



ARRL Periodicals Archive – Search Results

A membership benefit of ARRL and the ARRL Technical Information Service

ARRL Members: You may print a copy for personal use. Any other use of the information requires permission (see Copyright/Reprint Notice below).

Need a higher quality reprint or scan? Some of the scans contained within the periodical archive were produced with older imaging technology. If you require a higher quality reprint or scan, please contact the ARRL Technical Information Service for assistance. Photocopies are \$3 for ARRL members, \$5 for nonmembers. For members, TIS can send the photocopies immediately and include an invoice. Nonmembers must prepay. Details are available at www.arrl.org/tis or email photocopy@arrl.org.

QST on CD-ROM: Annual CD-ROMs are available for recent publication years. For details and ordering information, visit www.arrl.org/qst.

Non-Members: Get access to the ARRL Periodicals Archive when you join ARRL today at www.arrl.org/join. For a complete list of membership benefits, visit www.arrl.org/benefits.

Copyright/Reprint Notice

In general, all ARRL content is copyrighted. ARRL articles, pages, or documents--printed and online--are not in the public domain. Therefore, they may not be freely distributed or copied. Additionally, no part of this document may be copied, sold to third parties, or otherwise commercially exploited without the explicit prior written consent of ARRL. You cannot post this document to a Web site or otherwise distribute it to others through any electronic medium.

For permission to quote or reprint material from ARRL, send a request including the issue date, a description of the material requested, and a description of where you intend to use the reprinted material to the ARRL Editorial & Production Department: permission@arrl.org.

QST Issue: Sep 1995

Title: A K6STI Low-Noise Receiving Antenna for 80 and 160 Meters

Author: Edwin A. Andress, W6KUT

[Click Here to Report a Problem with this File](#)



2010 ARRL Periodicals on CD-ROM

ARRL's popular journals are available on a compact, fully-searchable CD-ROM. Every word and photo published throughout 2010 is included!

- **QST** The official membership journal of ARRL
- **NCJ** National Contest Journal
- **QEX** Forum for Communications Experimenters

SEARCH the full text of every article by entering titles, call signs, names—almost any word. **SEE** every word, photo (including color images), drawing and table in technical and general-interest features, columns and product reviews, plus all advertisements. **PRINT** what you see, or copy it into other applications.

System Requirements: Microsoft Windows™ and Macintosh systems, using the industry standard Adobe® Acrobat® Reader® software. The Acrobat Reader is a free download at www.adobe.com.

2010 ARRL Periodicals on CD-ROM

ARRL Order No. 2001

Only \$24.95*

*plus shipping and handling

Additional sets available:

2009 Ed., ARRL Order No. 1486, \$24.95
 2008 Ed., ARRL Order No. 9406, \$24.95
 2007 Ed., ARRL Order No. 1204, \$19.95
 2006 Ed., ARRL Order No. 9841, \$19.95
 2005 Ed., ARRL Order No. 9574, \$19.95
 2004 Ed., ARRL Order No. 9396, \$19.95
 2003 Ed., ARRL Order No. 9124, \$19.95
 2002 Ed., ARRL Order No. 8802, \$19.95
 2001 Ed., ARRL Order No. 8632, \$19.95



ARRL The national association for **AMATEUR RADIO™**

SHOP DIRECT or call for a dealer near you.
 ONLINE WWW.ARRL.ORG/SHOP
 ORDER TOLL-FREE 888/277-5289 (US)

A K6STI Low-Noise Receiving Antenna for 80 and 160 Meters

Here's how you can make a low-cost, low-noise, 21-foot-square receiving antenna that's certain to boost your DXability.

By Edwin A. Address, W6KUT
12821 Corte Dorotea
Poway, CA 92064
Photos by the author

In his accompanying *QST* article,¹ Brian Beezley, K6STI, brings to our attention the details of how an antenna can be designed to eliminate (or greatly reduce) power-line noise to aid low-band reception. Brian's article includes the description of a 25-foot-square receiving antenna and matching section along with some observed operational characteristics. While Brian explored antenna design trade-offs with his computer software program, with his guidance, I built several prototype antennas. Here, I'll share the performance, operational and construction information I gained as Brian progressed to final design.

Although I had to shorten the sides of the antenna to 21 feet to fit my available real estate, the results achieved at my location in omnidirectional signal reception and power-line-noise cancellation with such a simple 10-foot-high antenna are remarkable! This deviation illustrates the fact that you can make substantial dimensional changes without performance degradation provided symmetry is maintained and the resulting feedpoint impedance is matched to the feed line.

The higher the Square, the greater its output level. After using a 21-foot Square on 160 meters, Brian and I are confident that small Squares can be made for each band and perform well. The antennas can be easily mounted on towers using horizontally positioned poles (such as quad antenna spreader poles²), or installed on posts as phased arrays to get directivity in a small area.

The Test Location

The Square is an ideal antenna for hams living on small lots located near power lines that generate noise heard on the 40, 80 and 160-meter bands. My location is ideal for testing. It is between—and about one block from—the arms of a Y formed by a 30-year-old, 6.9-kV ac San Diego Gas and Electric distribution system that has had its voltage increased without benefit of insulator upgrade, its load increased by changing to higher power-handling transformers without benefit of increased wire size, and its

maintenance service decreased as the power company strives to reduce cost: a typical suburban area suffering from gradual hardware degradation that leads to line-noise generation. This area is located 12 miles from the Pacific Ocean and is subject to considerable day-to-day variations of temperature and humidity. During the test period, there was plenty of rain and the overall noise level was lower than normal, many times only S7 rather than the usual S9+. However, we still had multiple noise sources to deal with while observing Square performance.

My lot lacks sufficient space to install even a modest Beverage, but its pie shape permits the installation of two 80-meter $\frac{1}{4}$ - λ wave phased verticals, $\frac{1}{4}\lambda$ apart, at the rear of the property. The verticals (with a gain of 4.9 dB) work well for transmitting, but when receiving, all signals—however strong—become victims of great batches of power-line noise. The noise sources are multiple and surround the location. Stations frequently can be heard, but not copied well—or at all.

The Search for Quiet

Using a shortened 80-meter horizontal trap dipole at 84 feet and vertical rotary loops has not solved my noise problem. My two-element, full-size, 40-meter Yagi at 73 feet provides the best S/N, but the signals are very weak and my linear amplifier doesn't like it when I forget to throw the antenna switch before transmitting! It kicks off line and during the three-minute wait for it to return on line, I've usually lost the intended contact! I've been continually trying to improve reception with antennas, and have spent hundreds of dollars on black boxes. Both have helped on single noise sources, but they've been unable to cope with multiple noise sources.

The EWE Antenna

A EWE antenna described by Floyd Koontz, WA2WVL, in *QST*³ was undergoing tests when discussion of my results with Brian triggered his research that led to the Square design. I found the EWE to be a good antenna. I aligned its cardioid patterns

on long path and short path, the same paths as my two $\frac{1}{4}$ - λ verticals. The vertical component of my line-noise sources, however, was still overwhelming when picked up by the two vertical portions of the EWE, leaving me with an unacceptable S/N. After the EWE, I tried a horizontal, 25-foot-per-side triangular antenna, 10 feet high. Noise was reduced from that picked up by the EWE, but was still more than I had hoped for. At this point, Brian decided on a square antenna design to get complete noise cancellation between both halves of the antenna. I then built the 21-foot Square.

Scouting for Noise Sources

Once the antenna was ready, Brian visited my radio shack and, following a quick check, decided that we needed a survey of noise generation on the premises. I chased around turning off various devices to eliminate noise received on various antennas, or through the house wiring: We found several contributors. As a result, we recommend that you frequently survey your home and immediate surroundings to identify and eliminate noise from fluorescent light fixtures, variable voltage controls for lights, touch-controlled lamps, bug-killer traps, electric blankets, electronic air-purifying systems, packet terminals, computers and so on.

Overall Performance Observations

Our survey showed us that reception of noise from ac noise sources within a household may not be eliminated or reduced by the Square (such noise may be delivered on, or radiated from, the ac lines strung through the house), but that power line noise about one block away will be. At my location, the Square antenna pattern appears to be omnidirectional and effective in reducing noise from multiple power-line sources. Summer—when everything dries out and arcing is everywhere—will test its omnidirectional capabilities to the utmost.

During testing, an unexpected bonus of the Square surfaced: We noticed that the antenna frequently drops background noise several S units. It's our assumption that this noise is a collection of lower-level subur-

¹Notes appear on page 41.

ban-area ac noise, so the effect we experienced may only be apparent in cities and towns. Whatever the sources, the noise reduction is a boon to reception. Theory and observations say that atmospheric noise and electrical-storm disturbances (noise crashes) won't be eliminated by the Square, but my Timewave DSP-9 audio filter helps lower atmospheric background noise level, and a noise blanker helps on certain types of repetitive impulse noise—even some types of power-line noise. The combination of the DSP-9 and the Square is more effective than either one alone.

Performance

After a month of testing, I find that listening to SSB and CW signals on 80 and 160 meters is incredibly more comfortable using the Square, and I've been able to copy weak DX signals on the Square that I could

hear—but not copy—using any of the other antennas. (An extract from my log is shown in Table 1.) Although my 160-meter performance checks were not as exhaustive as those I performed on 80 meters, I compared my DX reception with the local 160-meter Big Guns daily and found that I could copy all the signals they heard, but for a shorter time during the window. I'm so encouraged with the results that I'm now erecting a vertical for transmitting.

It's important to realize that the Square is not a substitute for a directional antenna. If you can install long Beverages, do so. However, the omnidirectional nature of the Square may still come in handy in the absence of many Beverages if multiple noise sources exist.

Construction

The Square is simple to build, install and

tune. Figure 1 shows the Square as viewed from above. Here I'll tell you what's required to make 21-foot Squares for 80 and 160 meters, or a single Square that works on 80 or 160 meters at the flick of a switch.

Each Square is 21 feet on a side, 10 feet high and made of inexpensive #14 TW house wire. The antenna is fed at opposite corners using feeders made of 450- Ω open-wire ladder line made with plastic spacers positioned about 6 inches apart. The two feed-line sections are each about 15 feet 6 inches long. Length isn't critical, but the sections must be of *equal* length to maintain antenna symmetry. Some sag in the lines is acceptable if they are cut long, but I prefer to cut the sections as exactly as possible and then pull the supporting lines taut to reduce wind whipping. Be sure to keep the antenna as square and level as possible in a horizontal plane even though the ground beneath the antenna slopes away.

At the Square's center, the two pieces of ladder line join inside a 4 × 6-inch plastic box and attach to the 4-turn primary winding of a matching transformer (T1) via a loop-resonating capacitor (see Figure 2). T1's secondary winding connects to an SO-239 connector from which 50 feet of RG-213 run to the shack. C1 can be placed at the middle of the primary winding to maintain symmetry. For ease of construction, however, I placed the capacitor in series with one side

Table 1

Performance Comparison of the Antennas at W6KUT

	S Meter Readings for		
	Phased Verticals (no preamp)	Dipole at 84 ft (no preamp)	K6STI Square (20-dB preamp)
3814 kHz LSB*	9+	9+	8+
AM Noise	7.5	7.5	3
LSB Noise	6.5	5.5	1
CW Noise	6.5	5	0

Compare the noise-only S-meter readings with those of the signal + noise readings. Note: The S-meter readings were taken using a Yaesu FT-1000D equipped with a meter movement linear between S4 to S9.

*LSB signals from W5 area stations were being received on this frequency.

Noise *only* for the various modes was measured on a clear frequency (3783 kHz).

Filter bandwidths: AM, 6 kHz; LSB, 2.4 kHz; CW, 500 Hz.

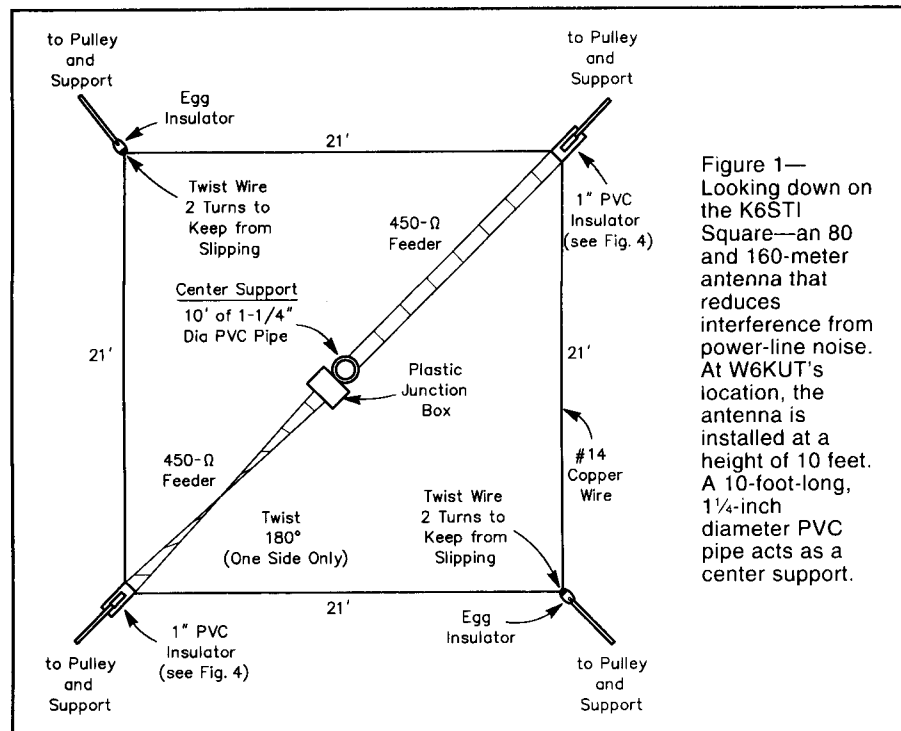


Figure 1— Looking down on the K6STI Square—an 80 and 160-meter antenna that reduces interference from power-line noise. At W6KUT's location, the antenna is installed at a height of 10 feet. A 10-foot-long, 1¼-inch diameter PVC pipe acts as a center support.

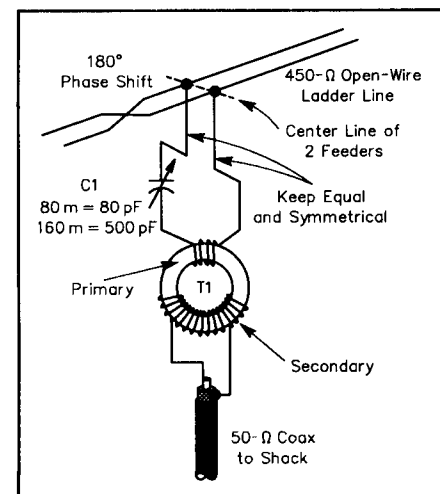


Figure 2—Details of the matching network for 80 and 160-meter single-band operation when using 450- Ω open-wire ladder line. This network is included inside the junction box (see Figure 1) of each 80 and 160-meter antenna. (A Radio Shack 270-223 plastic box makes a suitable enclosure). C1 is a compression trimmer or air variable capacitor with a capacitance of 80 pF for 80 meters and 500 pF for 160 meters. C1 is connected in series with one leg of T1's primary winding. T1 consists of an FB-77-1024 ferrite shielding bead wound with #24 enameled wire. For 80 and 160 meters, the primary has 4 turns. The secondary winding consists of 10 turns for 80 meters and 20 turns for 160 meters.

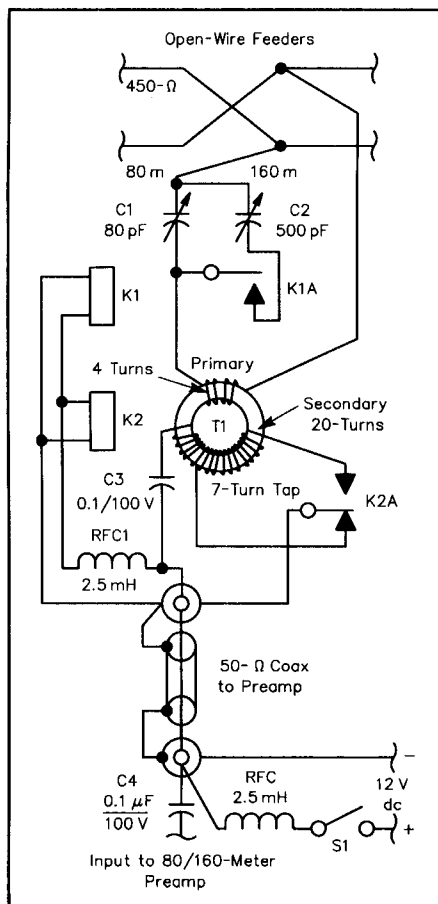


Figure 3—Matching network for a duo-band (80 and 160-meter) K6STI Square. Relays, powered through the coaxial-cable feed line, provide the required LC switching. A Radio Shack 270-223 plastic box is used for the enclosure.

C1—80-pF air variable capacitor or compression trimmer
C2—500-pF air variable capacitor or compression trimmer
C3, C4—0.1-μF, 100-V disc-ceramic capacitor
K1—SPST relay, 12-V dc coil (Radio Shack 275-135)
K2—SPDT relay, 12-V dc coil (Radio Shack 275-241)
RFC1, RFC2—2.5 mH, 100 mA
S1—SPST toggle switch
T1—Amidon FB-77-1024 shielding bead wound with #24 enameled wire; 4-turn primary, 20-turn secondary, with a tap at the 7th turn.

of the primary winding with no detectable performance degradation.

For C1, I use a surplus compression trimmer that tunes above and below the resonance point. On 160 meters, a 3/4-inch-square, multiplate, mica-dielectric compression capacitor is used; its original capacitance range ran from 475 to 1800 pF. Calculations showed a need for about 475 pF, so I removed plates until there were only three per side and ended up with a capacitance range of 250 to 780 pF.

T1 consists of a primary and secondary winding of #24 enameled wire wound on an Amidon FB-77-1024 core. If your an-

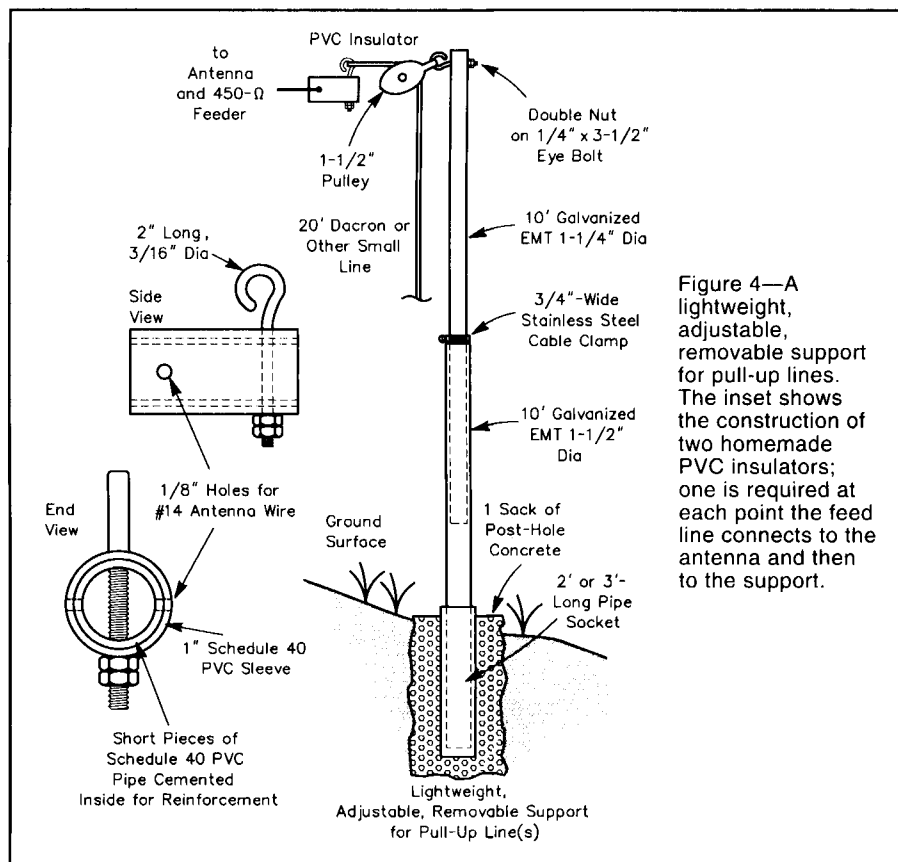


Figure 4—A lightweight, adjustable, removable support for pull-up lines. The inset shows the construction of two homemade PVC insulators; one is required at each point the feed line connects to the antenna and then to the support.

tenna has dimensions different from those shown—or if the feed-line section impedance is other than 450 Ω—you may have to experiment with the tap placements on T1 to find a match. If the dimensions and feed line are about the same as shown, the given turns numbers should work.

Figure 3 illustrates how the feed system for my antenna is matched for both 80 and 160 meters. An SPST switch and a 2.5-mH RF choke provide relay operating voltage via the feed line. This permits remote selection of 80 and 160-meter operation. At the antenna end, dc flows through another RF choke. C3 and C4 are 0.1-μF blocking capacitors used to protect the input of the preamplifier or receiver from the relay operating voltage and to keep from shorting the dc to ground in the junction box.

Two relays are used to permit best symmetry on the feed-line side where additional capacitance is added for 160-meter operation using an SPST relay. Selection of a 7-turn tap for 80 meters or a full 20 turns for 160 meters requires an SPDT relay. (Note: If an 80-meter transformer only is made, use four turns on the antenna side and 10 turns on the feed-line side). Small, 12-V dc relays are available from many surplus houses and from Radio Shack for less than \$2 each.

Figure 4 shows an inexpensive, removable and adjustable support pole and homemade PVC insulators used to hang the Square. The junction box containing the matching network is supported by a 10-foot

length of 2 1/4-inch schedule 40 PVC pipe. A reducer and an 18-inch-long detachable 3/4-inch-diameter PVC extension are attached to the box. The pole is set 18 inches into the ground at the center of the Square. The removable extension permits you to build the antenna at ground level, then raise or lower it as needed with the pulleys. The Dacron line I use to raise and lower the antenna has proved itself reliable during years of service and I recommend it.⁴

When assembling the Square, remember that one of the open-wire feed lines must be rotated 180° to obtain power-line noise cancellation by the two halves. To get good noise cancellation, maintaining symmetry in the two halves of the antenna is important. Maintain symmetry in each antenna leg, from the start of the two feed-line sections to the center junction, and from the junction to the matching transformer winding inside.

Tuning the Square

We used an MFJ-208 HF/VHF SWR analyzer and a Startek 35-BG frequency counter to tune the antenna, by feeding output of the analyzer to the coax connector or feed line from the shack. (Any of the presently available antenna analyzers should do the job.) Using the given values, all that should be necessary is to sweep the frequency range and find the meter dip. (Use an insulated tuning wand to eliminate hand-capacitance effects when adjusting compression trimmer capacitors.) The frequencies should bracket 3650 kHz for

80 meters. If they don't, use a different value of capacitance. Set the oscillator to 3650 kHz and adjust the capacitor to get a minimum SWR; 1:1 should be possible within the capacitor's range. If an SWR of 1:1 isn't achievable, T1's turns ratio may require adjustment. A turns ratio change should be required only if a major change is made in antenna or feed-line geometry.

I don't recommend using a transceiver for tuning the antenna because the matching network capacitor's dielectric may be punctured. If you do use your transceiver, keep the output power at its lowest level. However, we found that because of the low power output from the MFJ, AEA and other antenna analyzers, the reflected power reading on 160 meters can be misleading where significant fundamental, or harmonic, broad-cast-station RF is present. This energy is detected and indicates as reflected power; the indicator registers full scale and nulls aren't visible. At K6TQ, with his 135-foot-tall, 6-inch-diameter vertical, a nearby broadcast station on 1000 kHz overwhelmed the MFJ and AEA instruments, so we resorted to using a transceiver. At my location, no broadcast signals interfered with the Square during testing.

For the two-band antenna, first tune the 80-meter section as described previously, then activate the relays (applying battery voltage locally) and adjust C1 for a 1:1 SWR at 1870 kHz.

Preamplifier

I pressed into service a homemade, all-band, three-pole band-pass filter used in multi-multi contest operations. The filter enclosure also contains a 20-dB preamplifier. I prefer a gain of 20 dB to keep levels within a reasonable range when switching between antennas. I have not found the

band-pass filters to be of any help on receiving with the Square at my location. W6YA, however, installed an 80-meter band-pass filter to solve local AM broadcast station overload when using his horizontal 80-meter dipole.

Selecting Feed-Line Material

Our first tests were conducted using currently available 450-Ω feed line manufactured with alternating 1½-inch open spaces and 1½-inch-long plastic sections (50% coverage). During our evaluation, we found that by setting the Square's resonance at 3650 kHz, we got S-meter readings at 3500 and 3800 kHz that were only about two S units down from resonance peak, and, with minor receiver-gain adjustment, there was no noticeable change during operation. We also found that resonance would drop about 200 kHz when the feed line was wet from heavy condensation or rain (San Diego never has ice, so that condition wasn't tested!). The 200-kHz excursion seemed a bit excessive, so we tried exterior 300-Ω TV line installed in a section of ¾-inch PVC tubing between the center and antenna feed-line connection points. This proved mechanically ungainly, but worse, matching-network requirements became very difficult to achieve with available components, so we abandoned the use of 300-Ω line.

Knowing that a large impedance variation exists from one end of the feed lines to the center, Brian dug out some old ladder line. It has small plastic spacers 6 inches apart and a conductor spacing of about 1 inch. We calculated the impedance of Brian's open ladder line to be 500 Ω, and two

pieces of this line were installed without support, the antenna ends being pulled taut. Resonance shifted only from 3650 to 3495 kHz from dry to soaking wet, an acceptable shift. On 160 meters, the resonance shift was about half that of 80 meters.

It's important to realize that a shift in resonance will only cause a variation in signal level, *not* a change in S/N. We can easily tolerate a bad-weather resonance shift resulting in some reduction of level, but not a loss of S/N. The resulting SWR change is meaningless since we're not transmitting with the antenna. A small loss of signal level is the only penalty, and it's easily recovered by a tweak of the audio control.

Summary

A leading supplier of wire and cable reports that quality control of available open-wire line of the type we chose to use is poor, and that the spacers tend to fall off easily. If such line is used, find some way of securing the spacers.⁵ In the future, we may make our feed lines using #14 wire with a conductor spacing of 2 to 4 inches and home-made spacers. A change in matching transformer turns ratio and resonating capacitor values may be required. Brian's configura-

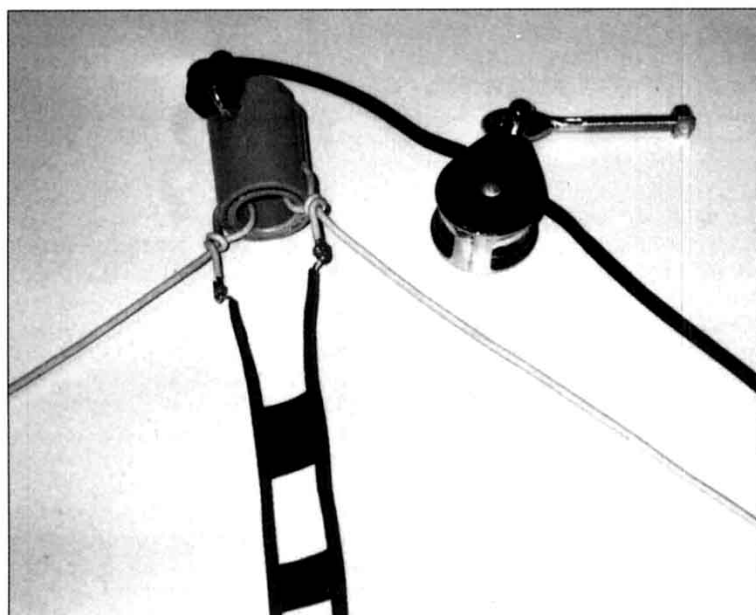


Figure 5—Attachment of the 450-Ω line to the antenna arms and homemade PVC support insulator.

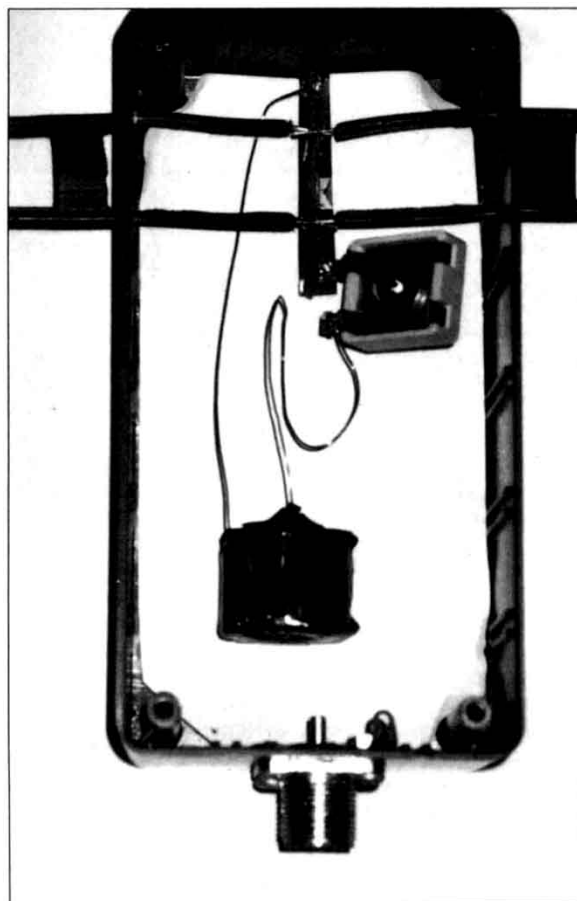


Figure 6—An inside view of the matching network enclosure. The secondary winding has not yet been added to the transformer (wrapped in electrical tape) and no connection yet exists to the SO-239 feed-line connector.

A Search for Better Hearing

Although I live in the country, miles from any town, signal reception still suffers from local power-line noise. This noise generally manifests itself in two ways: First, as a single-source noise that has an identifiable direction and is most prevalent during damp foggy weather; second, as multiple sources generated by hot, windy weather conditions common much of the time in this area of California. Signal levels from either of these noise sources often are S9 or stronger. (Yes, I've had the local electrical utility company working on this problem—with little success.)

These noise levels greatly reduce my operating enjoyment particularly on 75 and 160 meters where I must (as many others do) use vertically polarized arrays. At least on 40 meters and up, I have rotary Yagis and can minimize the noise somewhat by antenna positioning.

A couple of years ago, I decided to attack the hearing problem on 75 meters. First, I made both of my transmitting antennas (a bobtail curtain for north/south directions and a delta loop for east/west) more directional. That provided noise rejection from some directions. I did this by adding two more bobtail curtains in line and spaced $\frac{1}{4} \lambda$ apart. These are phase switchable for unidirectional of either 20° or 200° with about 20 dB F/B ratio.

For east/west, I added another delta loop, spaced $\frac{1}{2} \lambda$ from the first, phase switchable for unidirectional east or west, with a F/B of about 15 dB. These changes helped reception and also added a bit of forward transmitting gain. But I still needed more noise reduction, so I installed a 2- λ , two-wire Beverage switchable for either 45° or 225°. This helps reduce atmospheric noise, but does little toward reducing the power-line noise. Still looking for improvements, I built Charlie (W7XC) Michaels' version of the Null Steerer.* This system really works great on the single-source noise. I can typically null such noise from S9 down to S2 or S3, and can also often null QRM such as RTTY. Unfortunately, this setup doesn't work well when the hot, dry winds arrive and the multiple noise sources fire up.

Along Comes the Square

When Brian, K6STI, and Ed, W6KUT, offered me material describing their noise-reduction work, I was more

than happy to try another approach to reducing the noise level. I built Ed's version of Brian's Square and although I didn't build it in the most ideal environment—because of convenience and expedience—it really does work!

Even though I have five acres for my antenna farm, I'm running out of space with six towers and several wire antennas already planted. So, I nested my Square among these antennas. In addition, the Square is situated about 20 feet from a chain-link fence and about 50 feet from a barn covered with aluminum siding. One corner of the Square is supported by one of my towers. Two corners of the Square are supported by existing guy wires and the fourth corner of the antenna is supported by a wood pole attached to the chain link fence. However, each corner does have at least six feet of antenna rope separating it from its metallic support.

Even though my installation of the Square is certainly less than ideal, the antenna works. Any and all line noises are reduced simultaneously from typically S9 to S1 or less. With a 15 to 20-dB preamplifier in the receive line, the desired signal is nearly the same level as when received on the transmitting antenna. For example, I recently noted a mini pileup on 3795 kHz. The noise level was sizzling at S9 on my transmitting antenna and I *could not hear* the DX station. When I switched to the Square, there was C21/ZL1AMO at S5 (with 15 dB of preamplifier gain) and zero noise! I worked a good one that morning that would not have been possible without the Square. So, even if the space available for this antenna is restricted, be assured it will work—and work well. Try to keep the antenna as square and symmetrical as possible.

I'm going to build a Square for 160 meters and am looking forward to next fall when I can test another Square's effectiveness on the weaker 75-m long-path signals.—Keith A. Fowler, W6BCQ

*Charles J. Michaels, W7XC, "The Null Steerer Revisited," QST, Jul 1994, pp 29-33.

tions have kept the size of horizontal loop and feed-line impedances such that only a capacitor is needed to resonate the loop.

Brian feels that if the Square is raised to 20 feet to improve signal strength, feed lines could come down at an angle to a 10-foot-center pole (so that tuning could be easily achieved) without seriously degrading performance. This has not been tested.

If anyone builds a Square antenna and finds it caked in ice one day, please let Brian or me know what happens to the Square's resonance! Have fun constructing—and pleasant listening!

Edwin Andress was first licensed in 1934, when in high school, as W6KUT. He caught the DX bug immediately, has been chasing DX continuously since then and has worked 376 countries. He's a member and past president of the San Diego DX Club and a member of the Southern California Contest Club.

Ed has a BA in physics from Fresno State College. His background in radio is varied and extensive, including service in World War II with the US Signal Corps, in Korea as an engineering officer with AACCS (Airways and Air Communications Service) and in the Persian Gulf conflict in 1991 as a radio officer on board

a tank-carrying vessel.

He's worked as director of engineering for KERO-TV and radio (1953-1959); vice president of Ling Electronics (1959-1969); as an independent contractor (1969-1971); product line manager at Scientific Atlanta (1971-1986) and again as an independent contractor (1986-1991).

At age 77, Ed's still climbing towers and playing with antennas!

Notes

¹Brian Beezley, K6STI, "A Receiving Antenna That Rejects Local Noise," QST, elsewhere in this issue.

²For information on fiberglass spreader sources, see *The ARRL Antenna Book*, 17th edition, page 21-6. Other sources include: Eur-Am, PO Box 990, Meredith, NH 03253-0990, tel 603-279-1394, and NCG Co—Comet Antenna, 1275 North Grove St, Anaheim, CA 92806, tel 800-962-2611, 714-630-4541, fax 714-630-7024.

³Floyd Koontz, WA2WVL, "Is this EWE for You?", QST, Feb 1995, pp 31-32.

⁴Synthetic Textiles Inc, 2472 Eastman Ave, Ventura, CA 93003, tel 805-658-7903, fax 805-658-7620.

⁵Several tips on securing open-wire feed-line spacers have appeared in the Hints and Kinks column. For starters, see Glenn E. Yingling, W2UW, "Kinky Wire Aids Building Open-Wire Feed Line," Hints and Kinks, QST, Sep 94, p. 94.

QST

Strays



At the ARRL Arkansas State Convention in Little Rock on April 1, newly elected section manager George Mitchell, K15BV (r), presents a plaque to Bob Ideker, WB5VUH, in appreciation of his outstanding service to the section. Bob served two terms as Arkansas section manager, but didn't seek reelection for a third term.

LARRY PRICE, W4RA