COMMUNICATIONS CORNER

Multi-band trap-antennas

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WHILE RECENT ADVANCES IN ELECTRONics have improved transmitter and receiver performance tremendously, all that fancy high technology does very little good if you can't get a signal out (or in). Remember the old ham adage: "You can't work 'em if you can't hear 'em." We have yet to come up with a high-tech solid state antenna that is superior to a wire!

Current technology has made it possible to put full 3–30-MHz coverage in a transceiver not much larger than a shoebox. Band-hopping is so easy that most amateurs who operate HF can shift bands with a twist of the wrist. But, what's the advantage of a high-tech, full-coverage, broadband rig if it takes 10 minutes to tune up the antenna on a new frequency? For maximum convenience when band-hopping, many amateurs use multi-band antennas—dipoles, verticals, or directional beams. However, the fact remains that those multi-band HF antennas have not been improved much by high technology. They still use old-fashioned *traps*, a trap being an ordinary parallel-resonant circuit.

Let's look at a typical situation. Our new amateur has just purchased a Whiz-Banger All-Band Solid-State Digitized Signal Squirter, and to get his money's worth he wants full coverage with beams for 10, 15, and 20 meters, and dipoles for 40 and 80; all that on a 20-by-100-foot city house-lot. Because of the lack of space, and because the neighbors aren't too happy seeing a tower loaded with antenna elements swinging close to their homes, our all-band amateur cuts his antenna hardware down to a minimum—just two antennas for five bands.

How it's done

Imagine a quarter-wave dipole antenna for the 10 meter band. It measures about 16 feet end-to-end, and can be made of aluminum rod or thinwall tubing supported at the center feedpoint. Alternately, it can be made from wires strung from end-supporting insulators.

If we want to cover a lower frequency—say on 15 or 20 meters—with the same type of antenna, we need a length of approximately 23 feet for 15 meters and 35 feet for 20 meters. It seems that no single length will work for all three bands; yet we can purchase antennas where a single element serves for 10, 15 and 20 meters, or 40 and 80 meters, or even 80 through 10 meters.

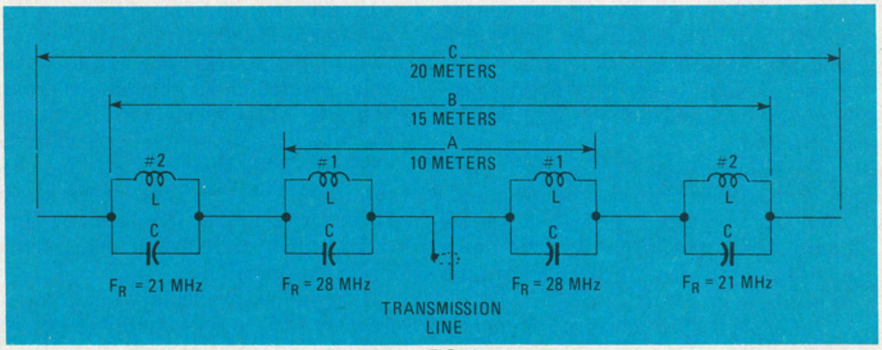

FIG. 1

The "magic" is performed by the traps we mentioned earlier, which make a single antenna element appear to be the correct electrical length for several bands. Let's look at Fig. 1, which illustrates how traps work for a three-band 10/15/20-meter dipole. (You can carry the idea through to a 5-band antenna.)

Antenna-segment "A" is the correct length for a 10-meter (28-MHz) quarter-wave dipole. The parallel-resonant "#1" L-C traps at the ends of that segment are tuned to the center of the 10-meter band and electrically isolate the "A" section of the antenna from the remaining wire. As far as the transmitter is concerned it "sees" only the dipole antenna represented by "A."

If the transmitter's output is changed to 15 meters (21 MHz) the "#1" L-C traps are no longer resonant at the operating frequency; they appear as a slight inductance in a dipole now having a total length "B." The "#2" traps at the ends of the "B" segment are tuned to the center of the 15-meter band and isolate "B" from the remaining wire length. Because of the slight inductive effect of the "#1" traps, the end-to-end length of the "B" antenna is slightly less than the calculated dipole length for 15 meters.

When the transmitter's output is changed to 20 meters (14 MHz) both the "#1" and "#2" traps are no longer resonant at the operating frequency; they appear as small inductances in a dipole of length "C." The total length "C," again because of the small inductive effects of the traps, is slightly less than what would ordinarily be calculated for a 20-meter dipole antenna.

Because of those inductive effects, it gets a little tricky to adjust element lengths for the lower frequencies—it's usually done by a final tweaking of the section lengths—but the process can be carried through two more sets of traps (for 20 and 40 meters), resulting in a five-band antenna covering 80 through 10 meters. Often, the 40 meter antenna is used on 15 meters. (But, when traps are used, the 40-meter antenna isn't all that great on 15 meters).

Trapped beams

While we have illustrated traps using dipole antennas, the same theory applies to any other elements used in a directional beam, whether driven or parasitic. For example, the typical 10/15/20 meter beam is a parasitic array with a non-driven director and reflector. Each parasitic element is tuned to the band in use by means of traps, just like the driven dipole-antenna.

If you get the urge to build your own trap antenna keep these rules in mind: The traps must be "rock-stable." That means that they must be enclosed in a weatherproof housing so that moisture won't change their characteristics. Also remember that there is a very high RF-voltage present at the ends of the antenna, so low-voltage receiver-grade components mustn't be used. The inductors must be wound using heavy wire such as you would use for a transmitter tank-circuit, and the capacitors should be of the type known as "transmitting" micas. (There are lots of surplus transmitting micas around.) If you're not into building your own traps, it's possible to purchase commercial traps for home-brew amateur antennas. Inquire at any of the larger amateur-equipment distributors. **R-E**