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A Compact Multiband Dipole

This three-band dipole makes a perfect first antenna for HF.

Zack Lau, W1VT

This antenna is short and sweet. It uses 20 feet of #14 AWG ladder line as an impedance matching element on three popular HF bands — 10, 20, and 40 meters. Add an antenna tuner to load it up on 40 meters, and you can put out a good signal, despite its short 48-foot length.

Covering Three Bands

I optimized the impedance and length of a ladder line matching section to cover three bands, while factoring in the available choices of commercial products. My "magic" combination is 20 feet of 359 Ω ladder line and a flat top 48-foot end-to-end dipole of bare copper wire. This produced very low SWR across both 20 and 10 meters, as well as a reasonable feed point impedance on 40 meters.

The 48-foot dipole has a six-lobed pattern on 10 meters. Rather than trying to aim this dipole, just get it up as high as possible — at least 17 feet or a half wavelength on 10 meters — with the supports you have available. On 20 meters, it has a figure-eight pattern like that of a half-wave dipole. The 40 meter pattern is rather omni-directional.

Locate the antenna up in the clear, away from any branches, and use antenna insulators at the ends. The ladder line should be up in the air — not on the ground or wrapped around a metal pole. In contrast, the coax cable can be taped to metal supports with no adverse effects.

Construction

Figure 1 shows the antenna details and parts list. Use enough RG-58 coax to comfortably reach your station's single point entrance panel, including extra cable to form a "drip loop."[1] Use as many PL-258 UHF double female barrel connectors as necessary to allow more flexibility in choosing coax cable segments. The center insulator provides strain relief for the soldered connection between the ladder line and the antenna wires. A ½-inch PVC T connector (see Figure 2) works well for this purpose. Loop about 7 inches of wire through the holes on either side, and wrap the wires around themselves. Don't solder the wraps. After soldering the wires to the ladder line, bolt the ladder line to the T part of the connector. I used a ½-inch-long 4-40 stainless steel screw, nut, and lock washer. You can also use hot glue to keep the hardware from working loose. The center insulator is a high impedance point, so you do need a good insulator. Attach the end insulators so that the ends of the wires are exactly 24 feet from the center of the center insulator when stretched out. No need to solder, just twist the wires to hold the insulators in place.

You can make an effective current choke balun using 8 feet of RG-58 coax wound up into an eight-turn bundle held together with black tie wraps. This choke isolates the antenna from the outside shield of the feeding coax cable. I crimped a UHF connector to one end and soldered the other end to the ladder line. To protect the coax from corrosion, cover the solder joints with Scotch 2228 rubber mastic electrical tape,

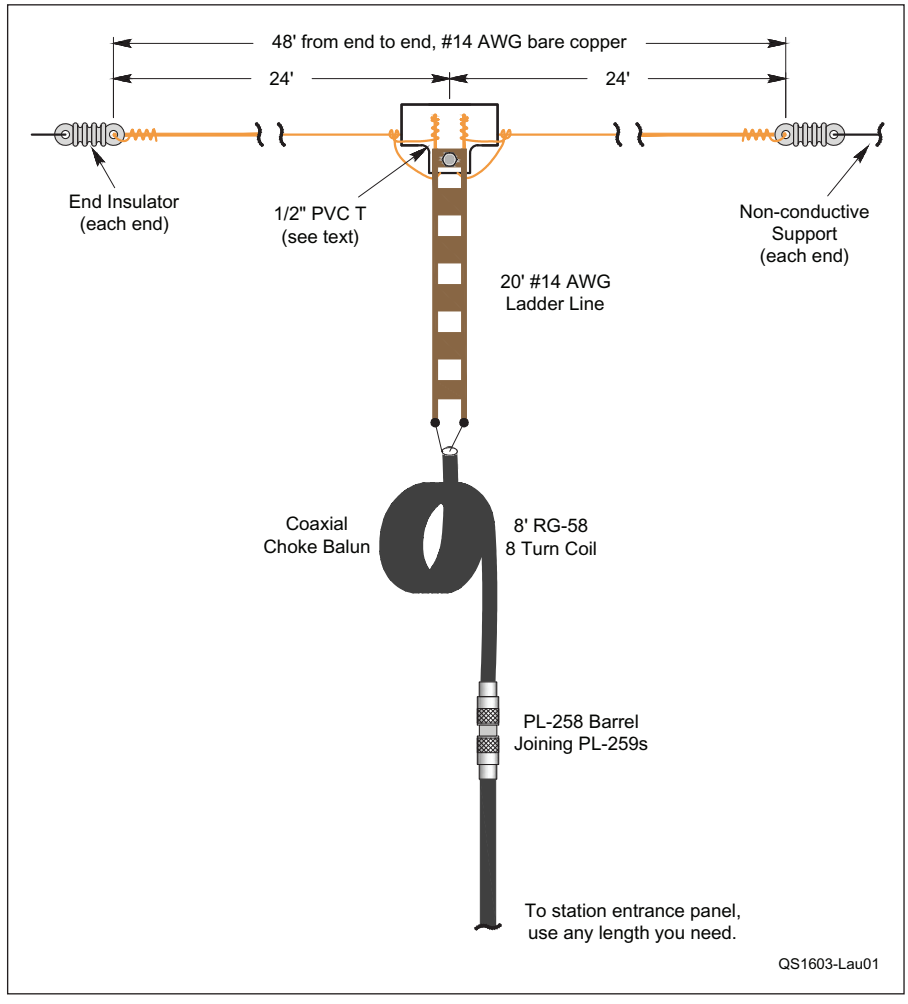

Figure 1 — You can make this 10, 20, and 40 meter multiband dipole from the following parts: 50 feet of #14 AWG wire, 2 dipole end insulators, ½ inch PVC T for a center insulator, 20 feet of high impedance ladder line (JSC #1313, **www.jscwire.com** or Wireman #554, **https://thewireman.com**), PL-258 UHF double female barrel connector, 8 feet of RG-58 for the current choke, and RG-58 coax to comfortably reach your station's single point entrance panel.

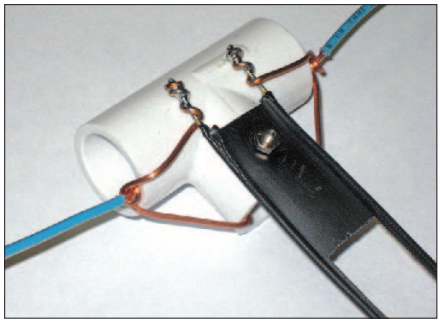

Figure 2 — Detail of the PVC T center insulator connections. [Zack Lau, W1VT, photo]

and then wrap everything up with Scotch 33 electrical tape. The coax-to-ladder line junction is a low impedance point, allowing the use of rubber to seal everything against the weather. The rubber mastic is also useful for sealing the PL-259 connectors — one layer of mastic and then a layer of electrical tape.

Antenna Tuning

You may need to tune the antenna for your particular location and height above ground. Proximity to metallic objects such as electrical wiring and other antennas will affect the resonant frequency. Tune in 6-inch increments by folding each side back 3 inches to raise the resonant frequency by 0.2 MHz on 10 meters. It isn't necessary to solder the wire; just wrap the wire around for a solid mechanical connection. Increasing the end-to-end length of the dipole will lower the resonant frequency. Once tuned, you should just leave the wire folded back, as there will be a small shift in frequency if you cut the wire. Start off with 25 feet of wire for each side of the dipole, and you should have sufficient trimming range, but you can solder on more wire if the antenna is too short. You should add equal lengths to both sides.

40 Meter Band Losses

You can expect about 2 dB of loss from the 20 feet of ladder line, 50 feet of RG-58, and antenna tuner. By comparison, if you tried to feed a 48-foot dipole with 70 feet of RG-58 and a tuner, you would lose a whopping 12.4 dB! A 48-foot dipole fed with 62 feet of ladder line and a balanced tuner would have about 1.2 dB of loss in the tuner and feed line — if you had no losses in the balanced to unbalanced transition. If you were to use the coaxial balun between the ladder line and the tuner, losses would shoot to 3.4 dB.

Variations on a Theme

If you use #14 AWG THHN house wire, start out with an end-to-end length of 47 feet. With #18 AWG ladder line and #14 AWG house wire, start with an end-to-end length of 44 feet and increase the length of the ladder line portion to 21 feet. You may need to compromise between a good SWR on 10 versus 20 meters, as the match isn't as good with this more commonly available ladder line. The shorter version may also work well on the low end of 6 meters, where CW, SSB, and JT65 activity can be found. But the shorter you go, the worse the efficiency is on 40 meters.

A suitable high-power choke balun would be four or five 1⅛-inch type 31 ferrite beads slipped over some RG-213 or LMR-400/9913 coax and held in place with black tie wraps.[2] This should work well as long as the SWR is low. But if the SWR is high, force feeding the antenna with a transmatch may overheat the ferrites and damage them permanently. You may see some SWR drift as a warning that the balun is overheating.

I attached a SO-239 female UHF connector directly to the ladder line, using a UG-177/U hood for some weather protection. I used some hot-melt glue re-flowed with a heat gun for weather protection. Using 42 feet of low loss LMR-400 would lower the total feed line loss on the ladder line and coax cable to just 0.5 dB.

I homebrewed a version of the ladder line using #14 AWG THHN house wire and Zareba Fin tube insulators, one inch-long insulator every 6 inches. After making a V groove in a block of wood to hold the insulators, I drilled 7/64-inch holes with 5/8-inch spacing. It was a lot of work to make the 20 feet of transmission line, but it worked quite well. You can eliminate two solder joints by using the same piece of wire for both the antenna and transmission line.

Notes
[1]**www.arrl.org/lightning-protection**
[2]Ferrite beads, Fair-Rite 2631102002, Mouser P/N 623-2631102002 (**www.mouser.com**).

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For updates to this article, see the *QST* Feedback page at www.arrl.org/feedback.

Feedback

■ There was a typo in Figure 4 of "Antenna Gain, Part III: How Much Signal Gets Received?" by Joel Hallas, W1ZR, in the January 2016 issue of *QST*, pp 45 – 48. The correct expression for the receive aperture of a half-wave dipole should have been shown as: $\lambda/2 \times \lambda/4 = \lambda^2/8 = 0.125\ \lambda^2 \sim 0.13\ \lambda^2$.

■ "Microwavelengths," on page 57 in the October 2015 issue of *QST,* presented an incorrect formula for path loss. The correct formula is:

$$Path\ Loss = 10log(4\pi d)^2 - G_{TX} - G_{RX}$$

■ In the article "All-Mode 1 kHz to 1.7 GHz SDR Receiver" by Jim Forkin, WA3TFS, published in the January 2016 issue of *QST*, there are two typographical errors. On page 30, a reference is made to using a dongle with an 850T tuner. This should read 820T. The proper designation is made in the parts list on page 31. In the parts list, C2 is listed as 140 pF, but is 150 pF. The DigiKey part number, however, is correct.

■ In the article "Done In One: Battery Backup For Your Wall Wart" by Paul Danzer, N1II, in the January 2016 issue of *QST*, the mechanical drawing of Q1, a P-channel MOSFET shows connections that may be unique to some RadioShack parts. Other sources for this part may use different connections for the gate (G), source (S) and drain (D). For example, if Q1 is purchased from a different source, the pinout diagram would be effectively reversed. D could be the middle pin and S the one on the right. It would be best to verify these connections for the part you buy.

In the same article, the positive and negative designations of Pins 1 and 2 of the 741 op-amp shown in Figure 1 are backward. The correct label should be Pin 2 (negative) and Pin 3 (positive). The circuit functions properly as shown, however.

■ In the article "Desk Microphone Power-On and PTT Indicators" by Don Dorward, VA3DDN, in the January 2016 issue of *QST*, LED1 in Figure 1 is reversed. The green cathode should connect to point Kg while the red cathode should connect to Kr.