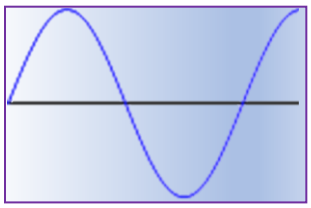
Ham 54 – Counterpoise and Dual-Band Antenna, Ham Brew

Dr. Marc & Rosemary © 220805



1. An antenna is radiating into the air around the earth. Therefore, the ground is part of the circuit. How does it couple to the earth?
2. A counterpoise, sometimes called a ground-plane, completes the antenna path. The counterpoise is simply a conductive metal surface. The impedance coupling depends on the metal length, surface area, height above ground, and earth characteristics. Tuning to 'match' is simply shortening lengths.
3. First, the physics. For the Tech exam, you learned to do this in your head. Frequency in MHz * wavelength in meters = 300. For 150 MHz, the wavelength is 2 meters or 78.7".

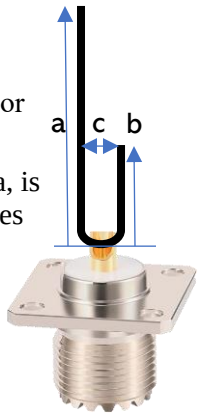
λ(m) * f(MHz) = 300

Fun project
Partially fill a cup with water. Put 2 different metals in water. Use a dc voltmeter to measure voltage between the metals. That potential is causing corrosion.

4. To get peak energy transfer, one-quarter wavelength is optimum as seen on the figure. The 2-meter VHF band is 144-148 MHz. For the center frequency, wavelength is 80.9". One-quarter length (a) is 20.22". For 435 MHz UHF, length (b) is 6.8".
5. Bend the two sides from a continuous rod. Separate (c) by about 10 mm. Since this is in near-field, it is not critical to radiation. Solder to the SO-239.
6. What is a counterpoise? It is simply a metal base for mounting 3 items.
   a. Attachment to a mast or support. Use hose clamps or u-bolt.
   b. A connector between the antenna and coax (feedline).
   c. Radials for coupling.

NMO Solder

7. Radials are extensions to improve the impedance coupling. On a portable radio, a single conductor may comprise the counterpoise, called a tiger-tail. A minimal fixed operation uses 3 radials. These were typical in old CB set-ups. A better system uses four, which provide symmetry to the radiation pattern.



8. How long should the radials be? One-quarter wave or 20.22" for resonance. A dipole is a quarter wave antenna with one radial. Distance is measured from the antenna. The photo is 18" rods. With the connector and bracket, the length is about right. Shorter does not critically affect SWR.
9. Few antennas have a good SWR match with the earth. The impedance, and resulting SWR of the antenna, is influenced by the coupling of the radials. Some manufacturers use horizontal radials. A drop of 45 degrees lowers impedance and SWR.
10. Dissimilar metals are problematic. Stainless steel is the preferred mount. Only connect bronze or copper to the stainless. Other materials corrode more, which will cause a potential difference in the metals and crackling in the signal over time. Aluminum can connect to aluminum. Aluminum should never be in contact with steel or copper.
11. The RF-connector depends on the antenna. The mounting hole is 5/8". Two types are common with SO-239 on the bottom for coax connection. The difference is the top, antenna connection. One is a solder connection for panel mount. The other is a mobile mount NMO (New MOtorola). Many NMO connectors come with coax pre-installed, requiring a larger mounting hole.

12. Now the challenge. Come up with a configuration that anyone can build.
    a. Parts must be readily available, like Home Depot or Amazon.
    b. Cost must be low.
    c. Performance must be SWR <2.0
    d. Looks must be reasonable, if not professional.
    e. Device must be rugged, not easily damaged.
13. Build time is less than two-hours with SWR 1.3. These are the parts.
    a. Mount: L-bracket with 5/8" hole for RF, 4 threaded holes for radials, 4 threaded holes for SO-239. Brett, KI5TAX has a custom design.
    b. Radials: 4: 18" x 1/8" rods or 1/4" tubing. *Lowes*.
    c. Connector: 4: Spade lugs for #12 AWG, crimp to rods, then solder.
    d. RF: SO-239 or NMO to match antenna. *Amazon*. Leave >1.5" circle clear in the middle for NMO-type antennas.
    e. Bolts: 4: 10-32 x 3/8" with washers for radials. 2: 6-32 x ¼" for SO-239 mount.
    f. Coax: RG-213U is important. RG-8X does not work well for VHF/UHF.
14. Life is good. Enjoy!