A Truly Broadband Antenna for 80/75 Meters

Have you been dreaming about an antenna that will do justice to your no-tune, solid-state transceiver by letting you operate across the entire band from 3.5 to 4.0 MHz? Then this may be the antenna for you!

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With declining sunspots and poor conditions on the higher HF bands, 80 meters has suddenly become very popular. But, unfortunately, many hams are not able to use this band to its full potential. It offers every kind of ham activity from CW to phone, from nets and ragchewing to great DXing, but many hams are too limited by the frequency range of their antennas to enjoy this band completely.

Antenna-matching networks are one answer, but they spoil the advantage of the no-tune feature of modern transceivers. Matching networks also are often less effective than many hams think; they introduce losses. The losses can be significant at some settings which provide a match. With these things in mind, I decided to try some ideas that might give me a more broadbanded antenna. The prime requirement was that it be fed with common 50-ohm coaxial cable, with no traps, coils or capacitors.

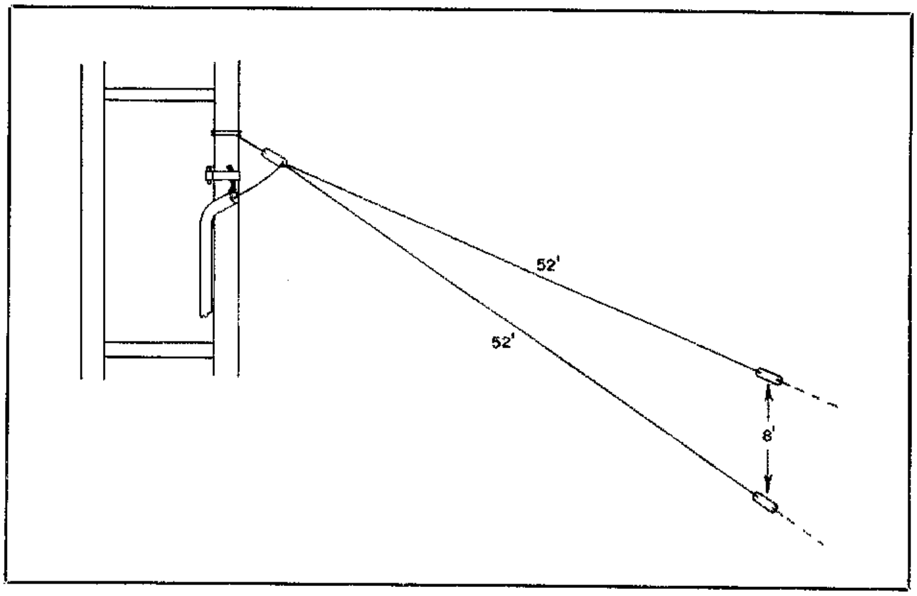

Fig 1—Arrangement of the original KØEOU experiment. The coaxial cable shield is connected to the tower, with both wires of the two-wire element connected to the center conductor. The wires are spread approximately 8 feet at the ends and are each approximately 52 feet long.

First, I tried a quarter-wave sloper. This antenna worked very well, with a bandwidth of 300 kHz between the 2:1 SWR points. It still, however, limited me from operating CW DX at the bottom of the band and the phone nets at the top of the band. There had to be a better antenna.

Antennas can be broadbanded by using large-diameter elements. With this in mind, I began experimenting with two-wire slopers, attached to a common feed point, but with the wire ends fanned out from each other. (See Fig 1.) This seemed to help, but not as much as I had hoped. It did, however, shorten the length required for the sloper. For those with a short tower, this idea could make an 80- or 160-meter sloper possible when a single-wire sloper would be too long.

The Fickle Finger of Fate Strikes!

While I was trying one of these two-wire antennas at a low height on my tower, the SWR was less than 2:1 from 3.5 to 4.0 MHz! After several attempts to get it to work the same way at the top of the tower, I discovered that these results could be attained only when my old quarter-wave sloper was at the top of the tower *and grounded* to the tower. (See Fig 2.) The two antenna elements were obviously interacting with each other, broadening the bandwidth tremendously. Further pruning of the lengths of both the sloper and the two-wire element resulted in the amazing SWR curves shown in Fig 3.

What's Going On?

I will leave the question of *why* it works to the experts. (See the sidebar to this article.—Ed.) Like a true ham, I subscribe to the old saying, "If it works, leave it up and don't mess with it." My guess, however, is that it is something like one-half of a two-element log periodic seeking its mirror image in the grounded tower. The top element is tuned for the lower portion of the band and the two-wire element for the upper portion. In fact, there is a little SWR "bump" in the middle of the band that seems to give further evidence of this.

How Well Does It Work?

Although I have no way of scientifically plotting the antenna pattern, it does seem to be vertically polarized. Good DX performance from the antenna seems to verify this. Because many contacts have been

The MININEC Analysis of the KØEOU Three-element Half Sloper

The Mini-Numerical Electronics Code (MININEC) analyzes thin-wire antennas, solving an integral equation representation of the electric fields using a method-of-moments technique. MININEC solves for the currents, impedance and patterns for antennas composed of wires in arbitrary orientations in free space and over perfectly conducting ground.

The impedance at the feed point calculates to be 79.4 + j1859.8 ohms. This assumes a perfect ground beneath the structure and simply a 3-foot extension of the tower above the connection of the upper wire. In practice, the impedance will be affected by both the ground conductivity and the top-loading effect of a beam antenna atop the tower.

A fair amount of current flows in the top section above the upper wire connection point. Top loading will affect the phase of this current, which will be reflected as a change in impedance at the feed point. In other words, the calculated data is not absolute. Use it as an approximation only.

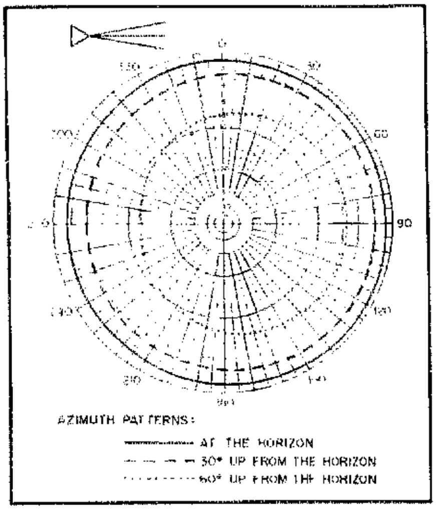

Fig A—Antenna azimuth radiation pattern for the KØEOU three-element half sloper antenna. Values are in dBi. Add 6.0 dB to the values shown.

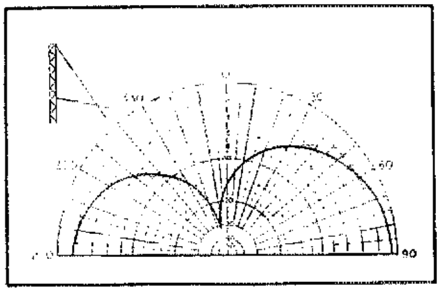

Fig B—Antenna elevation radiation pattern, in the direction of the wires, for the KØEOU antenna. Values are in dBi. Add 6.0 dB to the values shown.

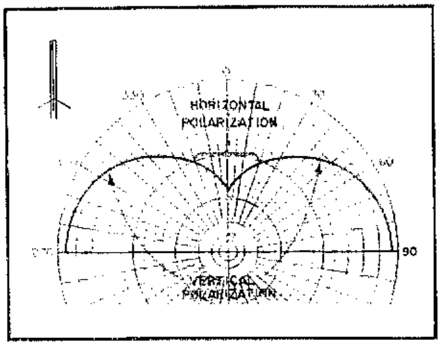

Fig C—Antenna elevation radiation pattern, in a direction broadside to the wires, for the KØEOU antenna. Values are in dBi. Add 6.0 dB to the values shown.

A relatively high current flows at the base of the tower to ground—more than in any other part of the system. This indicates that a good earth connection, and even a radial system, would offer highest efficiency.

The antenna patterns, Figs A, B and C, are also approximations. Polarization is predominantly vertical—at low angles it may be considered to be almost completely vertical. Broadside to the direction of the wires, the polarization becomes horizontal at high radiation angles, ie, above 75 degrees. At 60-degrees elevation, the vertical component is almost 16 dB greater than the horizontal. The vertical component increases significantly at lower elevation angles, being in excess of 30 dB above the horizontal component at a 5-degree elevation. These figures all apply in a direction broadside to the wires. In the direction of the wires, both "front" and "back," the radiation is entirely vertically polarized.—*Gerald L. Hall, K1TD, Associate Technical Editor,* QST

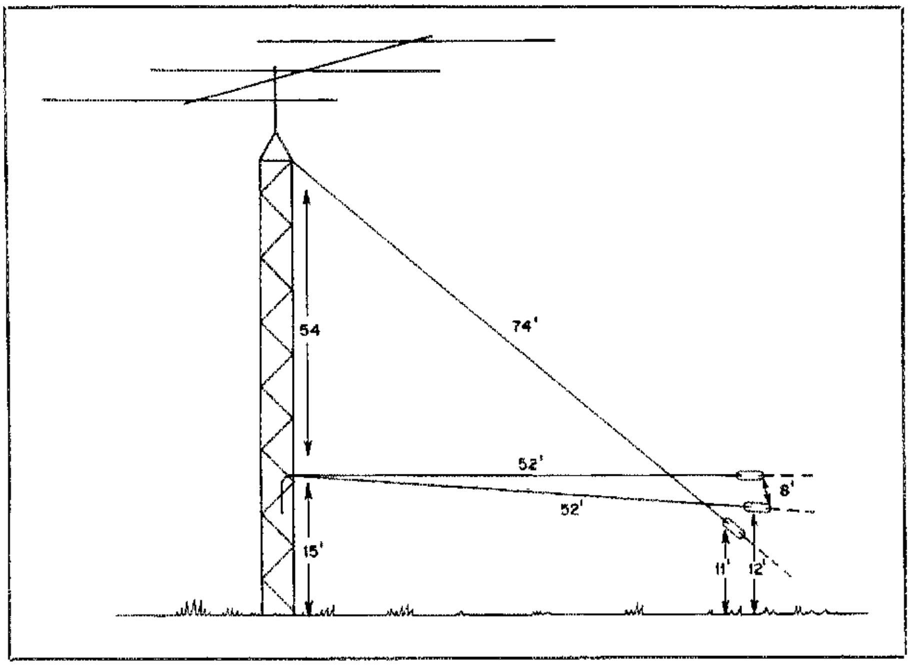

Fig 2—The antenna as constructed at KØEOU. The tower is 70 feet high. The feed point is as described in Fig 1 and is 15 feet above ground level on the tower. The sloper element is 74 feet long, is connected to the tower at the top end and slopes to a point 11 feet above ground level at the end.

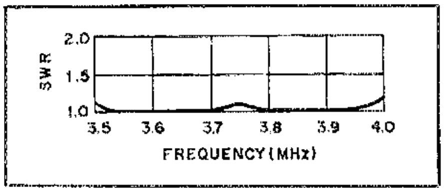

Fig 3—SWR measurements for the antenna at KØEOU. The highest SWR measurement between 3.5 and 4.0 MHz is 1.2:1.

made in all directions, the antenna probably has a fairly omnidirectional pattern. On-the-air comparisons with a quarter-wave sloper across town show that the antenna performs at least as well as the sloper. It also seems to have a little less noise on receive than the sloper.

Getting One Up for Yourself

If you have a tower over 40 feet high, you should be in business. The element dimensions will vary according to the height of your tower. My friend Kelly Davis, KD7XY, constructed one of these antennas on his 50-foot tower so we could see how the dimensions would change.

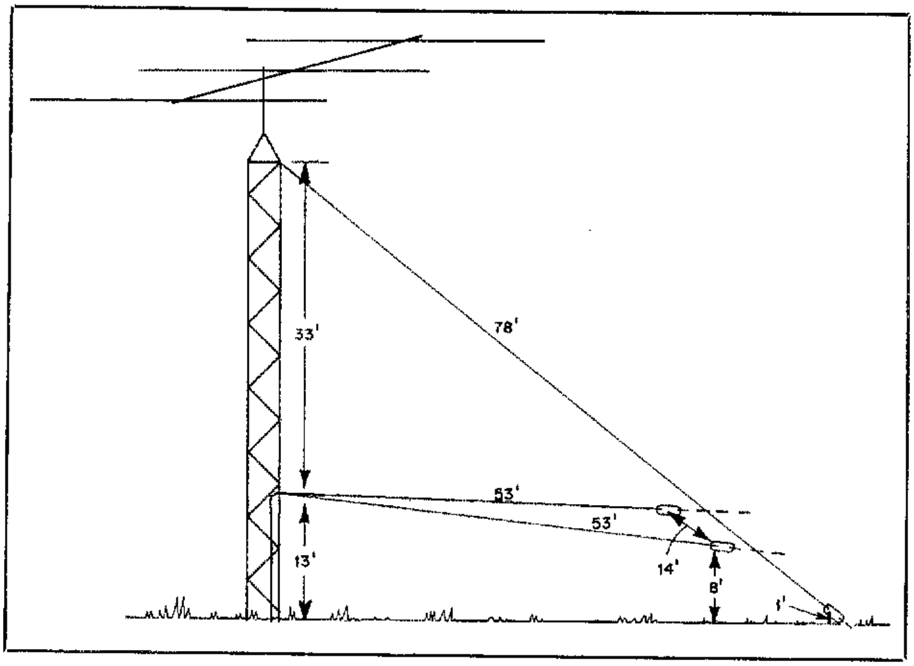

Fig 4—The antenna installation at KD7XY. The tower is 50 feet high. The sloper element is attached at 46 feet, is 78 feet long, and is only 1 foot above ground level at the end. The two-wire element is 53 feet long and is attached to the tower at 13 feet above ground level. Like KØEOU's antenna, it is virtually "flat" across the band; highest measured SWR is 1.4:1.

Measurements of his antenna are shown in Fig 4.

It is interesting to note that the height of the feed point on the tower does not appear to be critical at all. The angle of the wires in the two-wire element does not seem to be critical either. The sloper element, however, should come down *between* the two wires of the lower element. The sloper angle is about 45 degrees. As you attempt to get the lowest possible SWR from the antenna, remember that the angle of the sloper to the tower and its distance from the ground at the end will have an effect on the bandwidth. Because these antennas can be pruned from the ground, the trial-and-error method is easy. When pruning the antenna, remember that the two elements are cut for different frequencies. Changing the length of the top element changes the performance at the lower part of the band. Changing the lengths of the two-wire elements changes the performance at the top part of the band. Don't give up until your antenna SWR is, at the very most, 1.5:1 from band edge to band edge.

Use good insulators at the ends of each of the three wires. I used nylon fishing line at first, but one foggy, wet night the wire in the top element burned through in three places. It surprised me that there could be such high currents in a part of the antenna not even connected to the feed line, but I should have known better. Remember also that other objects around the antenna, such as other antennas or guy lines, could adversely affect antenna performance. Keep the antenna as much in the clear as possible.

Some Untried Ideas

I hope others will try some modifications to this antenna. For example, there should be no reason why a single wire for the bottom element won't work. My small city lot doesn't give me room to try a single wire, as it would surely need to be longer than the two-wire element. I would also like to see someone try cutting the top element for the high end of the band, and the bottom element for the low end. This could shorten the sloper element for someone with a shorter tower and may even give the antenna some gain in the direction of the two-wire element. It might also be possible to construct an antenna for another band inside of this one (40 meters, for example). The same feed point could be used, but with another sloper element for the second band. Another possibility is to construct the antenna with two dipoles. It is my guess, (and only a guess), that it is the merging of the ends of the elements that causes the 50-ohm impedance of the antenna.

Winter gives us the best conditions on the 80/75-meter band. You can be ready to use the whole band with this simple-to-construct and very broadband antenna.

[Editor's Note: Chuck Hutchinson, K8CH, erected one of these antennas at his Connecticut QTH and consistently works European and South American DX with 100 W and less.

Strays

ROANOKE DIVISION LEAGUE PLANNING MEETING

☐ The Blue Ridge ARS will sponsor the annual Division League Planning meeting in Greenville, South Carolina, May 10-11, at the Ramada Inn. The meeting starts 1 PM Saturday, May 10, and concludes that day with an informal dinner. The meeting resumes at 9 AM Sunday and ends at noon after the presentation of the written recommendations to the Director. This year's theme is "Packet Radio—How Can We Use It?" with Paul Rinaldo, W4RI, ARRL Publications Manager, leading the discussion.

The fee is $14 in advance, $16 at the door, and covers facilities, food breaks, dinner, mailing and other administrative costs. Checks (payable to Blue Ridge ARS) should be sent to Sue Chism, PO Box 6751, Greenville, SC 29606. Hotel reservations must be made directly with Ramada Inn, tel 803-227-3734. For special rates, be sure to mention you're with the "radio group" when making reservations.

Next Month in *QST*

Here are just a few of the many items awaiting you in May *QST:*

- a new type of RF-measurement system that's a step above its predecessor, the dip meter
- a peek at HF propagation conditions—now and in the future
- one group's secrets to achieving top Field Day scores, and rules for this year's event
- November Sweepstakes and EME Contest results, and June VHF QSO rules

Please note: Although we try our best to include in the next issue all the items we've advertised, from time to time we have to postpone publication for a month or two. If the item you're particularly interested in doesn't appear "next month," it most likely will be in the following month's issue.