Build a Portable Groundplane Antenna

Need a better antenna for your hand-held radio? Here's the answer.

By Zack Lau, KH6CP/1
ARRL Laboratory Engineer

Three wires and a BNC connector make a portable groundplane antenna that puts a rubber ducky to shame. You can build this groundplane design for 146, 223 or 440 MHz.

The rubber ducky antennas common on hand-held VHF and UHF transceivers work fine in many situations. That's no surprise, considering that repeaters generally reside high and in the clear so you and your hand-held don't have to! Sometimes, though, you need a more efficient antenna that's just as portable as a hand-held. Here's one: A simple *groundplane* antenna you can build—for 146, 223 or 440 MHz—in no time flat. It features wire-end loops for safety (sharp, straight wires are hazardous) and convenience (its top loop lets you hang it off high objects for best performance).

What You Need to Build One

All you'll need are wire (single-conductor, no. 12 THHN), solder and a female coax jack for the connector series of your choice. Many hardware stores sell THHN wire—that is, thermal-insulation, solid-copper house wire—by the foot. Get 7 feet of wire for a 146-MHz antenna, 5 feet of wire for a 223-MHz antenna, or 3 feet of wire for a 440-MHz antenna.

The only tools you need are a 100-watt soldering iron or gun; a yardstick, long ruler or tape measure; a pair of wire cutters; a ½-inch-diameter form for bending the wire loops (a section of hardwood dowel or metal tubing works fine), and a file (for smoothing rough cut-wire edges and filing the coax jack for soldering). You may also find a sharp knife useful for removing the THHN's insulation.

Building It

To build a 146-MHz antenna, cut three 24-5/8-inch pieces from the wire you bought. To build a 223-MHz antenna, cut three 17-5/8-inch pieces. To build a 440-MHz antenna, cut three 10-5/8-inch pieces.

The photos show how to build the antenna, but they may not communicate why the cut lengths I prescribe are somewhat longer than the finished antenna's wires. Here's why: The extra wire allows you to bend and shape the loops by hand. The half-inch-diameter loop form helps you form the loops easily.

Make the End Loops First

Form an end loop on each wire as shown in Fig 1. Strip exactly 4 inches of insulation from the wire. Using your ½-inch-diameter form, bend the loop and close it—right up against the wire insulation—with a two-turn twist as shown in the bottommost example in Fig 1. Cut off the excess wire (about ½ inch). Solder the two-turn twist. Do this for each of the antenna's three wires.

Attach the Vertical Wire to the Coax-Jack Center Pin

Strip exactly 3 inches of insulation from the unlooped end of one of your wires and follow the steps shown in Fig 2. Solder the wire to the connector center conductor. (Soldering the wire to a coaxial jack's center pin takes considerable heat. A 700- to 750-°F iron with a large tip, used in a draft-free room, works best. Don't try to do the job with an iron that draws less than 100 watts.) Cut off the extra wire (about ½ inch).

Attaching the Lower Wires to the Connector Flange

Strip exactly 3 inches of insulation from the unlooped ends of the remaining two wires. Loop their stripped ends—right up to the insulation—through opposing mounting holes on the connector flange. Solder them to the connector. (You may need to file the connector flange to get it to take solder better.) Cut off the excess wire (about 2¼ inches per wire). This completes construction.

Adjusting the Antenna for Best Performance

Bend the antenna's two lower wires to form 120° angles with the vertical wire. (No, you don't need a protractor: Just position the wires so they just about trisect a circle.) If you have no means of measuring SWR at your antenna's operating frequency, stop adjustment here and start enjoying your antenna! Every hand-held I

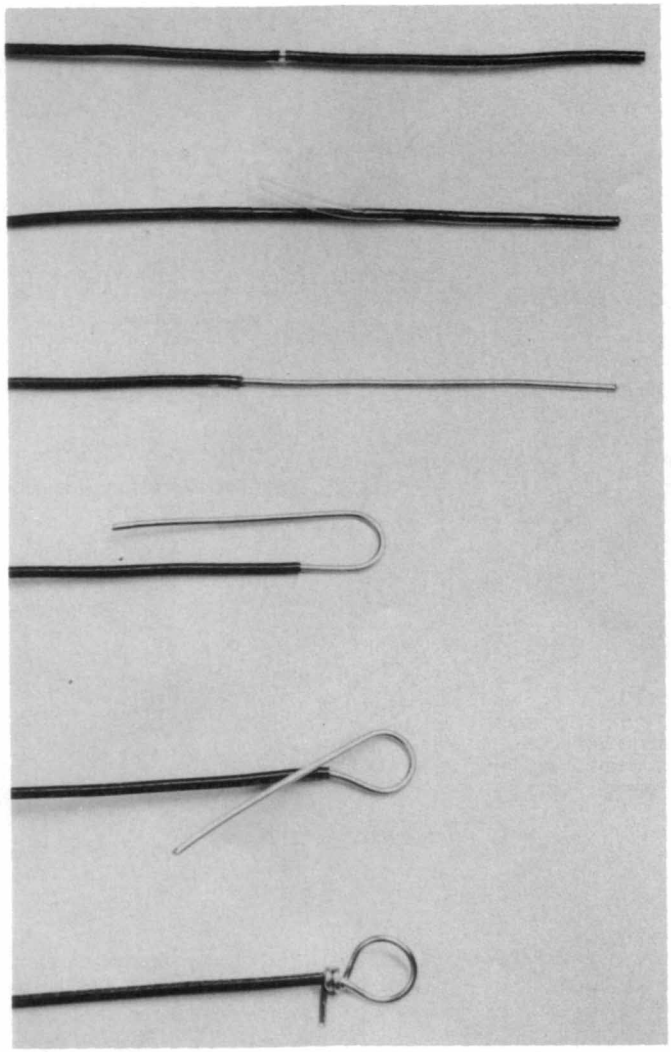

Fig 1—Making loops on the antenna wires requires that you remove exactly 4 inches of insulation from each. Stripping THHN insulation is easier if you remove its clear plastic jacket first.

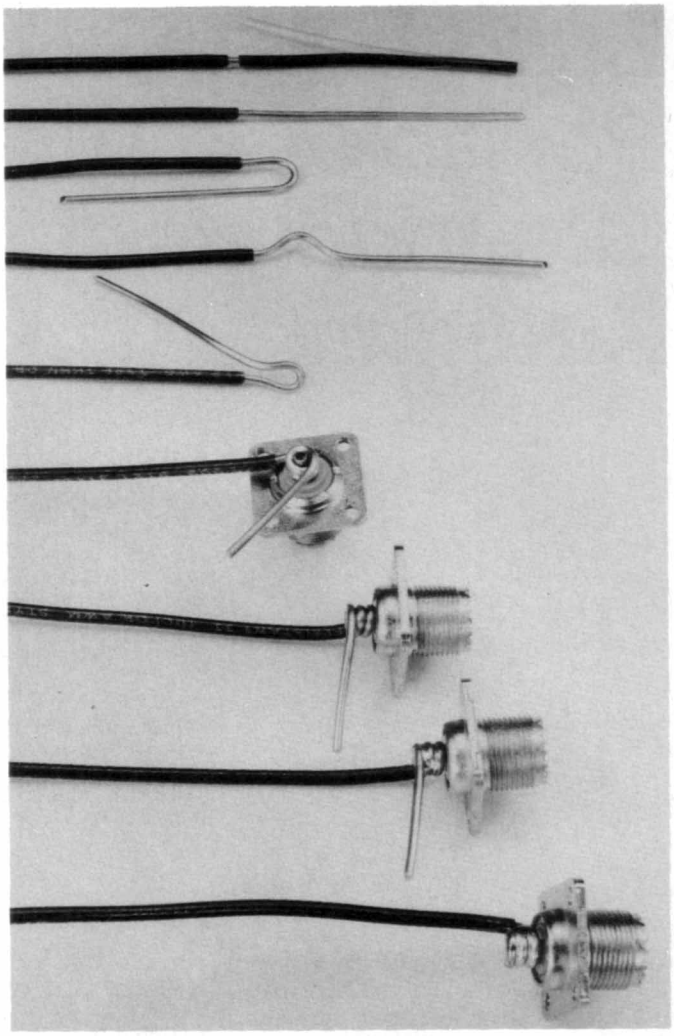

Fig 2—Remove exactly 3 inches of insulation to attach the vertical wire to the coax connector center pin. This photo shows an SO-239 (UHF-series) jack; the title photo shows a BNC jack. Use whatever your application requires.

What's a Groundplane?

This article emphasizes how to build and adjust a groundplane antenna for better communication at 146, 223 or 440 MHz. You can find out the technical details of *how* groundplane antennas work in Chapter 2 of *The ARRL Antenna Book*, available from your dealer and The ARRL Bookshelf.—*WJ1Z*

know of should produce ample RF output into the impedance represented by the antenna and its feed line.

Adjusting the antenna for minimum SWR is worth doing if you have an SWR meter or reflected-power indicator that works at your frequency of interest. Connect the meter in line between your hand-held and the antenna. Between short, identified test transmissions—on a simplex frequency—to check the SWR, adjust the angle between the lower wires and the vertical wire for minimum SWR (or reflected power). (You can also adjust the antenna by changing the length of its wires, but you shouldn't have to do this to obtain an acceptable SWR.) Before considering the job done, test the antenna in the clear to be sure your adjustments still play. (Nearby objects can detune an antenna.)

Plug and Play

As you use the groundplane, keep in mind that its coax connector's center pin wasn't made to bear weight and may break if stressed too much. Barring that, your groundplane should require no maintenance at all.

There you go: You may not have built a monument to radio science, but you've home-constructed a portable antenna that'll get much more mileage from your hand-held than its stock rubber ducky. Who said useful ham gear has to be hard or expensive to build? QST

Strays

***QST* congratulates...**

☐ Frank A. Gunther, W2ALS, on being awarded the Bronze Order of Mercury by the US Army Signal Corps. The award, recognizing his contributions to the Corps, was presented at Gunther's address to the Ft Gordon, Georgia, graduating class on March 25.

Among his many career achievements, Gunther was instrumental in the development of early military radio systems. He is past president and chief engineer of Radio Engineering Laboratories (REL), and was a colleague of Maj Edwin H. Armstrong.