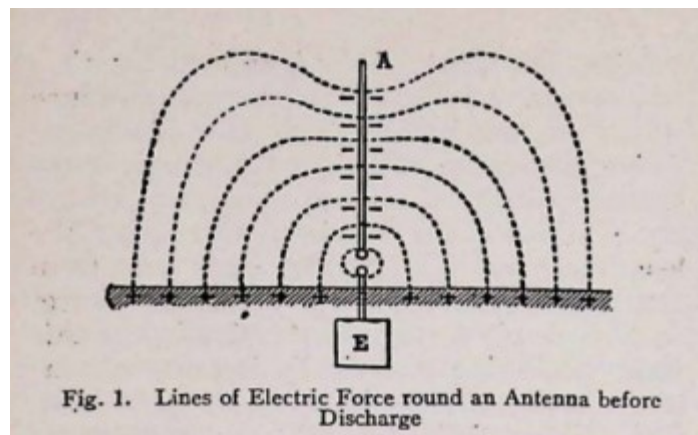


Fig. 1. Lines of Electric Force round an Antenna before Discharge

...an alternating current, generated by a spark gap in this case, at the bottom end, is causing a current to flow up and down the wire, and thus sets up electromagnetic fields like this:

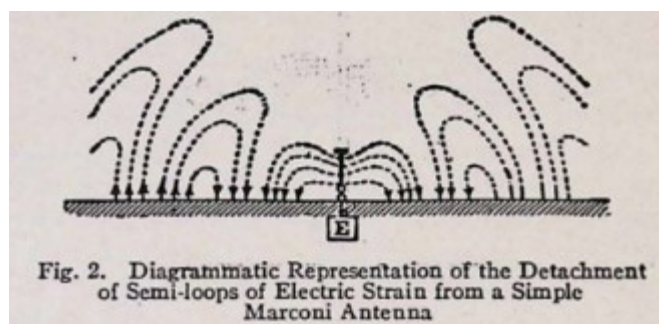
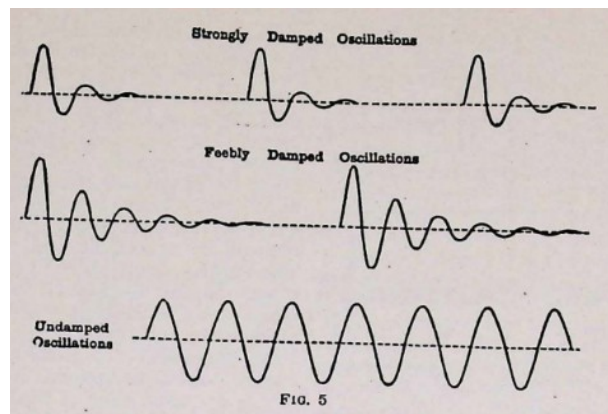


Fig. 2. Diagrammatic Representation of the Detachment of Semi-loops of Electric Strain from a Simple Marconi Antenna

The spark gap charging up and breaking down would cause an alternating current to flow back and fourth along the wire. This all happened at the end of the wire. So, in 1904, there was an end fed antenna... end fed.

And it turns out, that if you change the frequency of the arc oscillations, you can find a place where the oscillations will hit a maximum electric force along the wire. The alternating current frequency would hit a place where each successive pulse would run down the wire at the speed of light, bounce, come back, and then run smack into the next pulse. These pulses would pile and pile and pile up along the wire to a high voltage, and form a resonant standing wave along the wire.



We would have an “undamped” oscillation along our hunk of wire. This would occur at an alternating current frequency of where the physical wire length, in wavelengths, was half. It was a half-wave long.... half-wave.

So thus, in 1904, Professor J. A. Fleming, M. A., D. Sc., F. R. S., M. R. I., would have been using an end fed, half wavelength antenna, or as mentioned before, to use the cool verbage, an “EeeeFeeeHuhWah” antenna, and so be the coolest of cool hamsters.

So end fed half wave antennas are not new. In fact, they come from a really strong pedigree of half-wave resonators, going under various names, a.k.a. the Zepp, J-pole, Tee, dipole, inverted L, bobtail curtain, bi-square, Half Square, Inverted V, Folded dipole, Bazooka dipole, etc.

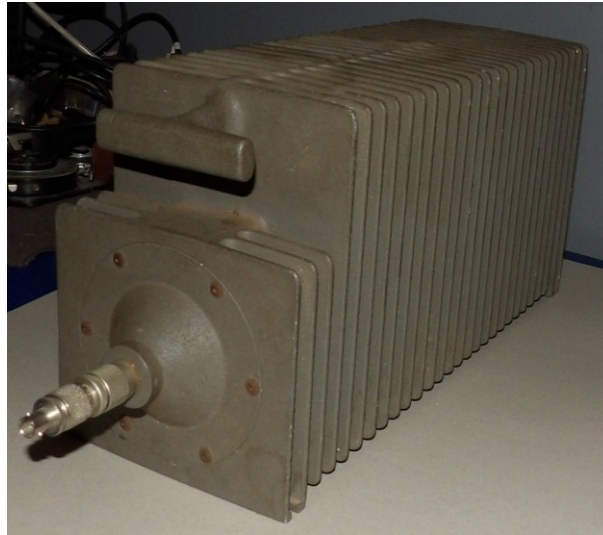
They all are half-wave resonators hung up in the sky. Since they are a half wave long, their patterns will all be pretty much equal, if in “free space”.

But, baby, nothing’s free, especially space. Have you seen rental prices lately?

Ok, it’s really about the surroundings and the feed that makes these antennas different. And, based on the feed method, thickness, how and where the half-wave wire is draped, bent, or coiled, and what’s next to it, the radiation pattern can be all over the place. SO all half-wave

resonators are not created equal. We want something that performs like it is in free space, but not...

Like, to put it another way, what we would really want is to have an antenna that matches our transmission line and transmitter output impedance of 50 ohms with no match loss, and covers all the ham band frequencies with a really low SWR. OK. Here is a picture of this antenna:



This antenna does what we want, but save one thing. It takes our transmitted power and puts it into a material that turns all that alternating current energy into a form of electromagnetic radiation, sure, but not the same frequency. By the magic of material science, it radiates a much higher frequency, that we know as thermal heat, and not on our ham bands. Phooey.

So we would really more like to have an antenna that preserves the frequencies we feed into it, then, and radiates electromagnetic energy at those particular frequencies. So an antenna that gets itself or any surroundings hot, is not doing what we want. It is wasteful. It is not a good antenna.

So this is where the match and radiation environment comes in. Let's start with the match.



What is the reason for matching the antenna and the transmitter? What is going on here, anyway? Well, let's get some more basics out of the way, like maximum power transfer.

Maximum power transfer is simple, but important. Let me try to explain. Let's say we have a battery with some V, that delivers some I. Are the V and I infinite of our battery? No, not in my world. Thus, the battery has a maximum voltage, and maximum current it can deliver.

Since these voltages and currents are limited, we can model these limits by an internal resistance, that we can pretend is inside the battery. Let's call it R_S . The S is maybe for "source", but if you don't understand that, then maybe it can be "sardines", but it doesn't really matter, so whatever.



We can also pretend this internal resistor dissipates power, depending on what we connect to the battery, so it can get hot. You can find this out how hot this internal resistor gets if you ever short out a LiPO or something. No, there's not really a resistor in there, but we are just simplifying the complex chemical actions as an approximation. Still the result will be: Bang!

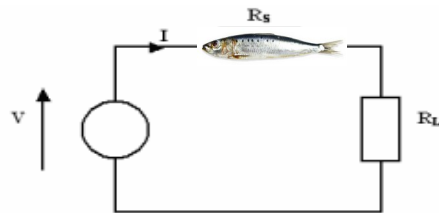
OK. Batteries and power supplies have internal resistances. It is an easy thing to calculate, using ohm's law, such that:

$$V = I \times R_S$$

or, by the magic of الجبر , (...westerners call it "algebra") we can rearrange this equation to give us our internal magic battery sardine resistance, R_S , as:

$$R_S = \frac{V}{I}$$

We can then connect this R_S to our load, R_L , and make a wire map, or diagram of what we want to discuss, like this:



The load can be anything. Light bulbs and resistors are fine. Some IKEA coffee cup warmers? Ok. Maybe a George Foreman Lean Mean Fat Grilling Machine cooker? Sure!



Whatever. But we want to get the maximum power from our source battery into R_L . Since R_S is really not a physical resistor, but is our way of describing the voltage and current limits of this battery, we can not change it. But we can change the load resistance, R_L , by how many light bulbs or George Foreman cookers we can hook up at once.

So the real question is: what would be the R_L to get maximum power out of the battery?

Well, at the extremes, R_L can be either open, or a dead short, an infinity of cookers wired in parallel, or no cookers hooked up at all. Since the power is:

$$P = V \times I$$

We want to maximize V and I to get the most P out. If R_L is an infinite number of cookers wired in parallel, or a dead short circuit, then $I = I_{SC}$ will be maximum our battery can deliver. But if so, what would be the voltage across the infinite stack of cooker R_L , then? The voltage across a short is zero. So the power delivered to R_L will be zero because:

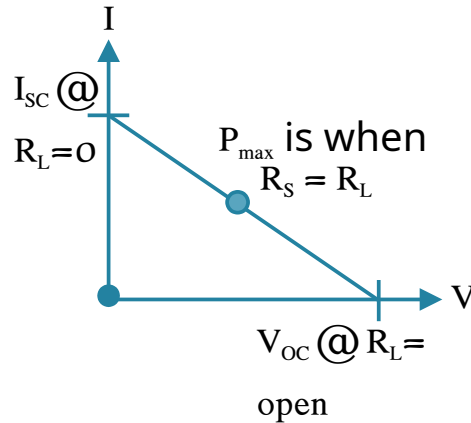
$$P = V \times I = V \times I_{SC} = 0 \times I_{SC} = 0$$

Likewise, if we set the load to an open circuit, like no cookers, we get the maximum open circuit voltage across R_L . We get V_{OC} . But then the current will be zero through an open circuit. So, again, the power delivered to R_L will be zero.

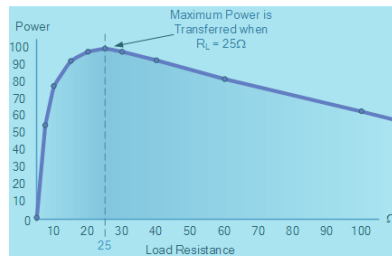
$$P = V \times I = V_{OC} \times I = V_{OC} \times 0 = 0$$

So there has to be some value of R_L between a total open circuit, and a dead short that delivers maximum power from our battery to our load. It turns out that when we match R_S with R_L , we make them the same, and the maximum power is transferred from our battery to the load.

That's what we want, P_{MAX} . That would be the point of maximum power transfer from the battery to the load: *Maximum Power Transfer*. $R_S = R_L$. Get it?



Here's a graph I swooped off the web showing how the power changes with different R_L values:



I also first plotted this way back in 1980 to get a feel for what was actually going on here. Notice how the power to the load goes up fast to some maximum value, then slowly drops off as the load resistance keeps going up. The resistor gets real hot real fast, then starts to cool off as we keep increasing it's value. The maximum power transferred to the load is where $R_S = R_L$.

Nice, but what about transmitters and antennas? Will a George Foreman cooker work as a super high gain antenna? Maybe....

This maximum power transfer theorem is what is also used for antennas and transmitters, but has to handle alternating currents. So at AC, remember that resistors also can have inductance and capacitance about them. So in the case of alternating current generators, the $R_S = R_L$ is more accurately described as AC resistances, or impedances, like Z_S and Z_L . So for maximum power transfer we now have:

$$|Z_S| = |Z_L|$$

and since with impedances, there may be angles involved, soooooo....

$$Z_S = Z_L^{conj}$$

The little "conj" is an angle sign flip. That means any inductance can be canceled by

capacitance, and vice versa, but maybe you don't need to worry about any of this. Just remember there is a "sweet spot" of an impedance value our transmitter wants to sing into, and if we go too far astray, that internal resistor can get real hot, and maybe even blow something up.

Like our battery, V and I are from alternating current generators, such as signal generators, transmitters, and AC generators. These things have some internal "resistance" that needs to be accounted for, just like our battery. We need to "match" this in whatever we connect to them to get maximum power transfer out.

Consequentially, our designs of coax, transmitters, and cable have been chosen to have maximum power transfer internal impedances of 50, 75, and maybe 600 ohms. And to get our EFHW to eat as much power as we have, we will either have to come up with some sort of "50 ohm to EFHW" load resistor conversion thingie, or make a transmitter that matches directly to whatever the EFHW impedance happens to be.

Ok, that was a bit of a deep dive, and I am just getting warmed up to launch into what SWR is about, but I am going to stop here instead. Suffice it to say, that is why our cables and transmitters are usually 50 ohm impedance. They are designed to have *Maximum Power Transfer* at 50 ohms. So we want to match our antenna and coax to the same value, to obtain maximum power from the transmitter to the antenna. In fact, some transmitters will blow themselves apart if they can not see the maximum power they generate go out of them. That's why operating a transmitter into either an open or short can damage it.

Ok, but what about the EFHW's resistance? What is the R_L of an EFHW?

Good question. We did that kinda long painful bit there so you hopefully understand why we *MATCH* our antennas cables, and transmitters. It's to get *maximum* power transfer from our transmitter to the antenna.

But now we need to say something about what an antenna's resistance is.

That depends... Lots of things affect the antenna resistance. One of them is where we hook up the transmitter. That's called the feedpoint. It's where we feed the current and voltage into the antenna. If we choose a low resistance, we get a large current at a low voltage. If we choose a high resistance point, we get a small current, with a high voltage. But to get the most power into our antenna, we need maximum power transfer from our transmitter, so the R_S of our transmitter will equal the R_L of our antenna.

Let's take a half wavelength radiator. Measuring the voltage and currents in this hunk of wire ideally, we would get something like this:

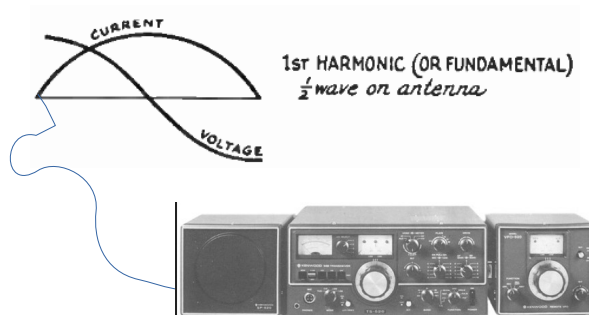


Notice that no matter where we are on the wire, there is some voltage potential, and some current flowing. Using ohm's law:

$$R_S = R_L = R_{ant} = \frac{V}{I}$$

We can solve for a resistance. This R_{ant} is the radiation resistance at wherever we attach to the antenna. The power from our transmitter will see a resistor of this R_{ant} resistance as the load resistance, R_L .

Let's attach our trusty Kenwood TS-520 (...not the "S") at the end, like in an end fed half wave antenna. Here:



Notice at the end, where we attached our feedpoint, we have maximum voltage, and a current of zero. OK, so what is the load resistance here, we need to match for maximum power transfer? Well, using ohm's law we get:

$$R_L = R_{ant} = \frac{V}{I} = \frac{V}{0} = !? \dots uh - oh \dots$$

Let's not quibble about divide-by-zero, and this is an ideal situation, in outer space, and flat earth, with perfect conductors, and tax-free'dom, but let's just say that as the number on the bottom of the fraction gets smaller, the result gets bigger. So with a real small number on the bottom of the fraction, the R_{ant} is going to be real big. It is approaching an open circuit. The TS-520's going to be unhappy like this.

Yes, but Mr. Smartiepants, MY deluxe "EeeeFeeeHuhWah" works just fine with my "Brand-X" EFHW matcher! Right. That's where the ideal situation versus reality comes in. The EFHW is very sensitive to it's surroundings. It's impedance can vary from really high, like 10,000

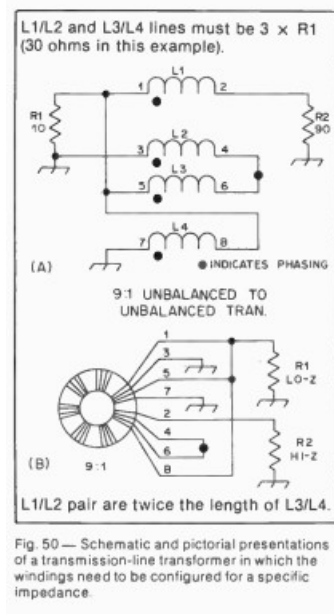
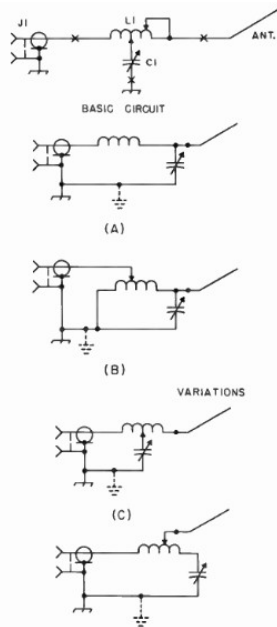
ohms, to maybe 5 ohms, if you lay it on the ground. SO it's all over the place.

So designing a matching gizmo that takes our 50 ohm TS-520 (...not the "S") transmitter and feedline to our EFHW is going to be a bit tricky. We have to design a matcher to hit an impedance target we can't see. So most EFHW matching networks go for low to high impedance transformations, with lots and lots of adjustments and taps and such to fidget with. And yes, there are losses in these networks. They don't match with 100 % of the power going through them.

Like, for example, the ferrite donut matcher types usually get warm. The coil types also heat up, mostly in the coil losses. There are transformer and coil self-resonances, too, so beware.

Want a quick idea of how well your matcher is doing? Set up your EFHW, transmit a bit, then feel the magic matcher network. See if it's hot. Is it? A -3 dB loss isn't bad for a matcher. A tube final rig has a PI network that usually goes from the few thousand ohm plate impedance circuit to 50 ohms, and those are around 50-60% efficient. Also a solid state final stage goes from real low impedances, like 0.1 ohms, to 50 ohms, so again, about 50% of the power gets through.

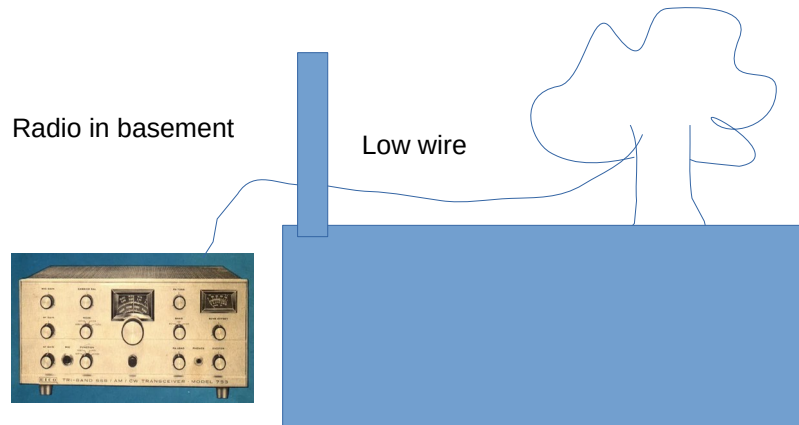
Every matcher has losses.



There is another way. You can take a fixed matching network, like a ferrite transformer, and then mess with the EFHW's position until it happens to end up suiting your matching network's desired impedance. Like, we could use some sort of donut transformer, with a high turns ratio, and then mess around with the EFHW wire end until it looks like the tap we have on the transformer. The antenna then suits the transformer we have built. (...or bought.)

Once, when I was a novice, I used a half wave wire, and moved it around our back yard until it directly matched the 50 ohm R_s of the EICO 7-drifty-3 transmitter I was using. No matching

network needed at all. Of course, this EFHW was almost on the ground, but you get the idea. The EFHW is a sensitive antenna to it's surroundings, so I could walk out back and move the wire around to easily get a match into the EICO's 50 ohm PI network.



How did it work? Well, I could make a few paltry contacts. My transmitter was happy, delivering the maximum power into this antenna. But I am sure most of the energy was going into the ground that was close by. It also picked up a lot of weird power line noise, and I got enough nasty RF burns off the metal knobs, so that I took to wearing mittens when using the rig.

Anyway, unknown by me at the time, I was using the ground as my matching method, sacrificing radiation for an easy match, like the dummy load example. This EFHW was a worm warmer. But I could make a few contacts, and that was good enough for WN8ZDF, who had only hunks of fencer wire swiped from his grandpa's farm to build an antenna. No, I didn't even have a piece of coax, but just put the wire right into the transceiver connector.

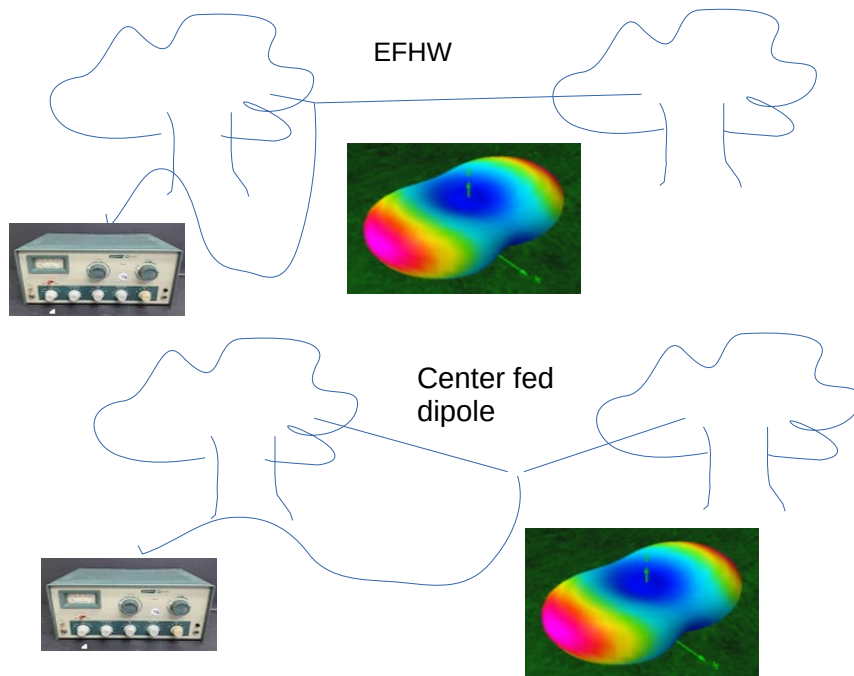
So that brings out the last bit of the EFHW discussion, the radiation pattern. What matters in the grand scheme of antennas is how much of our power from our transmitter gets coupled into the space around us. Remember the dummy load has a perfect *match*, and *maximum* power transfer, but not much of the energy we worked so hard to generate with our transmitter gets *radiated* on our ham bands.

So really, the match is secondary to whether or not the thing will even radiate. A 1:1 SWR doesn't mean anything, really. It just means you have maximum power transfer from your transmitter and feedline to your antenna. Think about it again. The dummy load has a flat SWR, yet it does not radiate on our ham bands.

Ok, but what *will* tell you something about how well an antenna will work? Manufacturer's claims? Nah. One way is by just looking at it. Like, is it a half wave or more long, including the groundplane? Does the matching network have lots of low loss stuff in it, or is it full of

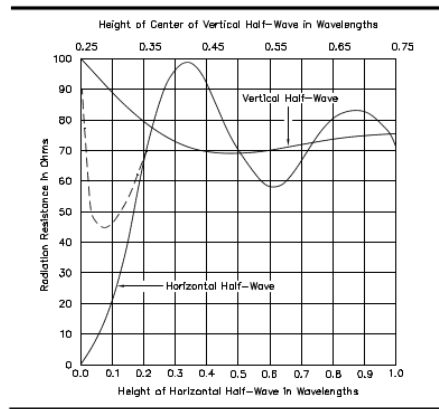
coils and traps? There is certain limits that you can not get around. One is length. Electrically short antennas do not have enough size to radiate. Even loop antennas have no magic. Loop radiation aperture is due to the size of the loop, $\pi \times \text{Diameter}$. This whole kind of “look at it” study is called antenna aperture, and it is a whole big thing. So I won’t drift over this right now.

I am trying to stick to the EFHW, but I keep getting lost in other things. OK, remember. It is a half wave resonator, so it bears more or less the same radiation pattern as all of it’s half-wave bretheren. How it interacts with it’s environment is also similar. So a half-wave dipole, and a half-wave EFHW over the same chicken yard, at the same height, is going to do just about the same as far as radiation goes. Don’t expect any magic difference, just because you happen to change the feed point of your Heathkit DX-60, provided you get your matching game together.



A lot more comes from how the antenna is oriented and how high it is. Check out KK4KOI. He’s devoted a lot of time modeling antennas. Sure, you can play with models, but bear in mind, those models are not going to precisely represent your particular chicken yard. They will give you a good idea of what to expect, though. Also bear in mind that a dB or two isn’t going to make any difference at the QRN and QSB receiving end on 80 meter CW.

What about a half wave antenna that does not require a matching network? Isn’t there some kind of antenna that looks like 50 ohms at it’s feed point? Yes. The dipole over “average” earth is about 70’ish ohms, depending on height. Also the inverted V does, sacrificing a bit of radiation. Here’s a graph to look at:



Like what the young WN8ZDF found out, we can tune our antenna's match impedance to whatever we want by varying the height. Of course, the amount of radiated power goes down, the closer we get to the ground, so there is no free lunch.

The antenna orientation, surroundings, and height cause big effects, but also there is operator skill. This is also a thing. How close do you listen? Do you tune around a bit and get a sense of what the band is up to? What experience do you have dealing with the ionosphere and the ever-changing band condition antics? Also, is anyone even listening for you? Also, are they having their own troubles with receiving noise levels on their end? HF is not FM and repeaters. It takes some practice to make a contact on HF, but that is the fun of it. And you also never know what you may catch.

For a few tips, try and back down a bit on the RF gain or flip in some attenuation, so the S-meter isn't bouncing all the time. That punching noise will make your brain start to ignore the racket all together. Less noise will also make your fatigue less.

Try a pair of headphones to cut out outside noise so you can concentrate, and ignore the kids/spouse/phone/etc. Then practice listening to weak signals right at the noise margins. See if you can get your brain trained to pick the words or CW out of the noise through the deep fades. I know this sounds nutty, but when you listen to noise and think you are just barely hearing some voices or maybe CW right at the margin, but can't quite make out what is being sent, then your ears are getting there. I picked this up from some of my weak signal Elmers. It really is an art, but it is a lot of fun. Your brain is trying to make words out of the noise and failing. That's good. It's ready for some weak signals.

I can go on and on and on, but if you want to do some study on your own, pick up an ARRL Antenna Book. It is an excellent well-written reference. I have the 1988 one here, and am reading chapter 3 right now.

There is so much more than I can possibly tell you in this little article, so you will have to show some initiative of your own if you want to know more.

I also have some of my old school books. Two are “Antenna Theory”, by the greek guy, Constantine Balanis, and also W8JK’s “Antennas” book. These are more in depth, academic, and “what if...” theoretical, but cover stuff made with shapes other than wires. But hey! ...with 3-D printers nowadays, along with conductive paints, I wonder how many crazy antenna designs can be realized by hams if we try them out. I just wish I had more time to play!

Website Updates

by
Matt, N3NTJ

Have you checked out the website lately? Supposing you wanted to see a past newsletter. Well, you are now in luck. I created a “SPARC Newsletters” page on the website and have most of the 2025 newsletters already posted. It is under the “About SPARC” tab on the website. Now, you can go back and peruse past newsletters at your leisure. That brings up another thing....

SPARC Market Place

by
Matt, N3NTJ

Do you know that you can sell things directly to the club members? Sure, but it has to be ham radio related. For instance, the new Marketplace page I created on the SPARC website already has some items. It’s for members who have stuff for sale or are looking for items. We already have three items listed. There’s a tab at the top of k3ir.org for members to easily find the page.

The club currently has these three items for sale to help pay for the solar system, and ultimately reduce our power bill. So you can buy something, and feel good about contributing to the club’s well-being, too. Check the website, for more recent items listed/sold.

1. **Tokyo HC-2000 HF Antenna Tuner.** With the price of eggs nowadays, the eggs are not included. Sorry. Tuner only. \$400. For sale by SPARC. Contact Harry at hbauderrm@gmail.com



2. **Icom AH-4 Remote Tuner.** HF+6m. New – still in box. \$425. For sale by SPARC. Contact Harry at: hbauder@gmail.com



If you're a member of SPARC and have an item for sale or an item that you are looking for, contact us to place your ad here.

Meeting Night

Like most clubs, there sets in a sort of monthly pattern of meetings, etc. Like, for SPARC, the usual average monthly general membership meeting is held the fourth Tuesday of the month, at 7:00 PM, at Lancaster County Public Safety Training Center (LCPSTC). Sometimes these things change, especially in the winter. Why are you looking at this newsletter for such information? Go to K3IR.org and check the calendar

tab.

License Test Sessions

Want to upgrade your license? How about get a license? You will need one to be a ham operator. There IS a test. You are required to know something. It's not just a \$\$\$ thing. Demonstrating that you indeed know something is another matter altogether. So you will need to study some materials. There is plenty of on-line information to help you get your license. Ask us. We are here to serve. Go to k3ir.org and ask for help.

Usually, testing is conducted at the SPARC site on the first Tuesday of every month. The fee to take the exam is usually \$14.00 payable on the K3IR website or in person, cash or check only. Go to K3IR.org and check the calendar tab to make sure.

If you do not already have one, go to fcc.gov and register for a FRN (Federal Registration Number). You will need this to interact with the FCC.

You can also pre-register to take the technician test, or upgrade, at Hamstudy.org. There is also a link on the K3IR web site to follow. Check the k3ir.org website for the latest in fashionable ham test news.

Upcoming Hamfests

by
K3KMT, et. al.

Did you know that Ralph keeps a list on his worldwide corporate website of local hamfests? He has a more complete, updated list than anyone else I know of, on this website:

<https://www.qsradio.com/index.html>

This is great, because I don't have to do this anymore! Go here to this web site and have a look.

But, alas, if you are not able to click the mouse because of arthritis, here's the ones from Mike's list last month that have not occurred:

03/20 & 21 - 56th Playground Amateur Radio Club Hamfest.

Location: Fort Walton Beach , FL

03/21 - FREDFest

Location: AmVets Post#2, Fredrick, MD

04/07 -Southington ARA Hamfest

Location: ???

04/11 - Warren County Radio Club Swapmeet, W2WCR, Queensbury, NY

Location: 720 Pleasant St. Southington, CT

04/14 - RAWNY Mini HamFest

Location: Church of the Nativity, Tonawanda, NY

04/18 - DELMARVA Amateur & Electronic Expo

Location: Georgetown, DE

04/19 - TWO RIVERS AMATEUR RADIO / COMPUTER SHOW

Location: Lincoln Borough VFD No. 184 Social Hall 4312 Liberty Way, Elizabeth 15037

04/25 - York Hamfest

Location: Glen Rock, PA

04/26 - MMARC Spring Ham Fest

Location: Odenton Volunteer Fire Department, Odenton, MD

References: FaceBook Group - HAMFEST (CT,DE,MD,NJ,NY,PA)

Volunteer – The club needs you.

SPARC currently has 131 “active” members on the roster. We have a lot to offer to our members. At this time we have a dedicated group of hardworking volunteers who keep the site running. Some say this is typical with most organizations. I don't think SPARC should be “typical” We need more real active members. Jobs range from the highly technical to the mundane but ALL are important. Please look at the list below and see if there is a place for you.

IT Team

Tower climbers and ground help

Operating building maintenance and cleaning

Operating building equipment maintenance and improvement

Porta Potty cleaning (not Pumping!)

Adopt a Highway crew

Elmers and Elm'ettes

Hamfest help, planning, etc.

Meeting programs and talks

Antennas! ...always more, bigger, higher.

Someone to take the trash home and pitch it when it's full.

Someone else to either eat or toss the old stuff in the fridge.

Someone to put the 6 meter beam up on a rotor.

Solar power wizard experts.

Fiscally rigorous scrupulous bean counters.