Ham 105 – Antenna Design for Greater Wave Length

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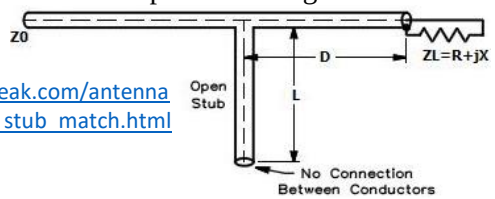
1. Moving to greater wavelength (lower frequency) from 2m/70cm requires more involved antenna systems.
   a. Every designer, engineer, and ham has their preferred antenna. Seldom are two the same.
2. Antenna categorization uses several ways. This is based on wavelength and arrangement. All configurations are 'ish'.
   a. A circuit is a complete circle with a source connection and a return called neutral or negative connection.
   b. An antenna is a field device with a radiator and a return called counterpoise or radials.
   c. The load or impedance is tweaked by changing the shapes and distance between the source and return.
3. Full-wave antenna has a total length about one-wavelength.
   a. Full wave designs are a closed geometry, whether a loop or rectangle. It is a folded (double, two) dipole.
   b. Their high radiation resistance about 300 Ohms (Ω), gives them high efficiency.
   c. J-pole categorization is challenging. It is a full-wave since it has a half-wave and two quarter-wave elements.
   d. J-Pole resistance is near 50 Ohms, since the connection location can be selected to meet that criterion.
4. Quarter-wave have an approximately quarter-wave radiator, although the entire length may be half-wave.
   a. Dipole has a quarter wave radiator and a quarter-wave return which is symmetrical or balanced. The impedance is about 72 Ohms.
   b. Monopole has about quarter-wave radiator with an asymmetrical or unbalanced return.
      i. The impedance approximates 25 Ohms.
      ii. The radiator is typically vertical with a horizontal plane of 4 or so radials for the return.
      iii. Radials drooped to 45 degrees increases resistance closer to 50.
      iv. Slighting increasing radiator length to .3 λ, the radiators can be about 1/12 λ to achieve resonance.
   c. Off-fed is an asymmetrical radiator and return. The impedance is typically very high.
      i. End-fed and off-center creates numerous harmonics making the antenna potentially multi-band.
      ii. Inverted F radiator is grounded one end, parallel to ground plane, and offset feed allows a shorter radiator.
5. Capacitive designs use screens or solid metal rather than simple wires for the radiator.
   a. The shape tends to a cylinder, cone, or disks making the extent much smaller.
   b. If an adequate air gap cannot be maintained, a dielectric is placed between layers of metal.
6. DC-resistance affirms the antenna connects to ground at 0 Hz, but not at higher frequency.
   a. DC resistance provides a path for lightning, transients, and noise.
   b. Still, the shape of the antenna causes inductance and capacitance which creates an impedance.
   c. The matching of the inductive and capacitive reactance determines the frequency.
7. Coax feed-line has an impedance of 50-Ohms resistance, with little reactance.
   a. If the antenna resistance is mismatched, not close to 50Ω, the SWR increases and the system is not as effective.
   b. Since the ground is the antenna system return, the relation to ground changes the performance.
8. Three fundamental grounds come into play.
   a. *Real earth* impacts the height and coupling. Height greater than half-wave gives less near-field interaction. Huge number of radials on earth is archaic without scientific basis. It helps because other things are less proper.
   b. *Plane* is an artificial earth created by multiple radials elevated to the base or feed-point for the antenna. Four is optimum mathematically, three works somewhat, five is superfluous.
   c. *Float* (counterpoise) results from a coupling coil at the base with one side not connected. These use other elements such as coax shield for the return path. Although they work, they are problematic.
9. Stacked antennas improve the system gain over one radiator.
   a. Colinear is multiple radiators connected in series / parallel combination to achieve impedance and gain.
   b. Phasing keeps the impedance in range of the coax. Series or parallel connections change the Z. The length of the coax must be precise.



www.arcticpeak.com/antennapages/single_stub_match.html

10. Tweaks compensate for design, construction, and performance.
    a. Reflectors change the direction of the antenna signal, pushing gain in one direction at the expense of another. To block, reflectors put more, longer, close spaced metal behind the radiator.
    b. Stubs are short section of transmission line (coax) inserted with a 'T'. Their effect depends on distance from the load and length of the stub. It may be L or C. An open stub radiates, while a shorted extends bandwidth 2 or 3x.
    c. Capacitive cap (lid) increases radiation resistance, for a short radiator. Similar effect to inductive base loading.
    d. Gamma match grounds the radiator to coax shield. Feed center through a series capacitor to a rod. Short the rod to radiator at a short distance location obtain match.
11. Life is good. Enjoy!