Newcomers and Elmers Net: VHF/UHF Antennas 7-23-17

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HT Rubber Duck is a severely compromised antenna

- designers know this and put in very sensitive receivers
- also assume you will be using a repeater which is also sensitive, higher powered, and high in elevation
- everything works fine until you are at the edges of reception/Tx
- very limited inside the house or car
- any external antenna will work better
- rubber duck can also be replaced with a telescopic antenna for better portable operation; still limited
- size of antenna is the key; anything less than an eighth wavelength (9") is almost useless
- ¼ (19") is better, ½ (39") best

Mobile antenna is a great option, even indoors

- get it near a window if possible, or on the second floor
- even better if there is some place to mount it outside
- needs a ground plane; something metal to make up the ground part of the signal; a metal baking sheet works great, or if indoors, a file cabinet, etc
- and of course a mobile antenna on the car will let a 5 watt radio sound great

Classic Antennas for Best Results
--J-pole
--Ground Plane
--Dipole
--Log periodic
--Yagi
-- Cubical Quad
--each design has strengths and weaknesses; every antenna is a compromise of some sort
J-pole is simple to build, and a good performer for general work
--does not have a lot of gain/directivity, but has other strengths
--can be made from basic ladder line or better
--numerous options/plans on the Internet
--can be extremely portable if you build a roll-up version

¼ Wave Ground Plane is a vertical antenna like the J-pole
--has a vertical wire or tube ¼ wavelength in height
--uses ¼ wavelength radials to complete the other half of the antenna
--easy to build, again many plans available online
--also no real gain, but good omni-directional antenna
--possibly the cheapest antenna to build
--portable like the J-pole and can be hung by a rope from a tree/support

Dipole
Basic, but many people ignore the dipole for 2m and above, but I am not sure why. A dipole is a dipole, regardless of what band you chose

- by this I mean it has the same radiation characteristics regardless of what band it is used on, given the same construction
- -- a half-wavelength dipole on 20m radiates the same on 2 meters – just the size is different
- Having said that, there is a reason most vhf/uhf antennas are made out of aluminum or copper – the wider elements increase the SWR bandwidth
- This means you have a broader range of frequencies with which to work without needed to re-tune the antenna
- I'll discuss some dipole options later which are constructed to use this aspect of broad-banded design
- Keep in mind two piece of copper or aluminum cut ¼ wavelength each and fed in the center is still a dipole; it doesn't have to be made out of wire

Dipoles are easy to erect, particularly in a horizontal polarization placement – hand it between two supports with the feedline coming down perpendicular to the antenna and you've got your dipole

- If you want a sloper, you can get some advantages of both horizontal and vertical polarization
- If you want a true vertical you only need to drop the dipole vertically from a support, secure the end closest to the ground to maintain the vertical position, and then run the feed line perpendicular to the antenna for at least a ½ wavelength
- Thus you could suspend the dipole from a tree limb, secure it at the bottom, and pull the feedline toward the trunk of the tree at 90 degrees and then follow the trunk down to the ground and into the shack
- Or hang it from the eve of a roof, a telescoping mast, or any other support – just make sure to run the feedline perpendicular to the antenna for at least ½ wavelength

A folded dipole can increase the bandwidth without a significant change to the antenna. Basically, a second ½ -wavelength section is added connected at both ends, and separated by a couple of inches – basically a very narrow loop or rectangle, with the ends of the feedline coming down toward the ground perpendicular from the center of the lower wire

- Another way to describe it is a full-wavelength loop with very short sides , with the bottom part of the loop coming together at the center of the bottom wire, but not actually connected
- The ends can then be connected to open line, or you can use a single piece of wire to form both the loop and the perpendicular feedline section
- The main advantage of the folded dipole is the increase in bandwidth without any additional significant material cost

Directivity
When talking about a ground plane antenna or a j-pole antenna, we are talking about the signal coming from a vertical element radiating in a 360-degree pattern, or roughly onmi-directional in the vertical plane

- When we talk about a directional antenna, like a log periodic or a Yagi, we are talking about antennas which direct their signal in a much narrower beamwidth (typically in a horizontal plane/polarization, but vertical Yagis and log-periodics works as well)
- There are advantages to both
- With an omni-directional antenna you can hear things from all directions roughly the same
- In a vertical orientation, a ground plane, J-pole, or dipole receives signals in a 360-degree pattern
- With a directional antenna like what we will discuss in a moment, you are going to hear things in one more strongly than in the other directions
- For example, a Yagi or log periodic pointed to the north will receive signals from the north more strongly than from the east, south, or west directions
- Because of this directivity more of your radio's power goes off into one direction, and usually this means your signal will go farther or be received more strongly than if the same power is sent out in an omni-directional pattern
- The downside of course is that you cannot hear stations coming in from those other directions as well, and so you will likely miss some calls you might have heard with an omni-directional antenna.
- On the plus side, if you are working a particular repeater, for example, you don't want to hear other repeaters other than the one repeater you want to work
- Likewise, if you are trying to work a station several miles from you on simplex, a directional antenna allows you to turn the antenna toward your friend's house and send a stronger signal in his direction, or receive his signal with less noise coming in from other directions
- An ideal setup would be to have both – one omni-directional antenna and one directional antenna

Log Periodic is more complex, but a substantially better directional antenna
--looks a lot like a TV antenna
-- log periodic elements, the radials coming out from the boom, are all active, meaning they are connected together and the whole antenna radiates power
-- The directivity come from the active mutual coupling that occurs between the elements
-- they are designed in such a way that they push the signal in the proper direction, concentrating it in one pattern versus in all directions
--has gain in the form of directivity
--lots of design options; will help you learn about antenna theory
--heavier and therefore requires more support strength
-- log periodics, like Yagis, may be stacked for additional gain

Yagi typically has highest gain and performance, most directive
--Yagis use multiple elements (1 reflector and one or more directive elements in addition to the driven element) to narrow the RF signal
--often called beam antennas
--many, many options and easy to build
--the longer the boom (that's the part that holds the elements) the more gain (at least up to a point)
--really good for portable work when trying to work in a particular direction
--also good for satellites, fox hunting, etc.

The Cubical Quad
The cubical quad, or sometimes just called the quad, is a loop antenna with roughly 4 equal sides, a square

- There are many different variations on this design as a search of the Internet for cubical quads will show, but for our purposes here I will just refer to the square as it is easier to visualize
- The square quad is a full-wavelength wire or tube formed into a square and fed at the bottom, side, or corner, with each giving different polarization options depending on the orientation of the quad, whether horizontal or vertical.
- Let's assume we are using wire just for illustration purposes. The wire is formed into a square with a break where the two ends of the wire meet – this can be at the center of the bottom or top of the square, at either of the sides, or at a corner.
- As you can visualize, this is a very simple design which actually has some gain through directivity
- It is roughly equivalent to stacking two Yagis together but with some advantages over that design in certain conditions
- A quad tends to suffer less interference than stacked Yagis, and some folks estimate it has a 2 dB gain over an equivalently sized Yagi setup
- If we were making a 2-meter quad we would be looking at an antenna roughly 20" per side, or slightly over 1-1/2 feet per side, a very small antenna, easily hidden, I might add!
- In an horizonal position it is still reasonably omni-directional, and in a vertical orientation it hears quite well in all directions, meaning you can get by without a rotor if you are trying to keep a low profile for the antenna
- If you rotate the square so that it is in a diamond configuration, you can use one support, which can be quite convenient
- You can actually add reflectors and directors just like a Yagi by adding additional loops in front of and behind the driven element to add greater directivity
- While this increases complexity a bit in terms of the support structure, the antenna is still small enough that this should not be much of an issue in terms of weight or size.

VHF/UHF antennas are a good place to begin experimenting
--useful for regular repeater work
--useful for satellites, fox hunts, portable work
--base stations either at home or at another location where you will be stationary

Antennas are small and manageable
--material costs are less
--easier to build by yourself in terms of size and handling
--takes up minimal space and can be taken down easily if needed
--you can use better materials in construction and not break the bank

Many Commercial and Homebrew Options
--search the Internet, magazines, and books for construction plans
--try several different types of antennas
--if possible, set up more than one kind for variety and options

Feedlines
The quality of the coax is extremely important for VHF/UHF antennas
--low quality coax cause a lot of your signal to be converted to heat, especially at 440 MHz
--keep coax runs as short as possible (under 50’ is good, 25’ even better)
--use RG213 or LMR 400 if possible, even on short runs
--the thicker coax provides a greater surface area for the signal, and less resistance
--make sure you know how the coax is to be handled near the antenna

e.g.:
--J-poles they usually need 5-6’ of coax going horizontally from the feedpoint before coming down
--ground plane antennas usually have the coax hanging straight down from the feedpoint

Height
Since VHF/UHF signals are basically line of sight, the higher you can get your antenna the better your coverage will be
--base antennas should be mounted 25 feet or more if possible
--if using a Yagi or Log Periodic antenna, consider adding an inexpensive TV antenna Rotor/controller to change directions when needed

Polarization
Keep in mind the polarization issue
--For most FM simplex and repeater work, antennas are vertically polarized, meaning the signals radiate out over the earth's surface
--For most SSB work antennas are horizontal

Connectors
While standard UHF connectors (PL-259/SO-239) will work for VHF and UHF, “N” connectors are preferred for UHF as there is less loss

- BTW, in case you are wondering, PL of PL-259 stands for “plug” and “SO” of SO-239 stands for “socket” – that may help you keep the male and female ends straight in your mind
- The reason this becomes significant is that as we go up in frequency, the wavelengths get much shorter
- As such, really short wavelengths can encounter resistance from connectors, and standard UHF connectors (a misnomer if I ever heard one!) offers more resistance than the “N” connectors because their impedance is not consistent along the length of the connector.
- When you get up into the microwaves, this is even more important, and it is why you will see BNC connectors on many scanners and similar radios
- BNC, TNC, and N connectors are all reasonably good up to 4 GHz, with TNC and N connectors being preferred for coax connections because they screw together rather than lock like a BNC connector

Books:

- Antennas for VHF and Above – Ian Poole
- Arrl's VHF/UHF Antenna Classics: Practical Design and Construction Details from the Pages of Qst – ARRL