Ham 157 - Triad tuning

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All antennas must be tuned (adjusted) to match the band. Commonly, antennas use elements (radiator and counterpoise) that are a quarter-wave (λ/4) long. Whether the element is constructed in a straight line, zig-zag, or wound into a single-layer inductor, the length is still nominally the same. The Triad antenna employs a resonant, wound inductor for antenna elements. The inductor performs as a nominal quarter-wave device. Consequently, tunable inductors are usable equally on the radiator or return (counterpoise and non-radiating dipole) side of the circuit. A key-point is three elements are employed.

One-type inductor is a high-frequency antenna for mobile use, whether an end-loaded coil or stick inductor of a hollow Fiberglas shaft. These illustrations are spiral wrapped version with nominal 14-gauge wire, including a tightly wrapped loading coil near the center. The mechanical base uses a standard 3/8”-24 thread. The electrical top has a 3.175 mm (0.125 in) diameter adjustable length whip. Performance improves by replacing the conventional high-resistance stainless-steel tunable whip with a more conductive copper, aluminum, or brass rod, where the environment permits.

The coil and whip combination controls three significant properties: (1) adjust the inductance L, (2) change the frequency f, and (3) move the SWR. In general, the radiator determines the frequency and the return side determines the impedance and SWR. Whether or not you are familiar with the equations, obviously the two interact. Multiple radiators can increase bandwidth or make a multi-band antenna.

$f = 1/(2\pi \sqrt{L\ C})$

Select radiator inductor for the operating band. Typically, 6, 10, 20, 40, 80-m

Select return inductor band-rating. The counterpoise can be rated for the same band or for a higher frequency band shortened up to one-third the wavelength. The shortening has many benefits, including covering multiple bands.

Mount the radiator on antenna adapter. Now, mount a return. Only one return may be easier for initial tuning.

Connect the antenna feed-point to an antenna analyzer. A Rig Expert Stick Pro works simply for this task. Select a setting to show SWR vs frequency. (<Ham <>Band). Observe changes as inductor length is adjusted.

Snap on 4 to 7 ferrite beads, mix 31. Put over coax within 8-in of the antenna connector. These mitigate the coax acting as a counterpoise. Back well away from the antenna when taking readings, to reduce coupling.

Adjust: Tuning requires two steps: adjust return and adjust radiator, then repeat. Lengthen a whip to lower frequency (longer wavelength). Shorten to raise the frequency (shorter wavelength). Avoid operating with the whip inside the loaded coil. The magic smoke will escape resulting in overheating. Cut-off the whip if necessary.

SWR = larger / smaller of antenna and coax Z

Start with the return whip at minimum length. This minimizes the physical size.

Adjust the radiator whip until the desired frequency shows on the analyzer.

Readjust the return. Continue to move SWR as low as practical. Typically, we see well below 1.5: 1.

f = Q * bandwidth

Readjust the radiator as necessary. Keep the frequency about centered.

Fine-tune the return. Then fine-tune the radiator. Continue until acceptable SWR vs. frequency is found.

Now add the second return. If only one was initially setup, you had a bent dipole. Adjust the second as necessary.

A triad of inductors widens bandwidth. As frequency goes lower, the Q of the antenna may make the bandwidth very narrow. The fix is in. Add a parallel radiator on a nominal 2-in metal bar or a second counterpoise. Tune each inductor to a slightly different frequency.

Mount the lowest frequency radiator and return first. Attach the radiator to the coax adapter through one hole of the metal bar. Get it completely tuned as above.

Mount the second frequency radiator on the bar. It will be the same band rating. Tune it to a higher frequency (shorter). Looking on the radio SWR meter, you should see two dips, one for each frequency, resulting in a wider bandwidth.

Multi-band is one of the holy quests of antenna design. Multi-band is fundamentally no different from a wider bandwidth setup. The second, higher frequency radiator would be a different band, within the earlier noted 3 to 1 ratio. For example, 10 and 6 would work as would 20 and 10-meters.

If using the Triad multi-band, make the counterpoise under the higher frequency radiator be on the same band as the radiator. Although other arrangements are possible, this seems to be the easier option to adjust.

Remove the analyzer. Connect coax to radio. Use internal antenna tuner, if desired. Congratulations on an incredibly small HF antenna footprint.

Life is good. Enjoy!