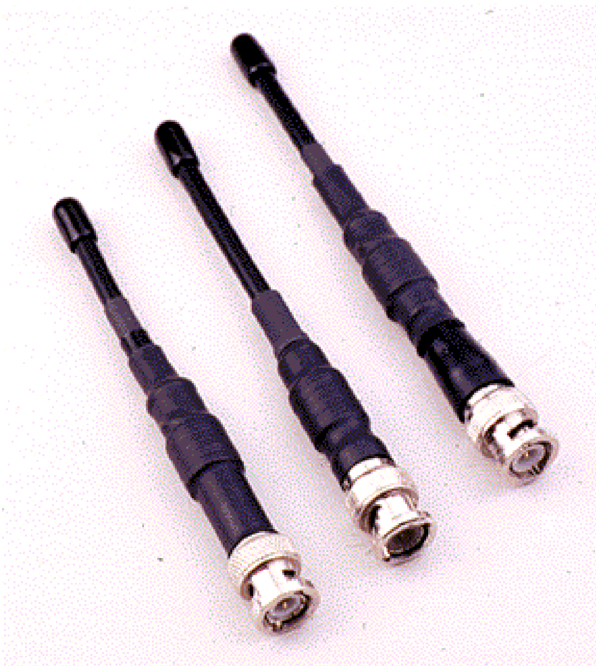
Make Your Own "Rubber Duckies"

Not the bathtub kind . . . the kind you stick on an H-T. For a few dollars and a couple of hours of fun, you can roll your own 2-meter rubber duckies that will likely perform better than many commercial units.

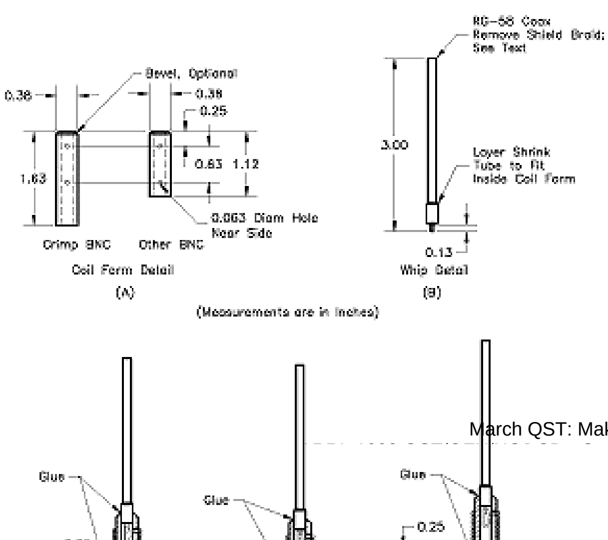
By Paul Stump, N0LRF



Getting all the ducks in a row. Here are three homemade duckies shown for physical comparison.

Has the dog chewed up...a car door snapped off...or you simply can't find that H-T antenna? Not to worry! You can build a replacement antenna that delivers a lower SWR and more RF output than the one that came with your radio—and you can do it for $10 or less and a couple of hours of fun! Let me tell you how....

This design is based on using a maximum applied RF power of 5 W at 144 to 148 MHz. The title photo shows three completed homemade rubber duckies. **Figure 1** shows the antenna cross-sections and part dimensions listed in the bill of materials. All materials are readily available, if not from your junk box, then from Digi-Key, Radio Shack or your local hardware store. [**1**]



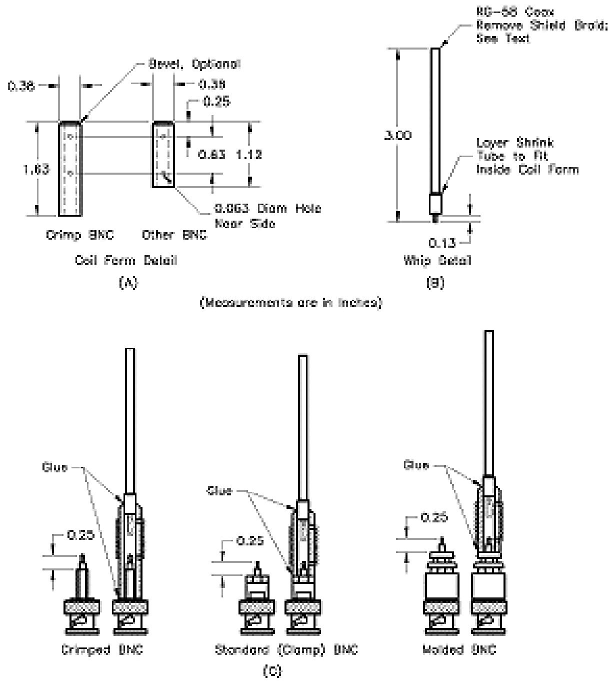


Figure 1—Making a replacement H-T antenna is relatively simple. The details show the dimensions and cross-sections of the coil form (A), whip (B), and the initial and finished stages of antennas (C) made with three types of BNC connectors: standard, crimped and molded.

1—Male BNC connector equipped with $^1/_4$ inch length of RG-58 coax

1—$^3/_8$ inch OD × $^3/_{16}$ inch ID coil form made from water-faucet tubing, CPVC or cross-linked polyethylene; available at hardware stores.

1—Tip cap, screw protector (Serv-A-Lite #10SP)

1—18-inch length of #24 AWG solid, insulated hook-up wire, or equivalent

1—Assorted heat-shrink tubing (Radio Shack 278-1627B or equivalent)

1—3-inch whip; modified RG-58 coax

1—Glue, CCA, "super" Hot Stuff Super T, or equivalent (available at hobby stores).

Initial Assembly

Refer to **Figure 1**. Prepare a $^3/_8$ inch OD × $^3/_{16}$ inch ID coil form from water-faucet tubing, CPVC or cross-linked polyethylene (all available at hardware outlets) as shown. Use a sharp utility knife to cut the tubing. Deburr the holes and edges. Optionally, bevel the top edge of the form. [**2**]

If you're starting with a bare BNC connector, insert a short piece of coax into the connector. Cut the coax at a distance of $^1/_4$-inch from the rear of the connector. Remove the coax outer jacket and shield at the end of the plug, leaving $^1/_4$ inch of center conductor and insulator. Hold the inner conductor and insulation with needle-nose pliers (otherwise, the center insulator can pull out with the stripping action), then strip and tin the center conductor to a $^1/_8$ inch length.

Insert one end of a length of #24 wire through the bottom coil-form hole and route it out the end of the form. Solder the wire end to the coaxial cable's center conductor. Slide the form onto the rear of the BNC connector and "super" glue the form to the plug as shown in **Figure 1**. [**3**] Allow the assembly to dry for 10 to 15 minutes while you prepare the whip.

Take a three-inch length of RG-58 coaxial cable. Using a small screwdriver, remove (push out) the coax center conductor and its insulator. Pinch one end of the jacket and shield. Grab the shield with long-nose pliers and remove it. Place the *outer jacket* over the center insulator and conductor. Strip and tin the center conductor at one end. Add enough layers of heat-shrink tubing at the base of the whip to provide a snug fit inside the coil form. [**4**]

Wind 11 turns of wire around the coil form, keeping the turns snug. Pass the free end of the wire through the upper hole in the form, then outside, and pull the wire snug. Trim the wire about $^1/_4$ inch from the end of the coil form. Strip and tin the wire end. Solder the whip to the coil-wire end. Gently feed the connection into the coil form with needle-nose pliers. While doing this, hold the upper turns of the coil against the form and create a loop of wire inside the form as shown in **Figure 1**. Insert the lower $^1/_4$ inch of the whip inside the upper end of the coil form.

Final Assembly

For optimal performance, use a VHF SWR/power meter and a field-strength meter to tune the antenna. If you don't, your homemade antenna may still work at least as well as the factory antenna. I used a Diawa Model CN-101L meter and a "homebrewed" multimeter/field-strength meter positioned about eight feet away from the transceiver. Connect your new antenna to the SWR/power meter using the proper combination of connectors. (A right-angle SO-239 adapter and a PL-259-to-female BNC adapter worked for me.)

Connect an *external* power source to your H-T (to avoid battery sag). Attach the radio's antenna output to the SWR meter's transmitter input with a three-foot (or shorter) length of coaxial cable. Attach your homemade antenna to the SWR meter's antenna port. Select a transmitter power setting of no more than 5 W. Choose a simplex frequency of 146.0 MHz and check the antenna's SWR and field strength.

Adjust the field-strength meter's location and its antenna for a mid-scale reading. (Now's a good time to commit adjacent radio channels to the H-T's memory: 145.00, 146.00, 147.00 and 147.90 for testing purposes.)

Connect your commercial rubber ducky to the SWR/power meter and check the antenna's performance on all five frequencies; log your measurements. Those are the numbers you're going to beat. We're looking for minimum SWR, maximum power and maximum field strength. Don't move any of the equipment and always key the H-T while standing in the same position (you act as a ground reflector).

Now, attach your homemade antenna to the SWR meter. Check the antenna's SWR and field strength. [**5**] Gently adjust the vertical position of the whip until there is an improvement in the readings. Try squeezing the coil turns closer to each other. Continue making adjustments until the readings are optimized. Once you are satisfied, run a bead of glue around the base of the whip. Place a length of $^1/_2$-inch-diameter heat-shrink tubing over the coil, overlapping both ends of the coil form. *Don't* heat the tubing yet.

Recheck the SWR and field-strength readings. I found that the addition of the shrink tubing *increased* the electrical length of the antenna and therefore, *lowered* the antenna's resonant frequency. If that's so, carefully trim the whip length in $^1/_{16}$-inch increments until the antenna is resonant at the desired center frequency (see **Note 2**). My antennas generally required two $^1/_{16}$-inch trim attempts to resonate them at 146.0 MHz.

Using a heat gun, hair dryer or a match, shrink the tubing while rotating the antenna. Recheck the SWR and field-strength readings at 145.0, 146.0, 147.0 and 147.9 MHz. If the antenna resonates below 146.0 MHz, clip a little more off the whip. If the antenna is resonant above 146.0 MHz, you'll either have to live with it, or try to pull the whip a bit out of the coil. If the antenna is still too short, you can carefully remove the shrink tubing with a razor or knife and make a new, longer whip. (You've got extra materials, don't you?)

Next, install the tip cap (which will slightly lower the resonant frequency). Recheck readings and trim the whip, if necessary. Finally, open the beverage of your choice and admire your work!

Acknowledgments

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Paul's primary Amateur Radio interests now include APRS to send weather data and to track himself and others, and HF phone. He's worked in the aerospace, navigational, communication businesses for the past 14 years. Paul is employed by GARMIN International in mechanical engineering. He's a charter member of the Kansas City APRS Working Group (KCAWG) at **http://www.kcaprs.org**. You can contact Paul at 3575 Hwy 68, Ottawa, KS 66067, e-mail **n0lrf@amsat.org**; his home-page address is **http://www.ott.net/~n0lrf/**.