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A Portable End-Fed Half-Wave Antenna for 80 Meters

This easily constructed, 144-foot EFHW antenna and tuner covers 3.5 – 4.0 MHz with low SWR.

Rick Littlefield, K1BQT

While I designed this easy-to-set-up antenna primarily for 80-meter ARES® (Amateur Radio Emergency Service) operation, it covers all frequencies in the 75- to 80-meter bands equally well with the aid of a simple matching network, which also makes it a great choice for vacations, special events, and field days.

Matching Network

End-fed half-wave (EFHW) antennas pose a matching challenge because the network must transfer RF energy from a 50 Ω source to a load resistance of several thousand ohms. For this application, I used a high-Q parallel-tuned LC network (see L1, C1, and C2 in Figure 1) in place of the ferrite-core transformer commonly used with multiband EFHWs (see Figure 1A). Although this choice restricts operation to a single band, it reduces losses and provides top-to-bottom band coverage by varying the value of C2.

The LC network components are mounted in a plastic project box to insulate them from the connection points (see Figures 1B and Figure 2).

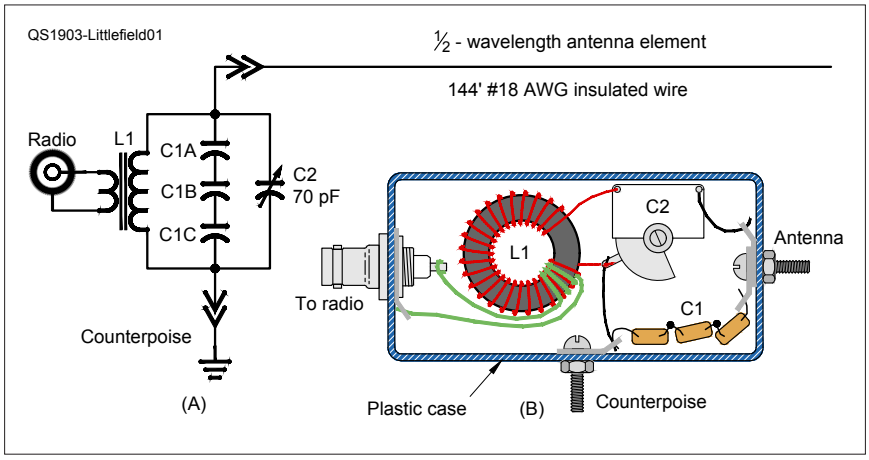

Figure 1 — At (A), a matching network schematic. At (B), the component layout.

$C1_A$ – $C1_C$ — Three series-connected 500 V silver mica capacitors (see text)
C2 — 70 pF variable capacitor, 1,500 V rating
L1 — 12.9 µH, 31 turns of #18 AWG enameled wire wound on T-106-2 toroid with three-turn primary of #18 AWG insulated wire wound over secondary

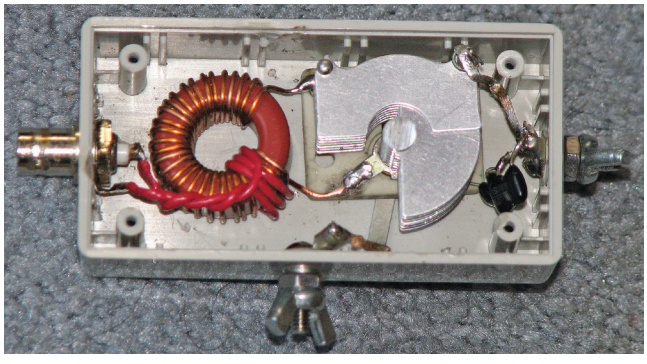

Figure 2 — An interior view of the matching network.

Counterpoise

All coax-fed EFHWs require a counterpoise to provide a reliable RF voltage return path to ground. Because the impedance presented at the feed point is extremely high, the counterpoise requirement can usually be satisfied with a 3-foot rod driven into moist soil or by laying 20 feet of wire on top of the ground.

Figure 3 — The matching network mounted directly to the ground rod with the antenna connection at the top of a plastic case and the coax feed connected at the case bottom. The tuning dial is calibrated to enable rapid setup and frequency adjustment.

Power Limits

EFHWs make great portable antennas, but they can pose a safety hazard at high power levels. With the network's 100:1 impedance ratio, the peak RF voltage present at the antenna terminal will be ten times higher than at the network's 50 Ω input. For this reason alone, I recommend limiting transmitter power to 100 W or less. When transmitting, always make sure the matching network and wire are inaccessible to sniffing pets and curious onlookers.

C2 must adjust over a 70 pF range to cover the band and it must provide sufficient plate spacing to handle 1,500 V or more. To ensure operator safety, connect the capacitor's rotor terminal to the low-potential (counterpoise) side of the network, and install a plastic tuning knob on the shaft.

C1 trims the network's operating frequency so that C2's tuning range falls inside the band. The exact value can vary, depending on stray capacitance contributed by the other components. Somewhere between 60 and 80 pF is typical. I used another variable capacitor to find the optimum value and then replaced it with an equivalent capacitor comprised of a string of three series-connected 500 V silver mica capacitors ($C1_A$ – $C1_C$). This approach gave me the non-standard value I needed while increasing C1's voltage rating. L1, a 12.9 µH inductor, is wound on a FT106-2 powdered iron toroid core using #18 AWG enameled wire. A three-turn 50 Ω primary is added at the counterpoise end of the winding.

Radiating Element

The 144-foot radiator is made from lightweight #18 AWG wire to facilitate antenna setup. Maximum radiation occurs along the midsection of the element, so it's important to raise the center as high as possible. Be sure to use insulated wire! If foliage contacts a bare conductor, it can detune the element, and human contact can result in a nasty RF burn. For disaster communication operations or field deployment, consider using bright red or orange wire for high visibility.

Setting Up

When scouting setup locations, look for a tree limb or structure 35 feet or higher to support the antenna's center, and make sure the far end conductor is out of reach to bystanders. At the network end, I've obtained excellent results driving a 3-foot aluminum rod into the ground for a counterpoise and mounting the matching network directly to it (see Figure 3).

During radio checkout, be alert for signs of RF feedback over the coax shield. If symptoms appear, add to the counterpoise. For portable operation, I try to keep the coax feed as short as possible and, for longer coax runs, I install a separate safety ground at the radio. Normally the antenna's 2:1 bandwidth will be around 100 kHz for any given capacitor setting with a minimum SWR of 1.2:1 or lower.

Conclusion

Amateur Radio's emergency preparedness has never been better, thanks to today's high-tech array of compact equipment, alternative power sources, miniature computers, and digital operating modes. Adding this frequency-agile antenna to your go-kit allows you to leave your bulky tuner at home and lighten the load when mobility and performance count!

Photos by the author.

Rick Littlefield, K1BQT, was licensed in 1957 at age 13 and holds an Amateur Extra-class license. He graduated from Mass Radio in Boston and holds a BA in communication, plus an MEd in educational psychology from the University of New Hampshire. After a 17-year career in instructional technology and courseware development, his love of ham radio lured him into RF engineering and technical writing. He is currently retired, after working for MFJ enterprises, TEN-TEC, Cushcraft, and Laird Technologies. A prolific writer and builder, he was inducted into the QRP Hall of Fame in 1996. His wife, Terry, is a former editor at *Ham Radio* magazine and the founding editor of *Communications Quarterly* magazine. Rick continues to work on projects from his home lab in Barrington, New Hampshire.

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