By Peter Koehler, KJ7WY

A Half-Square for 80 and 160 Meters

Get on 160 with an antenna that works well on both of the "top bands."

A few years ago I was approaching the achievement of DXCC on 80 meters and felt that my current station would not finish the job. I gave serious thought to the best way to make contact with the Eastern European countries I needed for the award. Because of cost, antenna improvements seemed the best option. My antenna was then a ladder line, center-fed, 160 meter dipole, 75 feet high, in an inverted-L configuration. With 400 W of RF this antenna showed good performance on 80 meters and tuned on all the other bands.

But, I wanted something better. A vertical seemed the obvious choice with its low-angle radiation pattern but the ground radial problem surfaced its ugly head. Searching the Internet, I came across the Web site of L.B. Cebik, W4RNL,[1] and an album of self-contained vertically polarized wire antennas. I discovered that loops and "bobtails" generally have a low angle of radiation, along with some gain and, a big plus—they didn't have need for a ground radial system.

I had some experience with a 20 meter loop antenna and liked it very much and my friend W7YS had a bobtail curtain for 40 meters. Locating a site for the antenna began. I live in a forested region, so tree supports are not much of a problem. I like the loop antenna, but, placed vertically, the loop would present a problem, as the bottom segment would be only about 10-15 feet off the ground. That might raise the curiosity of the neighborhood kids and the occasional elk. The half-square antenna became a stealthier alternative.

The half-square antenna is the little brother of the bobtail curtain, and is basically made of two quarter-wave vertical elements phased by a half-wave horizontal element. This broadside array does not need an extensive ground system. Being a vertical antenna, however, its performance is mirrored by the quality of the ground. Traditionally, half squares are voltage fed through 50 Ω coax to a vertical element through an LC matching network at the low point near the ground. Several articles mentioned a 50 Ω current feed point near an upper corner where the vertical element meets the horizontal element.[2,3,4] W4RNL also mentioned that a half-square could perhaps be fed with ladder line at the current point and matched with a tuner at the shack. Figure 1 shows the basics of the half-square antenna.

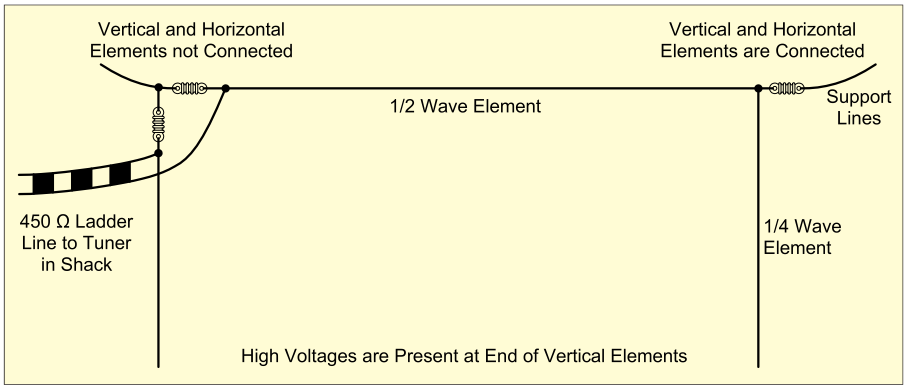

Figure 1—The basic "half-square" for 80 and 160 meters as outlined in the text.

The idea of feeding the antenna with ladder line intrigued me. The run from shack to antenna is some 350 feet and the attenuation of coax could steal any potential antenna gain. I modeled several scenarios with the *EZNEC*[5,6] demo antenna modeling program with particular concern for my poor ground situation. I came up with some element lengths slightly different than the traditional 1/4 wave vertical element and 1/2 wave horizontal element. *The ARRL Antenna Book*[7] and *The ARRL Antenna Compendium*[8] also provided insight on variations of the half-square setup. It suggested that the top horizontal section be placed parallel with the ground and that some variation in plumb of the vertical elements would not significantly reduce antenna performance.

With all of this background, I hung the half-square between two 80 foot trees. The horizontal element is 137 feet of 14 gauge copperweld wire and the 2 vertical sections are 73 feet tall and of 12 gauge wire. The upper corner is fed with 350 feet of 14 gauge ladder line to the top of a vertical element and the horizontal element, separated by a high voltage insulator. The other vertical element top is connected to the opposite end of the horizontal element. A 350 foot run is made back to the shack, where it is matched through an antenna tuner. As with all antenna construction, antennas should be built for safety. Here in northern Arizona, we experience healthy 40-60 MPH winds during the spring and fall months. The two trees that I've hung my antenna from do sway appreciably with wind gusts, so 3/8 inch haul line and copperweld wire are a necessity.

The greatest threat with half squares

[1]Notes appear on page 33.

(and bobtails) is that vertical elements contain very high voltages near the ends that are close to the ground. This can be dealt with in two ways. Either insert the lower ends of the vertical elements into PVC tubing or keep the vertical elements high enough such that nothing will come into contact with them. I used the latter approach, as my vertical legs fan out a bit and they are about 15 feet above ground level.

How does it work? My first contacts were on 75 meters with an EI and a G station and they observed a 1 to 2 S-unit increase with the half square over my 160 meter inverted L dipole. That compares favorably with the 3 dB or so of modeled gain the antenna exhibited. This is consistent with reports from stations broadside (the primary gain direction) to the antenna. The antenna helped me work several new Eastern European countries and satisfied my need for 80 meter DXCC contacts. Though the antenna was cut for the CW portion of 80 meters, feeding the antenna with ladder line allowed the antenna to be easily tuned for other frequencies. Surprisingly, it tunes very well on 160 meters and I prefer it to my 160 meter inverted L (whose location is not as good). On 160 meters the radiation is high-angle and omnidirectional; this is due to the close spacing of the 1/8 wave vertical section. Despite this, it has proved its worth on 160 when working Southeast Asia and Africa. It also performs well on 40 and 30 meters. On 20 meters and above, the antenna produces a very high angle of radiation and the 160 meter inverted L performs better. The antenna does have very quiet receive characteristics.

The benefits of the 80 meter ladder line fed half-square are that it works well on the lower bands (160 through 30 meters) and that it only takes up the space of that of an 80 meter dipole. My antenna is fairly high and its vertical elements are nearly perpendicular to the ground. *The ARRL Antenna Book* supports the fact that maximum height and straight vertical elements are not necessary for good performance. It suggests that a 40 foot high 80 meter dipole might be fitted with V-shaped 1/4 wave vertical elements for better broadside performance.

Current feeding this antenna in an upper corner with ladder line through an antenna tuner might be the ticket for those who want 160 meters included in their antenna's characteristics. One of the problems that the antenna solves is the need for a ground radial system, although the half-square is somewhat dependent on absolute soil characteristics. I do find that the antenna works best when my local soil moisture is high. Give the 80 meter half-square a try—it's an effective antenna!

Notes

[1]L.B. Cebik, W4RNL, "Self-Contained Vertically Polarized Wire Antennas: A Family Album Parts 1-6"; **www.cebik.com/scv0.html**.

[2]P. Del Negro, N2PD, "A Half-Square Array for 40 Meters" *QST*, Jan 1998, pp 46-49.

[3]H. Kennedy, N4GG, "The N4GG Array" *QST*, Jul 2002, pp 35-39.

[4]*The ARRL Antenna Book,* 20th edition, Chapter 6. Available from your local dealer or the ARRL Bookstore. Order no. 9043. Telephone toll-free in the US 888-277-5289 or 860-594-0355; fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

[5]*EZNEC* is available at **www.eznec.com**.

[6]L.B. Cebik, W4RNL, "A Beginner's Guide to Modeling with NEC," *QST*, Nov 2000, pp 34-38.

[7]See Note 4.

[8]*The ARRL Antenna Compendium, Volume 5*. Available from your local dealer or the ARRL Bookstore. Order no. 5625. Telephone toll-free in the US 888-277-5289 or 860-594-0355; fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

Peter Koehler's interest in radio dates to 1969, when he was an active shortwave listener. First licensed in 1996, KJ7WY now holds an Amateur Extra class license. Peter is a member of the Northern Arizona DX Association and, not surprisingly, enjoys DXing on the low frequency bands. He has an AS degree in electronics and an MS degree in Quaternary Studies. Peter teaches geology and does research at Coconino Community College and Northern Arizona University. He can be reached at 45 Ponderosa Dr, Flagstaff, AZ 86001; **kj7wy@arrl.net**.

NEW PRODUCTS

MILOG V6.4 LOGGING/ CONTESTING/STATION CONTROL SOFTWARE

◊ Hamtoys has recently released *miLog version 6.4*, an integrated *Windows*-based logging and station control program for general users, DXers, contesters and award chasers.

Features include rapid all-band/mode tracking and searching functions for DXCC, WAS, WAZ, WPX, IOTA, grids and counties. There are user-defined fields; multiple Telnet/direct *DXCluster* connections including e-mail and pager messaging of needed spots; QSL card and label printing; QRZ, *Callbook* and Buckmaster support; ADIF conversion; detailed country data and sunrise/sunset tables, plus extensive help files, all accessible via a user-friendly interface.

Contest modules support major contests and include CW and voice keyers, control of up to eight rotators, *MMTTY* support for RTTY operation, station/multiplier/band trackers, SO2R controls as well as LAN and Internet control of up to 25 computers, Cabrillo file-conversion and post-contest analysis.

Price: $59 via download, $69 on CD. Full details and a free demo are available at **www.hamtoys.com**. Orders and inquiries: **info@hamtoys.com**, tel 800-436-9013.

NEW LOW POWER AUTO TUNER FROM SGC

◊ SGC has announced the SG-211 MiniSmartuner antenna coupler for low power use. A unique feature of this tuner is that there is no need for an external power source. SGC has kept the current requirements so low that it is rated to run for five years on a single set of four alkaline AA batteries.

The unit is designed to meet the requirements for a lightweight, portable antenna coupler for low power applications. The SG-211 is rated to handle from 1 to 60 W of input power over a frequency range of 1.8 to 60 MHz. It is rated to match a wide range of antenna types and loads to an SWR of 2:1 or less. As with larger SGC tuners, the SG-211 remembers previous settings by frequency and recalls them from memory when returning to a previously tuned frequency. The operating instructions are silk screened on the case. Price: $179.95. For more information, contact SGC Inc, 13737 SE 26th St, Bellevue, WA 98005; tel 425-746-6310; fax 425-746-6384; **www.sgcworld.com**.

Z ANTENNA SYSTEMS COMPACT LOOP ANTENNAS

◊ Z Antenna Systems has introduced a line of compact loop antennas for the 30 to 10 meter amateur bands. These square loops are only 0.06 λ (49 inches for 20 meters) on a side. The loops are rated at an input power up to 200 W CW.

The loops (except the PL-30) are "backpacker friendly" and can be assembled with no tools (after the first time). The loop spreaders are made of PVC-40 plastic pipe. The antennas may be hung by the lanyard, or strapped to a nonconductive mast. The loop antennas consist of two active elements: an outer loop carrying real current to produce a magnetic field through the loop, and an inner electrode (looking like a loop) that produces a radial electric field between the electrode and the outer loop. Power is split (in phase) between the two elements with a multi-winding toroidal transformer. The outer loop contains an adjustable linear capacitor so that the center frequency may be raised or lowered. No coils are used in the loop antennas.

For more information see **home.cogeco.ca/~zantenna** or contact Z Antenna Systems at **np4b@arrl.net**; tel 905-525-3189.