Alachua County ARES/NFARC Tests New 4:1 Balun

by Gordon Gibby KX4Z

The off-center-fed dipole has been a star player in Alachua County, with wide usage by ARES, North Florida Amateur Radio Club (NFARC) and the Gainesville Amateur Radio Society (GARS) for deployments, picnics, and exercises. Generally, we've used a 4:1 Balun to get the higher impedance feedpoint down to 50 ohm for regular coax. In the past we've built simple *voltage baluns* and then added a 1:1 *current Balun* (sometimes right in the same PVC pipe enclosure at the antenna feedpoint) to reduce feedline common mode currents, radiation, and "hot cases" in the shack.

Vann Chesney AC4QS home-brewed a 4:1 Guanella Balun and reported it worked well for him -- this well-known design is a *current Balun* requiring 2 cores total (same as what we had been doing), but several sources indicate it is superior to our previous efforts. So I gave it a whirl!

A test Balun was constructed, designed to tolerate at least a half-kilowatt, using two FT-240-43 cores. (Kits And Parts Dot Com, http://kitsandparts.com/ , current price $8 ea, and they ship them *well padded*.) The thicker Teflon plumber's tape (intended for natural gas pipelines) was used to wrap the cores with about 25% overlap [About 40" total tape per toroid] , even though they don't have any really sharp edges. 16-gauge Remington-brand PTFE Teflon insulated, tinned, stranded wire was sources from Amazon [1] in red and white colors, two wires paralleled and taped every few inches with plastic electrician's tape, and wrapped 10 turns bifiliar on two cores and connected appropriately as shown in published building instructions.[2] This is a few more turns and a higher permeability core (825) than many utilize, but the goal here was to get adequate inductance in the winding so that the Balun worked properly even down to 2 MHz. A short test with only 8 turns didn't seem to show any huge improvement, so I stuck with 10 turns.

In order to test this, a 4:1 commercial medium-power Balun MFJ-911 was connected such that one Balun stepped 50 ohms up to 200, and the other dropped it back to 50. This two-Balun set was then connected from tracking generator output to RF input of a Siglent spectrum analyzer (normalized for 0dB with direct connection) and losses measured at typical ham frequencies. The results (the losses of TWO baluns) were far better than what we have seen with voltage baluns:

FREQ:	2 MHz	3.5 MHz	7 MHz	14 MHz	28 MHz
Combined losses of two back-to-back 4:1 current baluns:	0.07 dB	0.07dB	0.06 dB	0.25 dB	0.32 dB

SWR tests into the Balun (200 ohm resistive load on other side) indicated it had a good SWR well past 10 meters.

The loss data is almost difficult to believe, the losses are so low Losses are said to be larger if the Balun feeds a non-matched (non 200 ohm resistive) load. Power testing with matched conditions couldn't be carried out with the two baluns (the MFJ Balun isn't rated for high power). However, it can be conducted using a kilowatt-rated manual antenna tuner operating "backward" to convert 200 ohms back down to 50 ohms into a kilowatt rated Cantenna dummy load -- so exactly that setup was created with the test 4:1 Guanella dummy load on the transmitter end and a simple Radio Shack SWR/power meter measuring power into the system. An ancient Heathkit SB-200 amplifier was driven with CW to a power output indicating 300 watts for two minutes solid, at which point one of the 572-B plates was beginning to show some color, so the test was stopped and finger tip measurement of the FT-240-43 cores could not appreciate any increase in their temperature above room temperature.

We think we have a great design worked out, that can be built using $8 cores! For those not wishing to do the homebrewing, the MFJ-919 is likely built with similar technology.

[1] Red Teflon coated wire: https://www.amazon.com/gp/product/B071KX9312 Other colors are also available. Suggest #16 for 300 watts +; #18 for lower power. Cores *can* get hot, and the teflon insulation is designed so the wire remains insulated even with a hot core.

[1] http://www.k5wtr.com/k5wtr/manuals/ANTENNA%20&%20ROTORS/Balun_short_version.pdf provides nice schematic and photos, although I wound mine just moving around the core, not "jumping to the other side" as some of his photos show.