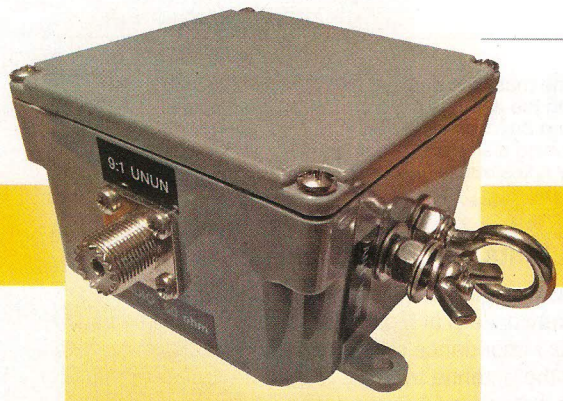

Build a 9 to 1 Unun Transformer

A useful unbalanced-to-unbalanced transformer can be built with easy-to-find parts.

Stan Johnson, WØSJ

An end-fed long wire antenna is typically fed with a 9 to 1 impedance ratio unun. I used a Laird 28B1540-000 core (Digi-Key part number 240-2319-ND). It has a 1.54-inch outer diameter and a 0.66-inch inner diameter, is 0.875-inch long, and costs less than a couple of dollars.

My unun is wound with #16 AWG Teflon™ insulated wire. I used three pieces — two are 17 inches long and one is 20 inches. I used three different colors to keep the wires organized and make the connections foolproof while white shrink tubing from a Harbor Freight Tools assortment package holds the wires together.

The unun acts as a transformer with a 3 to 1 turns ratio (9 to 1 impedance ratio) as long as the windings are phased correctly. The dots in Figure 1 indicate the phasing of the windings.

Step by Step

For additional detailed instructions with photos, please see the *QST* in Depth web page at **www.arrl.org/qst-in-depth**.

Step 1: Slip a ½-inch piece of shrink tubing over the three wires and position them up through the center of the core with the tubing centered on the outside. I placed the black wire on the left, white in the center, and longer blue on the right. Leave 2½ inches of wire sticking above the center of the core.

Step 2: Wrap a second turn and add another piece of shrink tubing. Make sure that the wires have not become twisted in the center of the core.

Step 3: Wind another two turns, adding shrink tubing and making sure the wires do not become twisted in the center of the core. Insert a piece of ½-inch plastic tubing in the center to hold the windings. Space all the windings at 90° to each other.

Step 4: The long end of the 20-inch blue wire goes to the antenna. The short end of the blue wire connects to the white wire that protrudes from the opposite end of the core. Trim and solder so that the wires remain snug against the core.

Step 5: Trim about ½ inch of insulation from the remaining end of the white wire. Cut the white insulation at the corner of the core and slide it about ¼ inch towards the wire end. Cut and trim the black wire from the bottom of the core, wrapping it around the white wire close to the core, and solder the connection.

Step 6: Add shrink tubing over the soldered connections. Install a zip tie around the unun to keep the windings pressed against the core.

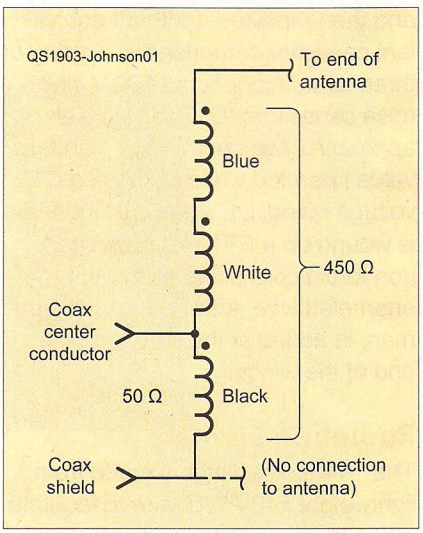

Figure 1 — The unun is connected according to this diagram.

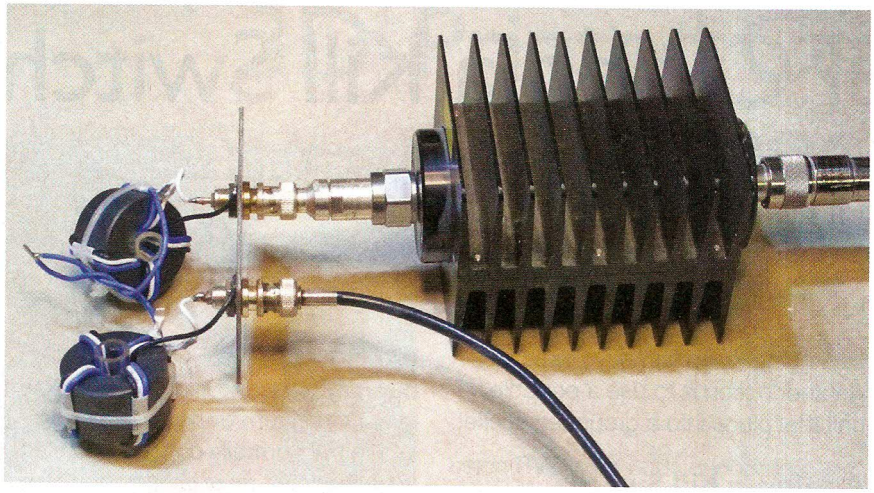

Figure 2 — A test configuration using two identical ununs positioned back to back.

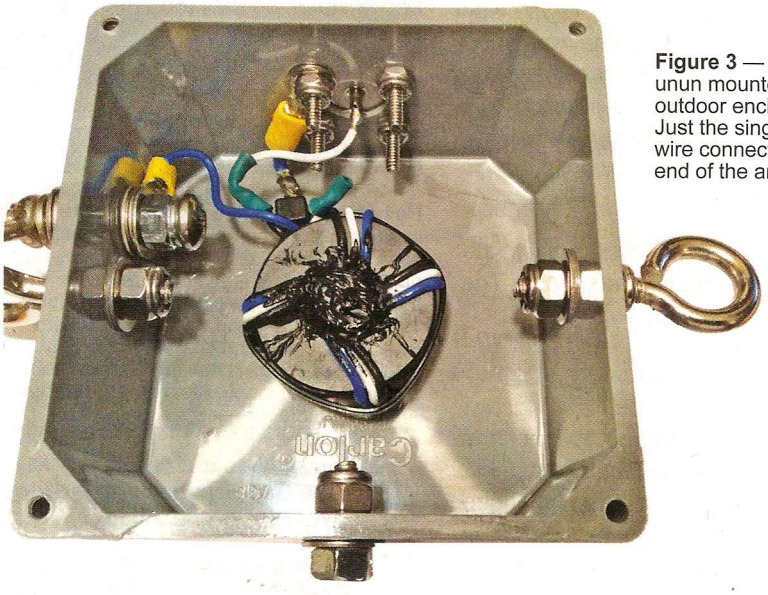

Figure 3 — The unun mounted in an outdoor enclosure. Just the single blue wire connects to the end of the antenna.

Testing

Solder the shield side of a coax connector to the black wire and the center conductor to the white wire. Connect a signal generator to the coax connector. Connect the first oscilloscope probe to the white wire and the second scope probe to the free end of the blue wire. Attach the probe ground clips to the PC board, as shown in Picture J on the *QST* in Depth page. You should see a voltage on the blue wire that is in-phase and three times the voltage on the white wire.

In another test, connect the unun to a 450 Ω resistor from the blue wire to the black wire (the shield connection). Measure the input impedance with an antenna analyzer. You should read around 50 Ω.

I tested the ununs at 100 W by connecting two ununs back to back in series. The first unun transforms the impedance to 450 Ω and the second transformed it back down to 50 Ω. Because the ununs are identical, I divided the measured power loss in decibels by two.

Table 1
Insertion loss per unun

Band (meters)	Loss (dB)
160	0.32
80	0.20
40	0.15
20	0.18
15	0.21
10	0.26

I connected the transmitter through a barrel connector to a 50 dB, 100 W attenuator and measured the RF power with a Hewlett-Packard 436A power meter, using an 8482A power sensor to get a reference power level in dBm. I then replaced the barrel connector with the two ununs (see Figure 2). The last step is to key the transmitter and record the dBm reading divided by two. Table 1 lists the unun measured losses across the MF-HF bands.

Figure 3 shows the finished unun in an outdoor enclosure.

All photos by the author.

Stan Johnson, WØSJ, was first licensed in 1961, and upgraded to Amateur Extra class in 1968. He has a degree in electronics from Iowa State University and a physics degree from the University of Northern Iowa. His career began at Bell Telephone Laboratories near Chicago and ended at the John Deere Product Engineering Center in Iowa as Scientist/Engineer. Since retiring in 2001, Stan enjoys building things, mostly out of junk. You can reach Stan at **w0scavengesjunk@gmail.com**.

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