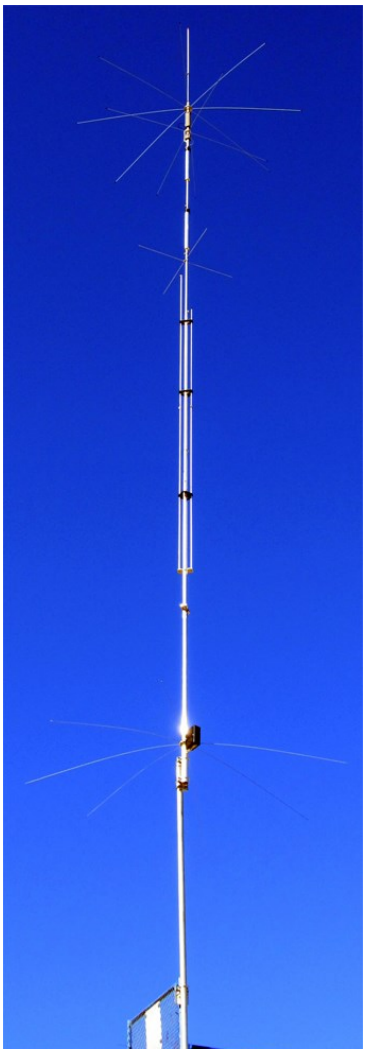
Brass Tacks

An in-depth look at a radio-related topic

Which HF antenna should I get?

You've earned your General class license, and now you're thinking of entering the wide world of *HF* (high frequency), which is ironically low frequency compared with much of the remaining amateur realm. After posting controversial questions on Facebook, you've finally decided on a very pretty, feature-rich HF rig, one that's supposed to deliver 100 watts to the airwaves, and maybe includes a built-in tuner. Being the educated ham you are, you already know what coaxial cable to purchase, and maybe even the connectors you're going to need. But that education has also taught you that you now face the most important question of all: *which antenna?*



Cushcraft R9 vertical

The decision about your HF antenna choice is not a trivial one. Some things to consider include home space restrictions, aesthetics (whether it looks nice with your home), and price. Ok, if money was no object, let's go straight for the jugular, shall we? You want a 200-foot *Rohn* tower, a *Yaesu* rotator system, *Cushcraft X7* beam antenna, with the *X-740* add-on, all connected by *Heliax*.

Well, you can dream, right? In reality, you live under the thumb of an HOA, your spouse will gladly allow an invisible antenna, and you only have $59 to spend on it. So, the goal is to get into HF territory within the limits specified by our environment. Not always easy, so let's break this down, and then arm you with the information you need to make an informed decision about where to go next. In general, we can categorize HF antennas into four kinds: *vertical*, *wire*, *beam*, and *other*, with some overlap.

Vertical HF antenna

Vertical antennas typically stand straight up, as the name implies, parallel with the pull of gravity, and more or less deliver a vertically (up-and-down) polarized emission. They're relatively inexpensive, work well for DX (out-of-country) contacting, but collect more noise than directional types. And it's fairly easy to design your vertical antenna to support multiple bands by installing *traps* on it, but traps do come at the price of excessive harmonics. (Trap design has been covered under *DIY* in the October 2016 issue of the *UVARC Shack*.) Vertical antennas are usually *ground-mounted* or *roof-mounted*, each with its advantages.

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Ground-mounted vertical antenna

Mounting your vertical antenna on the ground works well, as long as you have a really good connection to ground. But that requires two things: underground *radials* and a wet ground. The wetter, the better. In fact, if you could make your vertical float on salty seawater instead of dirt, that's about as good as you can get. And if you're mounting it on normal Utah ground, the more radials you install ***an inch or so*** below ground, the more you can make up for the lack of ground moisture. I'm not a fan of the "staple" approach, because vegetation has a habit of pushing things like radials up, catching in your mower.

Ground-mounting your vertical this way is great when it's free of nearby obstructions, like your house, your neighbors' houses, chain-link fencing, and forestry. Just don't forget about your radials when you go to dig that hole to bury your favorite pet some years later. Finally, the temptation to install or park future stuff (shed, RV pad, flower bed, trailer, swing set, etc.) on your vast, empty-looking real estate can be more than your spouse can bear.

Roof-mounted vertical antenna

If you choose to mount your vertical antenna on your roof, you're looking at a tall structure if you do it correctly. And if you want it to work well, once again you need to install radials. You should connect to the ground base of your antenna at least two radials per band, each about 1/4-wave long, installed symmetrically (on opposite sides from each other), and about 20 to 30 degrees down from level. Once again, while this vertical configuration tends to work well, your spouse might not appreciate its external beauty as much as you admire its function.

By the way, some manufacturers claim that their vertical antennas do not require radials, because they've installed loading coils that provide a match to the characteristic impedance. Problem is, the radials provide a *counterpoise* to the *radiator*, meaning they provide a complement to the radiating rod sticking up in the air, like a dipole standing on its end, so replacing the radials with a matching coil actually replaces half of your antenna with a circuit that does little to help with performance.

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Wire HF antenna

A wire antenna of one kind or another is typically the HF amateur's first antenna, primarily because of low-cost, availability, and ease-of-use. Most hams who want to get on the *lowbands* start out with a *dipole*, probably the most common HF antenna on the planet. A person can take a single trip to Ham Depot, and for less than $7, can build one of the very best-performing antennas that exists. Pretty much all you need is an SO-239 bulkhead connector, some PVC, and 35 feet of 14 gauge stranded wire, and suddenly you're joining an ongoing net in Iowa, or making contact with a kid throwing out CQs in Hawaii. This 20-meter version was featured in the July 2017 issue of the *UVARC Shack*.

But due to our dry Utah ground, you might need to get your dipole up higher than your house. Also, even though your dipole performs phenomenally, it's limited to a single band. Furthermore, you might not have the ability to get your dipole to stand flat-top, and will need to rely on a sloper, which is no more than a slanted dipole, or on an inverted-V configuration.

5-band fan dipole center section

One of the disadvantages of a dipole antenna is that it's designed for a single band. Like with a vertical antenna, it's not difficult to convert your dipole into a multi-band transmitter by installing traps on it. Otherwise, probably the two most popular alternatives are the off-center-fed (OCF) dipole and the fan dipole. A simple four-band fan design was featured in the October 2017 issue of the *UVARC Shack*.

G5RV antenna, coiled up

Yet another is the famed *G5RV* antenna, which requires plenty of height, tremendous patience, and some amount of skill to get working well in Utah. This is because the bottom of its vertical section needs to be raised as far above the ground and away from metallic objects as you can get it, due to its notorious ability to couple with nearby conductors. Additionally, its vertical ladder-line should be hung as close to 90 degrees from both horizontal elements as possible.

If you're looking to get into the really low frequencies (80 meters or 160 meters), but don't have several acres to spread out a large dipole antenna, an *inverted-L* might be your choice. Its design allows you to use part of the dipole length in a vertical section, reducing the necessary length of your property, but requiring greater height for the vertical section. Another, the end-fed half-wave (EFHW) wire antenna is like an inverted-L, but without the vertical section, which is replaced with an RF transformer for loading and matching.

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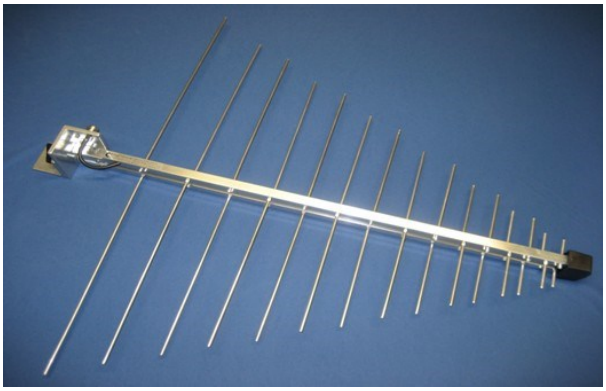
Couldn't a person simply create an antenna out of any old wire? Yes, you can, and that's referred to as a *random wire* antenna. Length and composition (copper, steel, aluminum, etc.) do not matter very much, but to make this conductor work as a transmitting line, you'll need a good *tuner* in many cases. Most tuners specify their maximum SWR or impedance (essentially, SWR = antenna impedance / 50 ohms), so that they can "tune" an antenna that presents an SWR of a specific amount or less. So, if your tuner's unable to handle a maximum SWR greater than 3.0:1 (very common with built-in auto-tuners), a random wire might not work for you, but if it can handle an SWR of, say, 10.0:1, you're probably in good shape with most random conductors.

Beam HF antenna

If you want a truly ham-looking antenna, a *beam* is for you. It performs well, brings in a lot less noise than a vertical, and looks fabulous. It does come with a few disadvantages, however. A beam requires a *rotator* (motor drive that you can work from within your shack, to turn the antenna in a particular direction), it might anger your HOA, and it's relatively expensive. Also, a beam tends to present a high wind load, meaning that it might not be able to withstand the same winds as well as a vertical, for example. Which means you'll probably need to install guy wires to the tower holding up the beam.

Yagi beam antenna

The two most common beams are the *Yagi* and the *log periodic* beam. A log periodic antenna is made from a collection of conducting elements of different lengths installed at specific distances apart, sized and spaced according to a somewhat logarithmic scale, to resonate on multiple bands. A Yagi antenna is similar, in that it's also constructed from a collection of conducting elements, but with one pair that's resonant at the *target frequency*, and others of sizes that are designed to sort of funnel the RF signal to maximize its forward gain.



Log periodic beam antenna

All the elements of a log periodic antenna are *active*, and typically support a variety of frequency bands, but suffer from limited gain. A Yagi typically only supports one to four bands, but usually exhibits large gain due to its *directivity*. The pair of elements that the feedline connects to, is the only part of the Yagi antenna that's active, but without the other (*parasitic*) elements, it's not much more than a dipole. A log periodic is a great performer, but a Yagi will typically set you back a little less.

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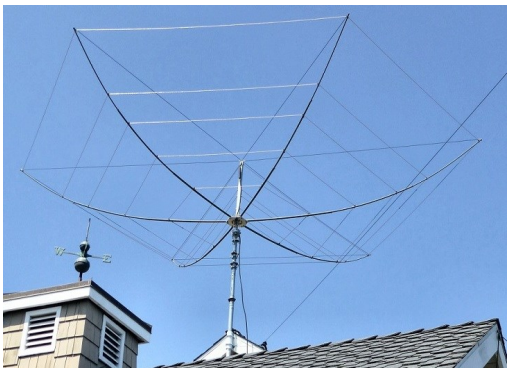
Other HF antennas

A *magnetic loop* is a great compromise antenna; that is, it performs well *receiving*, but not quite as well transmitting, due to its nearly omnidirectional (*cardioid*, actually) antenna pattern. It's made to be installed and worked indoors, but it's got a fairly large footprint (four to five feet in diameter), and must not be touched (3000 to 5000 RF volts can appear on it). If you mount it outside, well, that kind of defeats its purpose, because, if you can mount a loop out there, you can probably mount something better.



Hex beam antenna

Other types include portable antennas, like the *screwdriver* (for truck-mounting), *HamStick*, apartment antenna, *BuddiPole*, and *SuperAntenna*. Another is an outdated favorite, the *cubical quad*, a very large box-shaped antenna that looks like a wire outline of a Borg ship standing on your roof, nearly half the size of your roof. One more practical antenna you might consider is the *hex beam*, which looks like an upside-down umbrella, not as large as a cubical, but is a terrific performer.

Only for the sake of mention, other HF antenna types that I'll omit include the *EH antenna*, the *Hentenna*, the *Zepp*, the *Beverage*, the *Rhombic*, the *delta*, and the *doublet*. HF antennas can be designed in many configurations, and I've decided to only discuss the most popular types here, and leave the rest up to your curiosity.

Conclusion

So, with everything you know now, what's it going to be? Depending on your circumstances, you just might find that you have very few good choices. If this article proved more confusing than helpful, I apologize for throwing too much data at you. Sometimes having more choices isn't always better. But at least now you're a little better informed.

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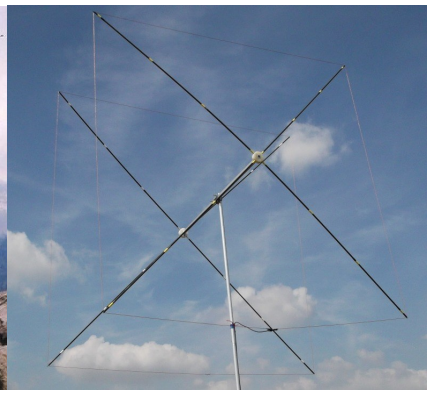
Magnetic loop antenna

Portability of a Buddipole



Cubical quad antenna