Homebrewed Baluns:
A Radio Club Project

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After many years of ARRL Field Day setups and teardowns, our local radio club, the Lake Area Radio Klub (LARK) in Watertown, South Dakota, decided it was time to replace the center insulators of our 80- and 40-meter dipoles. The center insulators had been used for at least 40 years. Rather than use plain center insulators again, we decided to build 1:1 current baluns. We ended up turning this into a club project and building 30 baluns. Many of our members also wanted some for their own use.

The Lake Area Radio Club used this balun design to replace 40-year-old center insulators.

Our Balun Design

In our design, we wanted each balun to have 50 Ω: 50 Ω balun operation from 80 through 10 meters; legal-limit power capability; a well-researched core material for optimum performance; measurably good amplitude and phase balance, and durability for long-term, year-round use in South Dakota.

Additionally, we wanted this to be a hands-on project, in which club members from all license classes could participate. Because this project took place in 2019, we weren't affected by any COVID-19 limitations, but the project could be made pandemic-friendly by checking in via videoconference.

We surpassed our frequency range goal, as we found that our design works well from 160 through 10 meters. Using the rule of thumb that the common-mode impedance should be 10 times the feed-line impedance, we aimed for at least 500 Ω minimum common-mode impedance from 3.5 through 30 MHz and had room to spare.

Few network analyzers with balanced measurement ports such as this can limit their bandwidth. The test circuit shown in Figure 2 gets around the need to make a balanced measurement by creating a ground reference in the middle of the circuit. The chosen resistor values create a minimum loss network, allowing for singe-ended voltage measurements.

Figure 1 — LARK's balun design includes four turns of RG-8X coaxial cable through a 1.2-inch OD ferrite sleeve (about 2 inches long), made from Fair-Rite's #31 material.

LARK Balun Parts List

- (1) Ferrite sleeve, Fair-Rite P/N 2631103002, from Kreger Components
- (1) SO-239 connector, silver-plated, Amphenol 83-1R
- (1) 2 feet of RG-8X coaxial cable
- (1) 6 inches of Schedule 40 2-inch-diameter PVC pipe
- (1) 2-inch PVC test cap
- (1) 2-inch PVC end cap
- (2) ¼-inch × 20 × 1⅞-inch stainless steel eye hooks for antenna connection
- (1) ¼-inch × 20 × 1⅞-inch stainless steel eye hooks for support
- (8) ¼-inch × 20 stainless steel nuts for antenna eye hooks
- (2) ¼-inch × 20 stainless steel nuts for eye hook support
- (4) #12 ring terminal solder lugs for antenna
- (4) #4-40 machine screws to hold the SO-239
- (4) #4-40 lock washers for the SO-239 machine screws
- (4) #4-40 nuts to hold the SO-239
- (1) #20 ring terminal solder lug for SO-239 shield connection
- (1) Vinyl label

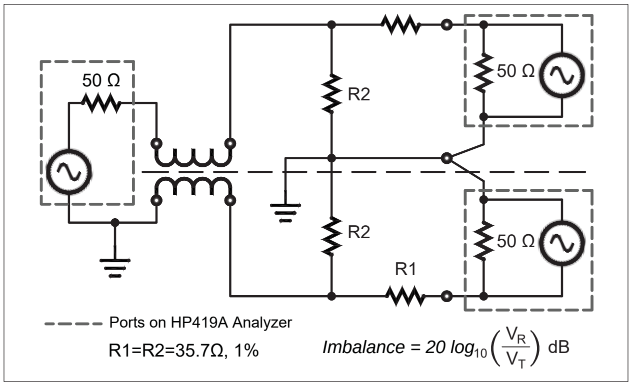

Figure 2 — LARK's test schematic.

The design for the balun itself was simple: four turns of RG-8X coaxial cable through a 1.2-inch outer diameter (OD) ferrite sleeve (about 2-inches long), made from Fair-Rite's #31 material (see Figure 1). Our research showed that #31 would provide a lot of inductance, hence common-mode impedance with just a few turns.

Rich Grant, KEØEPY, helped with the LARK balun assembly.

Figure 3 —The antenna connection on the outside of LARK's balun.

The use of coax instead of paired lead wire kept winding distributed capacitance low for use on 10 meters (our tests show that the balun even works well on 6 meters). A test jig (see Figure 2) was developed to test amplitude and phase balance over the applicable frequency range. Because most network analyzers are single-ended (unbalanced), the use of matched resistors in the test jig allowed us to test for both amplitude and phase balance.

It being pre-pandemic with no social distancing regulations, we were able to construct the baluns by way of forming an assembly line in Rich Grant's, KEØEPY, garage. As a retired owner of a plumbing and heating business, Rich's expertise was helpful in making everything come together (and stay together).

Tools and Supplies

Special tools weren't needed. We mounted an SO-239 connector in the center of a PVC test cap with stainless-steel machine screws and nuts forming the bottom of the balun, and used a standard cap for the top. We used ¼-inch × 20 stainless steel eye hooks. We connected the coax shield and center conductor to eye bolts inside the balun with electrical wire lugs held between a pair of nuts. The same arrangement for antenna connection can be seen on the outside of the balun in Figure 3. We also used Loctite sealant on the connections inside the balun, as it would be challenging to tighten them later.

We wrapped a thin layer of packing foam around the ferrite to slightly increase the bend radius of the coax, as we were concerned that too sharp of a bend might damage the coax. The foam also protects the brittle ferrite sleeves from damage during assembly, installation, and ongoing use. Although this step is optional, it acts as insurance against breakage. Bubble wrap would probably work as well.

To reduce corrosion, we used stainless steel eye bolts and other hardware. LARK got 40 years out of the previous dipoles, so our goal was longevity. The assembled units were tested on an HP 4194A impedance/gain-phase analyzer and the performance variance from unit to unit was negligible.

Conclusion

Most of the assembly was carried out over a few Saturday afternoons. Club members of every license class participated, as well as purchased finished units. A special thank you to Rich Grant, KEØEPY; Todd Kuhlman, KEØRVH; Scott Schladweiler, KØSHD, and Chuck Olson, KBØVXD, for their help during assembly. It was a great opportunity for mentoring and fellowship between club members.

The LARK balun was relatively easy to construct. It performs well over a wide frequency range and costs less than $30 to build using readily available ferrite sleeves and hardware available at your local building supply store.

Dave LeVasseur, NØDL, earned his Novice-class license in 1974. He upgraded to Amateur Extra-class in 1977, and earned an FCC First Class Radiotelephone Operator license in 1978. Dave has taught ham radio classes, and participates as a Volunteer Examiner (VE). He earned a Bachelor of Science degree in electrical engineering and is a named inventor on two patents involving transformer and communication technology. Dave has been a designer of inductors and transformers since 1982, and currently works at Minntronix, Inc., a manufacturer of inductors, coils, and transformers. He can be reached at **n0dl@arrl.net**.

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