Originally printed in the *YCCC Scuttlebutt*, Issue 128, April 1997

Beverage Notes

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After convincing my friend Peter Budnik, KB1HY, to host a first-time multisingle effort from his Burlington, Connecticut, QTH for the '97 ARRL DX SSB contest, I offered to help him with some antenna work, with an eye toward beefing things up on the low bands. Peter's antenna farm sits on nearly six acres at roughly 900 feet above sea level and looks over *miles* of sloping terrain—and in the "right" direction--towards Europe! It looked like Peter's place might have enough room to support a short (550-foot) Beverage, so I educated myself a bit using the second edition of *Antennas and Techniques for Low-Band DXing*, by John Devoldere, ON4UN. Among other things, John provides useful advice about using transmission-line transformers to match coaxial feedlines to Beverages.

Posts on the Top-Band Reflector mentioned a matching-transformer kit available from Carl, KM1H, who runs Radioworks in New Hampshire. He supplied me with a couple of ferrite cores along with winding information. KM1H specifies the use of an FT-114-61 core with 16 quadrifilar windings. His design offers the ability to separate the Beverage ground connection from the feedline shield. Alternatively, with the addition of a jumper, you can tie these two "grounds" together. The ON4UN design specifies trifilar windings for a variety of cores, with all ground lines in common (more on this later).

I decided to roll a couple of my own, using both ON4UN's and KM1H's design information. After building one of each type, I asked Dave Sumner, K1ZZ, if he could give 'em a "test drive." While his investigation was neither exhaustive nor scientific, K1ZZ used the two designs on his 550-foot terminated Beverage. He compared them using the same antenna, both with and without a matching transformer. Dave reported that the ON4UN design seemed to add "several dB" on receive--but he was reluctant to further quantify his observation without measuring. Dave also noted that it didn't make that much difference in his ability to hear signals, since both external noise and signals came up by the same degree. Not big news, but the experience convinced Dave to get three more of the ON4UN-design matching transformers for use with other Beverages.

Tests made with the KM1H-designed transformer resulted in less-than spectacular results. As I mentioned, the KM1H design uses separate grounds-- for the antenna ground and for the feedline shield. In fairness to KM1H, I could have done more work in this area--for example, putting the two "grounds" together and testing it that way. (ARRL antenna guru Dean Straw, N6BV, advises that he'd prefer to see all grounds tied together in such a system.) Since the ON4UN design seemed to work well right from the start, I decided to stick with it.

Building the transformers

Antennas and Techniques for Low-Band DXing says, "A 9:1 impedance transformer[using a high permeability ferrite core] will give a more than acceptable match for both 50 ohm and 75 ohm [feed] lines." And, "A transmission line transformer using trifilar winding is well suited to this purpose." Such a transformer should match the 450 to 600-Ohm impedance of a Beverage to either type of coax you might use.

John also relates that Victor Misek, W1WCR, has found that using the same winding information--and using a *stack* of two ferrite cores (made of the same material or "mix"), results in a transformer that yields "a 0.4 dB improvement in insertion loss." For example, W1WCR found that a stack of two (MN-

8-CX) cores resulted in an insertion loss of 0.21dB on 160 meters, as opposed to an insertion loss of 0.51dB with a single core.

To wind my transformers, I used nine trifilar turns of #24 enameled wire over a stack of two Amidon FT-50-75 ferrite cores. (These cores are pretty small, with an inside diameter of 0.28- inches and an outside diameter of one-half inch.) Such a transformer has a "minimum design frequency of 1.8 MHz," according to ON4UN.

Putting nine "trifilar" turns of wire on a stack of two ferrite cores is easy. Just cut off three separate three-foot-long lengths of #24 enameled wire from a roll of the stuff. Place the three lengths of wire side-by-side and give them a twist every inch or so along their length. Now pass this little cable through the two cores nine times, and you're done (each pass of the wire through the doughnut hole counts as a "turn," including the first pass). Cut the resulting pigtails to the lengths you require and sand or scrape the enamel finish off the ends of the wires (so the wire shines). Use an ohmmeter to identify the windings and label the end of each wire per the diagram in *Low Band DXing* (Figure 7-11, page 7-12.) Other types of ferrite core material also will work (two tables on the same page show you how to determine how many turns of wire you'll need for each type of ferrite material). You can coat the finished transformer (cores and windings) with a couple of coats of low-loss coil coating (I used liquid polystyrene or "Q-Dope"), or simply wrap the transformer with some good quality electrical tape (like Scotch 88).

To house each transformer, I used small plastic box (1x 2x 4 inches HWD) from Radio Shack (part number 270-220). Drill a 5/8-inch hole (to house an SO-239) in the center of the box (and drill four 4/40 holes to mount the SO-239's flange). Then drill a 10/32-inch hole, at each end of the box. The SO-239 accepts the coaxial feedline leading back to the shack from your Beverage. At one end of the box a 10/32 stainless-steel nut and bolt are used for the antenna connection. The ground-rod wire attaches to the same type of bolt at the opposite end of the box. Be sure to waterproof any thru-the-box connectors that will be exposed to the elements and you should be all set. One caution: Don't transmit into your Beverage via the matching system described here. While folks can, and do, transmit into Beverage antennas, this matching system--and the terminating resistor at the "far" end of your Beverage--will likely go up in smoke if you do!

What's it cost?

If you're resourceful, you should be able to build these matching boxes for around $10 to $15 a pop. The plastic boxes are about $2 from Radio Shack. I ordered the cores, enameled (magnet) wire, SO-239s and Q-Dope from Ocean State Electronics in Rhode Island (800-866-6626). The FT-50-75 cores cost me $0.75 each; the #24 magnet wire was $4.25 for 1/4 pound; the SO-239s were $1; a bottle (2 fl oz) of Q-Dope was $3.75, plus a $5 shipping charge. Add the stainless 10/32 hardware, 4/40 hardware, and lug connectors (for internal connections), to the total cost.

Purchasing Transformers

If you're not interested in scrounging the parts, winding the cores, and doing a bit of soldering to brew one of these yourself, then you can order a ready-made box from Industrial Communications Engineers (ICE), Box 18495, Indianapolis IN, 46218; tel, 317-545-5412. ICE offers a Model 180A matching box for $39 (plus $4.50 for shipping). The 180A has taps to select 50 or 75-Ohm coax feedlines. There are also taps to match 300/450/600 or 800-Ohm Beverage antenna loads. The 180A has dc blocking capacitors and a gas-discharge lightning protection system. ICE also sells a Model 181A ($39), which allows you to apply a dc voltage into your Beverage (for remote switching). Like the 180A, the '181A has a gas-discharge protection system. Finally, they offer a Model 185A "resistive load" to terminate your Beverage with. It has same high-impedance taps as the Model 180A and it costs $34. These units are rated for 10 W of continuous RF and 100 W on peaks. (I was told that these ratings are not specified

for transmitting into the boxes. Rather, they are what the boxes can withstand when your Beverage picks up energy from nearby transmitting antennas.) All of these boxes are made of 1/8-inch extruded aluminum (milled and tapped). And, if you're looking to buy
American, they're all made in the USA. (Prices, model numbers and telephone number were valid as of February 5, 1997.)

Transmitting, Terminating and Wire
Another Burlington, Connecticut, resident who has a nice location is YCCCer John Larson, NQ1K. Sitting on an average terrain of 670 feet above sea level, John has a panoramic view of the surrounding countryside. And he's got a 550-foot Beverage that he's managed to transmit into a time or two. However, he used #18 wire for his transformer windings. In addition, John's Beverage is not terminated (with a resistor) at its far end, so this allows him to apply some power to the system. The lack of a terminating resistor also makes his Beverage bi-directional (receives best off each end of the antenna). Speaking of terminating resistors, Dave, K1ZZ, originally used a variable carbon resistor to set up his Beverage. He eventually found that terminating his 550-foot Beverage with a 200-Ohm, noninductive resistor provided the best front-to-back ratio. The "500-foot" roll of wire John, NQ1K, purchased (from Home Depot) turned out to be not quite 500 feet long. He ended up splicing on another 60 to 70 feet of wire for his 550-foot Beverage. (Which means the "500 foot" roll was closer to 480 or 490 feet.) John used electric-fence insulators nailed to convenient trees to keep his Beverage an average of 12 feet above ground. The electric fence insulators are pretty cheap, too. John paid three bucks for 40 of them!

RF Feedback?
Dave, K1ZZ, recently observed that if he switches his Beverage [in line] while transmitting, "my keyer goes crazy." He speculated that there's some kind of transient he never noticed before. "It's probably easier for me to remember not to switch the Beverage while transmitting (why would you want to, anyway, except to burn off nervous energy) than to figure out what's causing it," he said. "Perhaps it's the sort of effect that Carl's design was intended to avoid." I suspect Dave's "transient" may be a result of RF feedback. (Here's where some experimentation with the KM1H-design transformer, with its ability to isolate the feedline shield from the ground at the Beverage matching box, might be worthwhile. But, I'll leave this for others to explore).

Here's another idea
Gary Nichols, KD9SV, introduces a nifty-looking circuit you can build, in the February 1997 *CQ* (page 32-33). This QSK-compatible circuit is designed to protect your receiver from being overloaded (or possibly damaged) by RF that might be picked up by your Beverage while you're transmitting on another antenna. This project (it's offered both as a kit and as a finished product), might be worth a look--especially if your radio was not designed with a Beverage in mind. Homebrewers will appreciate that the article provides a schematic and calls out Radio Shack parts numbers for this project.

Ideal Beverage Lengths
What's the "right" length for a Beverage? Frank Donovan, W3LPL, posted the most succinct discussion on this subject that I've seen to date. You can find this, and other useful information, at the KA9FOX Web site. Surf to: http://www.qth.com/ka9fox/mail_summaries.shtml

Ideal Beverage Antenna Lengths -- per W3LPL
160M: 290 Feet 585 Feet 880 Feet 1160 Feet
80M: 150 Feet 295 Feet 440 Feet 580 Feet
40M: 75 Feet 150 Feet 225 Feet 295 Feet

"Short Beverage antennas have a very broad main lobe, poorer response to low-angle signals and lower sensitivity. Of the four lengths listed above, the shortest length has a 3-dB beamwidth of almost 180

degrees--not very desirable! The second length has a 110 degree beamwidth (better, but still not good), the third length has an 80 degree beamwidth and the longest length has very desirable 50 degree beamwidth (but only 17 to 18-dB front-to-back ratio)."

In Closing

I consider chapter 7 of ON4UN's book required reading for those contemplating the deployment of a Beverage antenna system. When engineered properly, Beverage receiving antennas work great--and not just on the low bands. They can be used successfully on the higher bands too, like 20 meters, for example. Finally, if you want some exercise, you can always go out and "walk the Beverage," to see if the wire has been broken along its length. By the way, falling branches and deer seem to cause most broken-wire problems with Beverage antennas. Happy (multiplier, not deer!) hunting.

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