Superior Performance from a Unique HF Vertical

John Portune, W6NBC

Ground-mounted HF vertical antennas are popular for their low-angle radiation, reasonable size, and simplicity. They are, however, noisier than horizontal antennas and have no directional gain unless used in phased arrays. However, I have found a way to build a no-radial, small-footprint, ground-mounted vertical that outperforms other verticals of the same size. It is predominentaly horizontally polarized for lower noise, has 5 – 7 dBi of directional (azimuth) gain, and has the same low-angle radiation of a conventional vertical.

This no-radial wire-loop vertical was an Honorable Mention winner in the 2018 *QST* Antenna Design Competition.

Table 1
Bill of Materials

Quantity	Description
1	30+ ft. push-up telescoping fiberglass or metal mast
200 ft.	Guy cable, galvanized steel, or nonmetallic line
75 ft.	12 – 14 AWG solid/stranded, bare/insulated wire
1	Base-mounted antenna tuner or other matching network
1	1:1 current balun
Misc.	Mast and guy hardware and optional decoration

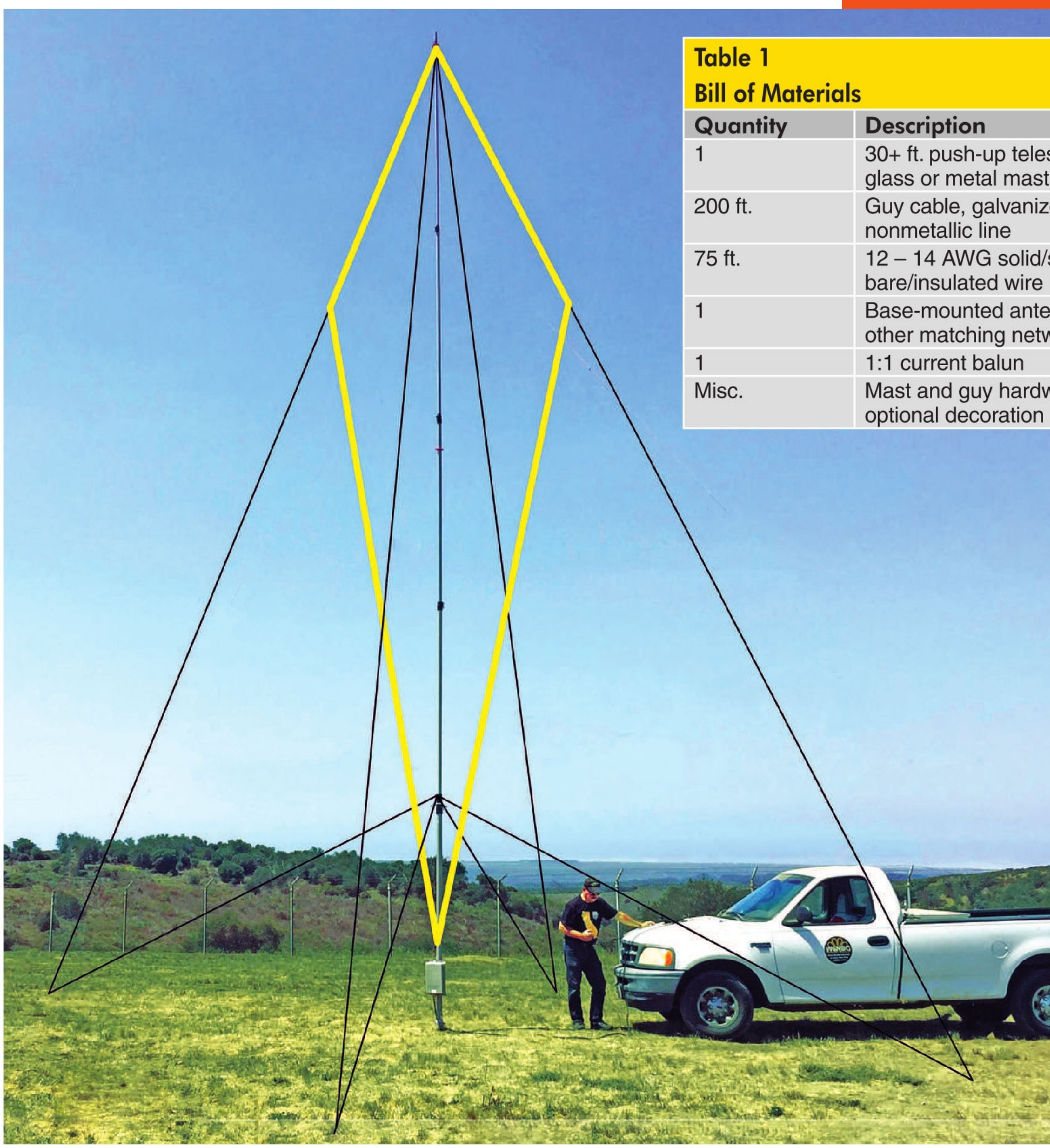

Figure 1 — The kite-shaped loop vertical installed at my radio club site. Loop wires are emphasized in yellow and the guy wires are shown in black.

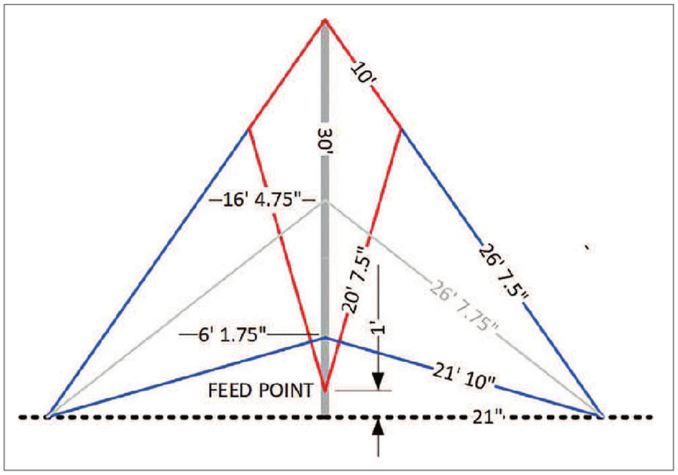

Figure 2 — Dimensions of the kite-shaped wire-loop vertical (red) with a full set of guy wires (blue).

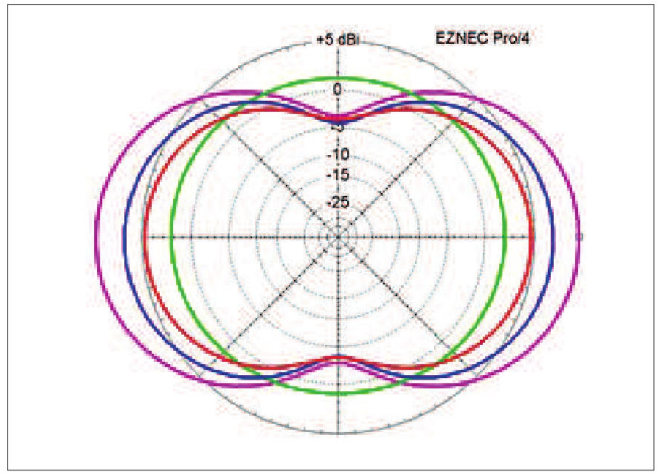

Figure 4 — Azimuth patterns and gains. Twenty meters is shown in red; 15 meters in blue; 10 meters in green, and 6 meters in violet.

Figures 1 and 2 show my solution to the major weaknesses of a conventional vertical. It is a kite-shaped closed loop operating as a vertical without the need for radials. Easily made from ordinary wire and a push-up mast, it efficiently works from 20 through 6 meters. It will also work on 40 and 80 meters with reduced — but still useful — performance. Table 1 shows the list of materials necessary for this antenna.

Design Concepts

As stated by notable ham author L. B. Cebik, W4RNL (SK), "Most human-made noise [QRM] is vertically polarized and of ground wave propagation. Hence, [conventional] ground-mounted verticals are more susceptible [to noise]. A horizontal antenna generally shows an immediate 3 dB reduction." While a conventional vertical cannot be horizontally polarized, a closed loop connected at the top and bottom can be. It may be either predominantly vertically or horizontally polarized, depending on how it is fed.

My kite shape gives this antenna two advantages. First, it is easy to construct using only antenna wire, guy lines, and a mast. The top antenna wires share 10 feet of two of the guys, and the bottom wires are supported by the guys. Metal guys with egg insulators are best for a permanent installation, whereas nonmetallic guys are best for portable operation.

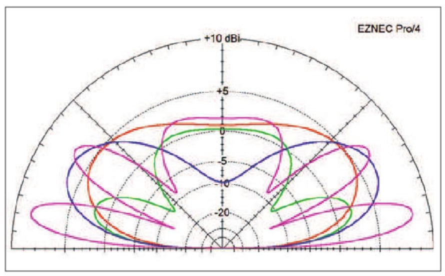

Figure 3 — Elevation radiation patterns and gains across different bands. Twenty meters is shown in red; 15 meters in blue; 10 meters in green, and 6 meters in violet.

The second advantage became apparent during modeling with *EZNEC*.[1] All the parts of most antennas do not radiate equally. This kite-shaped vertical radiates more from the top than a conventional vertical. Greater radiation height reduces ground losses and improves gain.

Figures 3 and 4 show the *EZNEC* elevation radiation patterns and gains of the loop on 20, 15, 10, and 6 meters over average soil. As a comparison, a conventional no-radial half-wavelength vertical dipole with the same base height has an elevation gain of roughly 0.22 dBi at a wave angle of 19°.

[1] Several versions of *EZNEC* antenna modeling software are available from developer Roy Lewallen, W7EL, at **www.eznec.com**.

A further aspect of this loop is that its natural resonant frequency is approximately 16.8 MHz, so it must be properly matched at the antenna. This can be accomplished with a remote autotuner, a manual tuner, or a relay-switched matching network enclosed in a weatherproof box. Because the antenna feed is balanced, it is important to isolate the tuner from ground with a 1:1 current balun at the tuner input. Do not ground or ground-mount the tuner. You can eliminate the tuner if you use the loop on only one band. In this case, make the loop a full wavelength on the desired band to match directly to coax with a simple L-matching network.

Finally, whereas a conventional vertical is omnidirectional, this kite loop can have 5 – 6 dBi gain in the familiar bidirectional donut-shaped pattern, as shown in Figure 4. However, at some mast heights and loop lengths, one or more bands may not exhibit gain.

As with a horizontal wire dipole, you may wish to orient the loop to favor one direction. Alternatively, you can make the gain electrically steerable by mounting a second loop rotated by 90° on the other two guys. Then a remote or manual switch box could switch the loops, either individually, in series, or parallel, or in-phase or reverse-phased. A second set of guys greatly decreases wind sway.

Figure 5 — The team of (from left to right) Chip, W6MY; Mark, KM6FXR; Dayle, KK6HNS, and Doug, KK6ITL, helped set up the antenna at our radio club site.

Figure 6 — Dayle Good, KK6HNS, pushing up mast sections while helpers gently hold the top guy wires.

Table 2
Azimuth and Elevation Gains and Wave Angles

Band (meters)	dBi Gain	Angle
20	4.88	38
17	6.15	32
15	6.58	29
12	4.62	23
10	2.21	12
6	9.71	10

The Mast

Most heavy-duty push-up masts are suitable. Surplus camouflage poles or even a tree can be used. My choice is an MFJ-1906HD 38-foot heavy-duty push-up telescopic fiberglass mast by MFJ Enterprises. The 1-inch mast section is used for the cross arm. Any higher mast sections are not used. The wire and guy dimensions shown in Figure 2 are designed for this mast. A suitable steel mast is the Channel Master CM-1850 40-foot telescopic push-up mast. For a metal mast, the top of the loop and the feed point must be insulated. As I have verified with *EZNEC*, a metal mast does not affect the loop performance.

For highly portable situations, a lighter-duty fiberglass mast, a windsock pole, or even a large fishing pole can be fit with lighter wire and guy wires. For the MFJ fiberglass mast, I created a set of 3D-printed parts for the guy rings, feed hardware, and clamps for one and two booms. The files are free for download at **w6nbc.com/kite**.

Erecting a push-up mast is straightforward. Begin by attaching the guys and antenna wires to the collapsed mast, laying them out straight in the appropriate directions. A stake driven into the ground and a bungee cord or a commercial mast anchor should be used to secure the bottom of the mast. Then, elevate the collapsed mast and secure it with the bottom set of guys.

Next, solicit assistants to keep the antenna wires and guy cables straight and to steady the mast with gentle tension on the guys as the mast sections go up. Figure 5 shows my construction crew at a recent club event.

Standing on a ladder, push up and secure the higher sections. Start with the top (smallest diameter) section and work downward. A common 6-foot step ladder is usually sufficient (see Figure 6). A 10-foot straight ladder, leaned against the guyed bottom section of the mast, may be needed for a metal mast.

Conclusion

On-the-air experience has shown this unconventional, kite-shaped, mainly horizontally polarized vertical to be an excellent performer in my antenna-restricted area. It has nearly the gain of a small beam and definitely exceeds the performance of conventional verticals. It is also well suited for ARRL Field Day and portable situations — the collapsed mast, antenna wire, cables, and hardware travel well in my RV.

Photos by the author.

John Portune, W6NBC, a native of Los Angeles, California, has been licensed since 1965. He was also a 10-year resident of the UK where he was licensed as MØGCK. John received a BS in physics from Oregon State University in 1960. He is retired from KNBC Channel 4 in Burbank, where he was a broadcast television engineer/instructor. John has been well published in *QST*, *World Radio*, and *73 Magazine*. He is active on HF, VHF, UHF, SSB, AM, CW, FM, and digital modes, and is an AMSAT satellite user. John is also currently a Volunteer Examiner team leader and is a frequent speaker at ham clubs. When not involved with ham radio, John enjoys steam railroading, pipe organs, and is a sushi enthusiast. You can reach John at **jportune@aol.com**.

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